Evaluation of the Landscape Performance Certification Program

Prepared for
The Municipal Water District of Orange County and
The Metropolitan Water District of Southern California
The U.S. Bureau of Reclamation, Southern California Area Office

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Executive Summary

This report documents an evaluation of a water conservation program in Orange County California that targeted large landscape water use through dedicated landscape meters—seeking to close the gap between effort (water management) and result (efficient water use.) The Landscape Performance Certification Program (LPCP) was pioneered by the Municipal Water District of Orange County (MWDOC) with significant funding assistance from The Metropolitan Water District of Southern California (Metropolitan) for large landscape customers in Orange County. The US Bureau of Reclamation contributed financial and staff resources toward this evaluation.

Evaluation Approach

There are three parts of the evaluation:

1. **Process Evaluation**—How was the program implemented and what worked and what did not work?
2. **Impact Evaluation**—What were the water savings produced by the program and how cost effective was the effort and how cost effective could it be in the future?
3. **Recommendations**—How can the program be made more successful? Can the program be replicated by other water agencies, and if so, how easy or difficult will this be?

Findings of the Process Evaluation

The process evaluation conducted numerous interviews to obtain perceptions of the program from each of the LPCP's stakeholders—the Metropolitan Water District of Southern California (Metropolitan), the Municipal Water District of Orange County (MWDOC), the retail water agencies, participating customers, property managers, and landscape maintenance contractors. Stakeholders were queried about ease of process, reasons for participation, value of the program to them, and aspects of the program they would like to see improved. While the detailed findings by each category of stakeholder are provided in Chapter 4, the findings are best summarized by theme as follows.

What's Working?

- **The Water Budget:** The water budgeting process is soundly meeting its intended purpose for providing the necessary information base for informed water use management. The program is perceived by participants as changing both their attitudes and actions.

- **Program Operation:** The program operates smoothly and the participating customers give the program overall high ratings. Customers state that the website and the reports are easy to access, straightforward and contain valuable information.

- **Loop of Accountability:** Typically, landscape programs struggle to get the HOA, the property management company, and the landscape contractors working together to oversee landscape maintenance in a water efficient manner. The Landscape Performance Certification Program effectively pulls the three stakeholders into the process and creates a "loop of accountability."

What is Not Working as Well?

- **Customer Participation**: The major finding of the process analysis is that, for a number of reasons that are detailed in this report, customer participation levels are far below their potential. Increased participation will deliver a higher volume of water savings to Metropolitan, MWDOC, and water agencies at a lower overall unit cost.

- **Agency Data Limitations:** Unfortunately, data limitations have prevented a number of agencies from participating in the program. The data issues fall into three categories:

    1. Several water agencies in North County have very small numbers of dedicated irrigation meters. Due to their large number of non-dedicated, mixed use meters, these agencies find the program less attractive despite having a large number of large landscape sites.

2. A number of agencies cannot locate existing dedicated irrigation meters within their agency's information systems, again making access to the program more difficult.

3. The most far reaching data issue is the inability for numerous agencies to automatically run monthly data transfers of customer usage data to the program vendor (ConserVision). Some agencies with older billing systems forgo the program because of this problem.

- **Site Measurement Data:** A major stumbling block to participation is the task of gathering site measurement data. Presently this responsibility lies solely on the shoulders of the customer. Typically, customers simply do not have the time or resources to initiate the data gathering process. As a result the customer elects not to participate.

- **Current Marketing Strategy:** Over the past several years, the program has relied heavily upon letter mailing campaigns and word of mouth to solicit participation. This current marketing approach is not enough to bring in the desired volume of customers for the participating water agencies.

- **Advertising Frequency of Top Performing Customers:** The program advertises the names of the most water efficient customers once a year. This inexpensive marketing vehicle needs to be increased dramatically in order to heighten program awareness and provide better motivation to strive for the bronze, silver, or gold medal status.

Findings of the Impact Evaluation

- **Average Water Savings:** Customers participating in the recent Phases 3 and 4 of the Landscape Performance Certification Program (that is, after November 2001) were found to save approximately 765 gallons per day on average (540 gpd – 991 gpd bound the 95 percent confidence interval). Customers participating in early Phases 1 and 2 of the Landscape Performance Certification Program (that is, before November 2001) were found to save approximately 367 gallons per day on

average (251 gpd – 512 gpd is the 95 percent confidence level). This sample compared 393 Phase 1 and 2 participants and 498 Phase 3 and 4 participants to 5,381 nonparticipating customers.

- **Effect on Peak Demand**: A secondary finding in this sample related to seasonal shape in this average savings effect. For the consumption data within our sample, the water savings were not constant throughout the year. The Landscape Performance Certification Program saved considerably more water in the peak summer period, up to 1300 gallons per day on the maximum day demand.

- **Cost-effectiveness of the Program:** The comparison of historically incurred direct program costs with the steam of benefits attributable to the program (net water savings times the avoided cost of additional water supply) paints a healthy picture--the present value benefits well exceed the present value costs, resulting in a positive $1.3 million net present value. Translating this cost benefit result into the commonly used cost-effectiveness metric for water supply results in an estimated cost per nominal acre-foot of 165 $/AF. These results suggest that the LPCP currently produces water savings in a fashion that is very cost-competitive with other water resource alternatives. The prospective analysis suggests that this cost effectiveness can be further improved by increasing the program scale. Chapter 6 discusses the additional indirect costs and benefits that were not included in this valuation exercise. For example, the water savings can reasonably be expected to reduce the "urban runoff" often associated with urban landscape irrigation, as confirmed by empirical measurements of urban runoff documented by MWDOC's award winning *Residential Runoff Reduction Study.*

Recommendations

Given the impact evaluation findings of significant and cost-effective water savings, the key focus of the recommendations is ***how to increase the number of water agencies and retail customers participating in the program to make it even more cost effective.*** Increased participation will deliver a higher volume of water savings to Metropolitan,

MWDOC, and water agencies at a lower overall unit cost. Recommendations for increasing participation fall into two categories:

1) ***Expand the number of participating agencies by:***

   a) Opening the program to all Metropolitan member agencies.

   b) Maximizing the number of participating agencies within the MWDOC region.

2) ***Expand the number of program participants by:***

   a) ***Creating a solution for the area measurement problem***-Currently this burden for customers causes many to forgo participation in the program. Stakeholders need to create a short-term solution (staff assistance, sufficiently accurate approximations, etc.) until more consistent and universal solutions (such as aerial or satellite measurement) can be worked out.

   b) ***Resolving data issues that block agency participation***

      i) Some agencies cannot identify dedicated irrigation meters within their territory; and/or

      ii) Agencies are incapable of performing, or leery of attempting to perform, regular monthly data transfers of customer water usage. Overcoming this hurdle may require direct assistance from Metropolitan/MWDOC and/or the assignment of this task as a priority by upper management of the retail agency.

   c) ***Creating a production-based, one-on-one sales and marketing initiative***- Take marketing from an intermittent activity to a standard and continuous component of the program. Program staff resources should be increased to make one-on-one sales/marketing a program priority. Increased investment of resources in marketing is warranted by the value of potential program benefits.

   d) ***Open the program to mixed use meter customers***- Expand beyond the limited universe of dedicated irrigation meter customers to increase the pool of potential participants.

To build on existing program success, each stakeholder has a role to play in continuing to improve overall program performance. Chapter 6 lists more detailed recommendations for each implementation stakeholder—Metropolitan, MWDOC, Retail Agencies, and the Implementation Contractor.

Chapter 1 - Introduction

In the past, attempts to improve large landscape water use efficiency have met with mixed success. Programs targeting landscape water use tread on sensitive ground. Residential landscaping has often been thought of as an integral part of customers' lifestyles and outdoor programs were difficult to implement because they required behavioral change to be successful.

Many retail water agencies have had difficulty identifying large landscape customers in need of the information that targeted conservation programs can provide. Yet other retail water agencies struggle with their billing systems to try to provide near real-time (i.e. monthly) information on water consumption for improved tracking of water management performance.

Also, homeowner associations and property management companies viewed conservation programs as a potential threat to property values. Furthermore, because the tasks of water use management are often contracted out, the incentives to follow through on recommended efficiency improvements remain indirect at best.

This report documents an evaluation of a water conservation program in Orange County California that targeted large landscape water users with dedicated landscape meters—seeking to close the gap between effort (water management) and result (efficient water use.) The Landscape Performance Certification Program (LPCP program) was pioneered by MWDOC with funding assistance from Metropolitan for large landscape customers in Orange County.

This report documents three components of a broad and thorough evaluation of the LPC Program that seek to answers to three different types of questions.

1. **Process Evaluation**—how was the program implemented and what worked and what did not work?
2. **Impact Evaluation**—what were the water savings produced by the program and how cost effective was the effort?
3. **Expectations, Recommendations, and Replication**—how can the program be made more successful? Can the program be replicated by other water agencies, and if so, how easy or difficult will this be?

Study Design

The Landscape Performance Certification Program evaluation documented in this report employs multiple data collection efforts and analytical methods to address each of the questions identified above. Table 1.1 below depicts the connections between the focus, data, and analytical methods.

Table 1.1 - Study Focuses, Data, and Methods

Study Objective	Focus	Data Sources	Analytical Methods
1. Process Evaluation	Program Design and Implementation	• Agency documents • Structured interviews • Contractor/Customer interviews	• Description • Qualitative assessment • Summary
2. Impact Evaluation	Water Savings	• Customer billing records • Weather data	• Descriptive statistics • Statistical modeling
	Cost-Effectiveness	• Program cost estimates • Water savings analysis	• CUWCC Guidelines for Cost-Effectiveness Analyses
3. Recommendations	How to improve the program	• Structured interviews • Customer survey • Water savings analysis • Cost-effectiveness analysis	• All the above

The three main study components used to evaluate the LCP Program were:

- **Structured interviews**. In-person and telephone interviews were held with a broad range of stakeholders—the interviewees included water agency personnel, implementing staff, water customers and irrigation management contractors, green industry professionals, and other interested parties..

- **Water use analysis**. For participating agencies, the research team analyzed historical account-level water use records. Careful data analysis was conducted to compare raw water use before and after implementation of the LPCP program. To control for potential biasing effects—including changing climatic conditions and varying customer characteristics— a sophisticated statistical analysis was conducted. Both the average daily water savings and the seasonal pattern of water savings was formally estimated and graphically depicted.

- **Cost-effectiveness analysis**. Results from the water use analysis and program cost data from the structured interviews were utilized to conduct a cost-effectiveness analysis. The cost-effectiveness analysis focuses on recent participants and examines the prospect question of how the program cost effectiveness is a critical function of program scale. As per CUWCC guidelines on cost-effectiveness, multiple perspectives were considered, including the customer, the retail agency, the wholesale agency service area, and the total society.

Report Overview

The remaining chapters of this report are overviewed below:

Chapter 2 - Program Description describes the LPC Program. It then evaluates the process by which this program was created, implemented, and adapted. This process evaluation includes:

- A discussion of the impetus for creation of the program;
- A description of how the program was initially designed and implemented; and
- A description of how the program evolved and was adapted through the history of the program.

Chapter3 – Impact Evaluation: Estimated Water Savings describes the results of the analysis of historical water use data collected from agency billing systems. The impact analysis documents how the water use patterns of participating customers have changed.

Readers interested in the technical details of data, methods, and complete statistical results should refer to *Appendix A*. Though much of this material is necessarily technical, this appendix takes pains to clearly communicate the problems and processes of a water use impact evaluation.

Chapter 4 – Process Evaluation describes the results of the interviews with program stakeholders—agency staff, customers, and green industry professionals. The process evaluation seeks to identify what worked, what did not work, and what could be improved.

Chapter 5 - Cost-Effectiveness Analysis, identifies and analyzes the costs and benefits of the LPCP program. The analysis conducts a prospective analysis to show how program cost effectiveness changes with the scale of the program. This information is critical to depict the value of program expansion.

Chapter 6 - Recommendations summarizes the findings of the process and impact evaluations. The qualifications and caveats to these findings are documented. Also included are recommendations that target the key impediments to program expansion—customer identification, inclusion of mixed meters, area measurements, and information management hurdles.

Appendix A -- Impact Evaluation: Data, Methods, Statistical Results contains more detailed information related to the data, methods, and statistical results of the impact evaluation. *Appendix B — Interview Protocols* contains the two interview protocols used in the process evaluation for conducting the in-person and telephone interviews.

Chapter 2 - Program Description

Overview

The Municipal Water District of Orange County offers its member agencies a Landscape Performance Certification Program (LPCP) for dedicated irrigation meter customers in an effort to save valuable water supplies and comply with Best Management Practice No. 5 Large Landscape water use efficiency. MWDOC's member agencies can elect to participate at their discretion.

Personnel for the LPCP work with dedicated landscape irrigation meter customers to create water budgets for their landscape areas and teach customers to maintain their schedules over time. Customers are motivated to participate in order to save money through a reduction in their water/sewer bills while MWDOC and its member agencies reduce their need for expensive imported water. Property managers, Homeowner Associations (HOAs), and landscape contractors are the primary targets for participation in the program.

The program receives funding from two primary sources:

- MWDOC
- Metropolitan Water District of Southern California

Additional Program Partners have included:

- Orange County Integrated Waste Management Department
- State Integrated Waste Management Board

Who Participated?

Today the program has 9 of 31 retail water agencies in Orange County on board and operating to serve a collective total of 47 HOA customers equating to 1,489 dedicated irrigation meters. Many of the retail agencies that do not participate feel that they have no immediate and critical need to conserve at this time. As a result conservation is not a priority and many do not have the necessary staff to implement a program such as this.

Other retail agencies that do not participate lack the data billing systems capability needed to identify dedicated meters. Participating agencies are required to submit, on a monthly basis, their customers' dedicated irrigation meter usage. Many non-participating agencies feel that the ability to regularly transfer customer usage data is beyond their capability. This key hurdle must be overcome for the program to be able to reach all of its targeted customers.

Table 2.1 – Participating Retail Agencies

Agency	No. of Dedicated Irrigation Meters	Participant (yes or no)	No. of Active Accounts	% of Active Accounts vs Dedicated Meters
Anaheim, City of	Unknown	*Yes but not currently active	0	Unknown
Brea, City of	184	No	0	0
Buena Park, City of	300	No	0	0
Capistrano Valley Water District	448	Yes	47	9%
East Orange County Water District	0	No	0	0
El Toro Water District	878	Yes	63	7%
Fountain Valley, City of	287	No	0	0
Fullerton, City of	252	No	0	0
Garden Grove, City of	310	No	0	0
Huntington Beach, City of	1026	No	0	0
Irvine Ranch Water District	3856	Yes	187	6%
Laguna Beach Water District	0	No	0	0
La Habra, City of	71	No	0	0
La Palma, City of	35	No	0	0
Mesa Consolidated Water District	853	Yes	184	22%
Moulton Niguel Water District	2299	Yes	189	13%

Agency	No. of Dedicated Irrigation Meters	Participant (yes or no)	No. of Active Accounts	% of Active Accounts vs Dedicated Meters
Newport Beach, City of	1135	Yes	48	Not available
Orange. City of	671	No	0	0
Orange Park Acres Water Company	0	No	0	0
San Clemente, City of	584	Yes	151	26%
Santa Ana, City of	375	No	0	0
Santa Margarita Water District	1712	Yes	558	33%
Santiago County Water District	0	No	0	0
Seal Beach, City of	0	No	0	0
Serrano Water District	0	No	0	0
South Coast Water District	494	Yes	62	22%
Southern California Water Company	0	No	0	0
Trabuco Canyon Water District	128	No	0	0
Tustin	193	No	0	0
Westminster	181	No	0	0
Yorba Linda Water District	692	No	0	0
	16964		**1489**	**9%**

Table 2.2 - Summary of Activation Levels

Agency	Date of Activation	Activated as of 12/31/01	Activated as of 4/30/02	Activated as of 8/31/02	Activated as of 12/31/02	Activated as of 4/30/02	Activated as of 8/31/03	Total
Capistrano Valley Water District	11/01/01	42	0	1	4	0	0	47
El Toro Water District	11/15/02	0	0	0	2	51	10	63
Irvine Ranch Water District	11/1/01	80	22	20	32	5	28	187
Mesa Consolidated Water District	4/15/02	4	2	109	0	30	39	184
Moulton Niguel Water District	11/1/01	161	14	6	0	2	6	189
Newport Beach	11/15/02	9	38	0	1	0	0	48
Santa Margarita Water District	11/1/01	333	1	20	17	0	187	558
San Clemente	5/15/02	0	7	31	28	39	46	151
South Coast Water District	2/15/03	0	0	0	0	62	0	62
Total		**629**	**84**	**187**	**84**	**189**	**316**	**1489**

Marketing

Industry professionals look at customer response as one of the key indicators of a program's viability. The response to this program hovers at a low level of successful activation; with participation from 1,489 meters of the estimated 17,000 dedicated irrigation meters available in MWDOC territory. This equates to an 8.7% response rate within the nine agency territory. The program has had phases where there were marketing pushes and large clusters of customers were brought on board the program. At other times, little to no marketing was performed relying solely on word of mouth and the addition of new program participants dropped to low levels.

Over the past several years, the program has relied heavily upon two outreach methods to solicit participation:

1. Letter mailing campaigns
2. One-on-one presentations
3. Workshops

Customers with existing site measurement data respond favorably to program solicitations via letter campaigns. When program solicitation letters were sent to Santa Margarita customers they found high customer receptivity. The reason for the high response – customers were drawn in by personalized information contained within the letter. The data included in the letter makes the offer credible to the customer.

The problem lies in that this group is only a small portion of the dedicated irrigation meter customer population. Generic letters sent to other customers failed to solicit a meaningful response. Additionally, the letter campaigns often reach the property management firms instead of the primary decision maker; the Homeowner Associations (HOAs) and property owners. With less direct tie-in to the payment of the water bill, the property management firms generally were generally less responsive than the HOAs.

The most persuasive of three outreach methods was the one-on-one presentations. The program offer is complex and this forum allows for full exchange of program information and benefits. Customers can ask and have questions answered about participation and water savings. Many customers interviewed stated that they signed up because of one-on-one presentations. These have been the highest response category by far, but the number of overall presentations has been minimal and sporadic.

Training Workshops

All customers or their representatives must attend a training session in order to become certified for program participation. Technical training sessions are designed to help both the landscape contractor and the property manager to:

- Manage sites efficiently
- Explain evapotranspiration and water budgets
- Review runoff and its implications
- Demonstrate the website and reports
- Learn how to market water use efficiency to prospective customers
- Learn how to incorporate water and green waste efficiency into standard business practices for business retention, new business services and/or increasing business profits

The information is unavailable as to how many training sessions occurred under the initial contractor, CTSI. Seven workshops were conducted by ConserVision in 2002. The balance of customers now attends the Protector Del Aqua (PDA) training offered through Metropolitan. Metropolitan does not pass along the cost of PDA to MWDOC. By routing customers through the PDA program, dollars can be spent in areas other than technical training.

Landscape Performance Certification Program Workshops

Date	Place	Companies Attending	No. of Attendants	Presenters
5/24/2002	El Toro WD	8	16	Ash, Sánchez, Berg
3/22/2002	IRWD	27	60	Ash, Sánchez, Berg
4/4/2002	Santa Margarita WD	6	7	Sánchez, Berg
4/18/2002	City of San Clemente Offices	2	6	Sánchez
6/6/2002	San Clemente City Hall	16	19	Ash, Sánchez

Landscape Performance Certification Program Workshops

11/13/2002	City of Orange	17	41	Ash, Sánchez
11/26/2002	City of Huntington Beach	6	16	Ash, Sánchez
	Total	82	165	

At this time the total number of trainees that have become program participants is unknown due to missing data from the early days of the program when records of this nature were not maintained.

Site Measurement Process

One of the key topics of discussion regarding this program is the difficulty of obtaining timely and accurate site measurement data. This data is used to establish the baseline water budget utilized throughout the program. The process of gathering the data requires the customer to walk the property, measure the landscape area and identify plant type valve- by -valve to establish the total area measurement for each meter.

Customers are given data collection forms and training during the technical training session. They are solely responsible for completing the forms and returning the information to ConserVision. This task is an obstacle for the customer and the program, causing time delays and lack of participation.

Copies of the site measurement forms are available as an attachment.

Customer Reports and Website

During the second phase of the program, one of the primary activities was to create a reliable internet based tool to allow simultaneous and timely assess to program data for landscape contractors, property managers and owners. It also eliminated an unwieldy volume of faxing.

ConserVision designed and implemented the website. Estimated development costs were $170,000 for completion of the website as it exists today. As with database and website development there were glitches, though minor in nature. The system is now stable, user

friendly and well received by customers. In the chart below is an example of a typical customer report available on the website. Should this program roll out to other water agencies areas outside of MWDOC's territory, these agencies could consider utilizing the MWDOC website developed by ConserVision instead of attempting to recreate it. The website would be available to other water agencies at no charge because it was developed with public funds

Customers are sent a monthly e-mail notification letting them know their reports are available for preview on the website. This e-mail notification also includes a program newsletter containing seasonally appropriate landscape maintenance suggestions. Copies of newsletters are provided as an attachment. When interviewed, customers stated they were generally satisfied with the website and reports. Their only recommendations would be to change the sender of the e-mail from ConserVision to the local water agency's name and to better label some of the column headings.

Account:	237685	**Area:**	35,719
Meter:	001377943	**% Turf:**	5%
Site Name:	Vista Norte	**Meter Type:**	Dedicated
Agency:	Santa Margarita WD	**Microclimate:**	Foothill
Landscaper:	W. B. Starr, Inc.	**Grass cycling:**	No
Property Mgr.:	Merit Property Mgmt. Inc.	**Mulch:**	Yes
HOA:	Vista Norte	**Divert/Recycle:**	Yes
Waste Hauler:	Not Available	**Controller Type:**	Real Time

The certification process was designed to provide motivation for a customer, both property managers and landscape contractors, to attain a desirable performance status ranking of bronze, silver or gold. The intent of the certification aspect of the program is to give companies that manage their sites with a high level of water use efficiency recognition and prestige coupled with a competitive business advantage over non-participants.

Certification is based on 1) collecting appropriate site data, 2) monthly performance of efficient water use and 3) green waste management. The more efficiency achieved at the customer site, the higher the performance status ranking. The list of certified companies is posted on MWDOC web site and is continually updated. Additionally, these top performing customers are listed in local newspapers each year.
Described below are descriptions of the three performance status ranks:

Level 1 Certification: (Bronze)

- Data collected and received on sites managed in Orange County
- Attend scheduled training classes
- Up to 50% of sites meet 100% water budget
- Use mulch onsite

Level 2 Certification: (Silver)

- Data collected and received on sites managed in Orange County
- Attend scheduled training sessions
- Up to 75% of sites meet 100% water budget
- Use mulch onsite

Level 3 Certification: (Gold)

- Data collected and received on sites managed in Orange County
- Attend scheduled training sessions
- *More than* 75% of sites meet 100% water budget
- Use mulch and divert other green waste to recycling or composting facility

At this stage in the program, no customer has moved beyond the Bronze Level. During the customer interviews, only one customer stated that it was leveraging its certification status and using it in business marketing materials. Other customers never raised the certification as a program benefit. In order to make performance certification more meaningful, focus needs to be given to a more well-developed advertising campaign along with a strategy to move customers to the silver and gold levels.

Program Evolution

The evolution of the Landscape Performance Certification Program spans four distinct phases. Phase I required the development of a landscape curriculum, program materials and training; Phase II initiated the development of databases, Internet capabilities and the inception of a focused outreach program; Phase III aimed to expand participation to those customers who would most benefit from the Landscape Certification Program. In Phase IV, which is currently underway, additional funding was secured to allow Program implementation to continue and to evaluate the program's effectiveness.

Historical Background

In 1991, the District became a signatory to the Memorandum of Understanding (MOU) Regarding Best Management Practices (BMP) for Urban Conservation in California. BMP 5 targets large landscape water-use efficiency and requires the implementation of water budgets and performance reporting for dedicated irrigation meters. BMP 10 includes provisions for wholesale agencies, such as MWDOC and Metropolitan, to assist their retail agencies with implementation of the MOU.

The Landscape Performance Certification Program was conceived in order to implement BMP 5 throughout Orange County. This regional implementation approach would not only offer a consistent program to the public but would encourage the development of higher quality materials, programs and systems. Agencies would pool their efforts in order to achieve economies of scale.

In the mid 1990s, MWDOC, Metropolitan and Moulton Niguel Water District conducted a landscape area measurement study to evaluate the accuracy and cost of four landscape area measurement methodologies. The objective was to determine the most appropriate methodology for use in the development of Landscape Irrigation Budgets (LIBs), which are generated based upon the irrigated area served by a dedicated landscape water meter,

the various plant materials irrigated and the local climate. LIBs fluctuate monthly as the weather changes.

Area measurement methodologies evaluated included the following: aerial photography and GIS-based parcel boundary overlays; parcel data; mail-out surveys; and on-site measurement.

The study revealed both aerial photography and on-site measurement methods were highly accurate, but also expensive when performed by the water agency. The parcel data approach was deemed unacceptable due to incomplete data. The mail-out survey method was reasonably accurate when performed by a landscape contractor and relatively inexpensive, but suffered from inaccuracies when performed by homeowners. As a result of this study, area measurements performed by landscape contractors became the basis of the LPCP.

Phase I (March 1999-March 2000): Landscape Conservation Curriculum

In March of 1999, the Landscape Performance Certification Pilot Program was initiated. Education materials were developed and workshops conducted. A comprehensive irrigation management-training program was developed independently and went beyond the scope of the existing *Protector del Aqua* program to train landscape contractors. The newly developed program materials included the following:

- Irrigation management principles;
- Irrigation technologies;
- Area measurement and data collection;
- Water budget calculations.

Early reporting methodology relied on a hands-on approach. The program vendor collected names and fax numbers and manually calculated water budgets. Fax numbers were used to communicate reports to participating customers. This early phase also

included the development of effective data collection forms, which would eventually be incorporated into a database.

"Certification" consisted of attending workshops, which were organized and presented to participants with detailed information on budgets, landscape horticulture and irrigation methods. The Program team educated customers on the costs of over-watering and under-watering. The level of detail presented in the workshops was appropriate for some participants while overwhelming for others who needed basic, practical information. The Program team developed and used a training manual with steps to calculate a water budget and manage landscape sites. A copy of this training manual is available upon request.

Later in Phase I, measurement data collection increased rapidly after area measurement data was determined to exist in the billing system databases of Santa Margarita and Moulten Niguel water districts. These area measurements were developed during the housing development process for reclaimed water supply and distribution system planning purposes.

In addition, during this time, the program received a grant from the state and county Integrated Waste Management Boards to combine efforts in the area of managing green waste to meet the Integrated Waste Management Act (AB939) waste reduction goals. Data collection efforts were combined for the added capability to assess mulching and grass cycling practices.

Phase II (April 2000 –March 2001): Information Technology

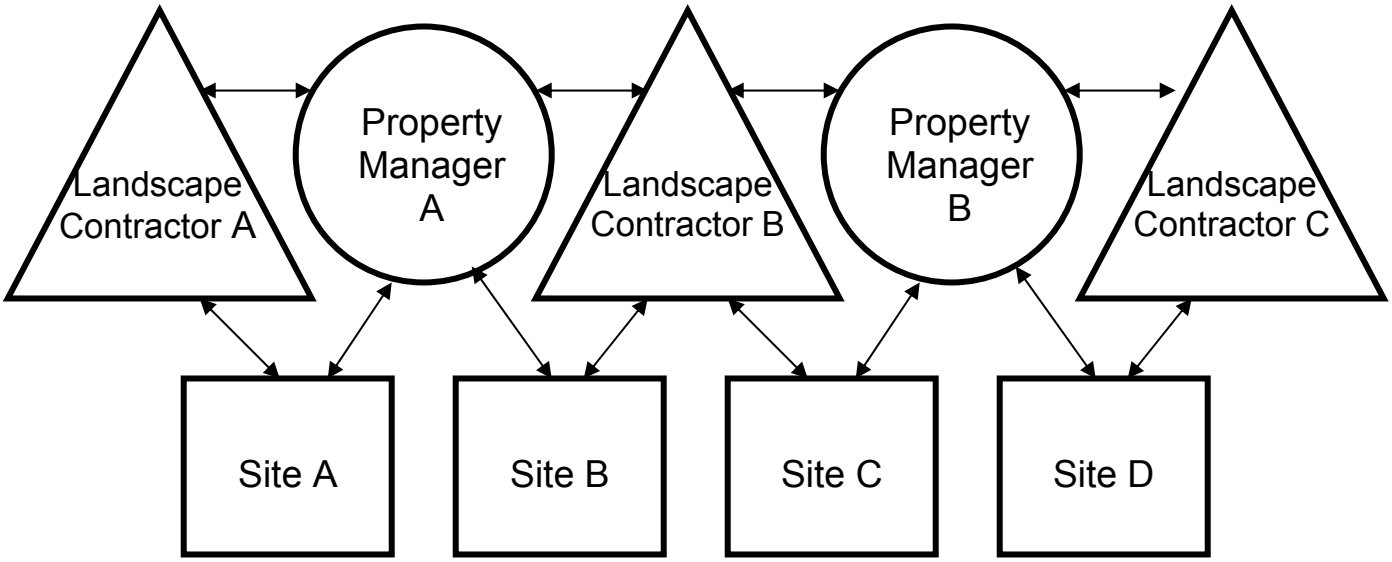
As the number of participants in the Program increased during Phase II, the method of faxing budget reports proved inefficient. As a result, project contractors developed an internet-based tool in order to allow access to program data and to expand database

capabilities. Although the data system was now available on-line, budget reports were still faxed. However, once e-mail capability was established, participants received notification via e-mail and obtained their landscape budget information from the website.

Phase II also marked the development of the Program's website, which contained large amounts of poor quality data and insufficient contact information. Hence, much of the effort in Phase II focused on transforming the data system and website into efficient tools. Efforts were made to increase the amount of contact information related to the meters in the database. Much of the data initially input into the database was later deemed to have questionable reliability

In addition to Internet capabilities, a "loop of accountability" was developed to promote the effective use of data and water budgets (See Figure 2.1). The concept consists of contacts between landscape contractors, property owners, and property managers. Emails would be sent to all three groups to foster communication and interaction. This allowed all the players involved to view the same report and information at the same time.

Figure 2.1: Loop of Accountability



During this phase, the notion of participant "activation" developed into two forms. First, activation meant that all data were obtained for the customer, including contact information and meter numbers. Second, full "activation" occurred when the water agency's consumption data was acquired for those meters. Once activation was completed, the loop of accountability became effective and all groups shared the same information.

Presentations and outreach continued during Phase II. Tom Ash continued to give talks and disseminated flyers and site data forms. The presentations were given directly to homeowners associations, landscaper maintenance contractors, city landscape maintenance staff and the County's Harbors, Beaches and Parks staff.

Phase II ended abruptly when the Program's vendor declared bankruptcy.

Program Hiatus (April 2001 – December 2001)

During the program hiatus, the program was maintained at a minimal level of operation until a new Program vendor could be selected. ConserVision was signed on as the replacement program vendor in December 2001.

Phase III (December 2001-March 2003): Marketing the Program

With a new program vendor under contract, marketing efforts for the Landscape Performance Certification Program resumed and were refocused. Workshops were redesigned to be more succinct and concise for practical implementation and limited to two-four hours. They were also conducted countywide to make the program more accessible. The program also continued to expand its outreach to include property managers, HOA board members and other landscape decision makers. Efforts were focused to bring together these groups and to obtain their contact information for future follow up. The program worked more actively and directly with water districts.

Phase III saw the development of greater electronic capabilities. More data could now be transferred electronically to databases, spreadsheets, and PDF files. For example, irrigated area data exists for three or four agencies. The program was (and continues) making an effort to obtain these data, merge them with mail records and send out customized notices to these potential participants, thereby facilitating program signup more efficiently. This process was completed with Santa Margarita Water District and continues to be worked on with other water agencies. All the customer is required to do is sign up. The customer incurs no participation charge. However, this process can take several months as the notices are first sent to the HOA board of directors care of the property management company for discussion and a vote at the regular Board meetings. Thus far, responses from HOAs have been positive.

Although occasionally the acreage data is unreliable, the performance focus is on the pattern of irrigation changes over the course of a year versus total irrigation. For cases in which the measurement is systematically too high or low, the changing patterns still demonstrate whether timers are being adequately adjusted.

Not all water districts within Orange County that want to participate have the data billing system capabilities needed to identify dedicated meters. In such cases, the program was (and continues) making efforts to collect contact information and dedicated meter number information from the customer before requesting consumption data from these districts. Although this involves more effort, the acceptance rate is significantly high when compared to mass mailings.

Phase IV (April 2003 – present): Program Implementation and Evaluation

Additional funding was secured to allow Program implementation to continue until March 31, 2004. In addition, an evaluation of the program's effectiveness by A & N Technical, Services, Inc., is currently underway.

Chapter 3 - Impact Evaluation: Estimated Water Savings

A Model Based Definition of Water Savings

Appendix A documents a careful statistical analysis of historical water consumption data to derive estimates of the net water savings from this program. The "net" water savings is the estimate of how much *more* participating customers saved than nonparticipants. The reader should note that this is a different construct than some estimate of "gross" water savings—the total amount of water saved. The water use analysis derived its estimate of net water savings by estimating water savings among 393 early participants (Phases I and II) and 498 later participants (Phases III and IV) defined relative to 5381 nonparticipating customers. The explanatory variables in these models include:

- The seasonal shape of demand
- Weather conditions
- Measures of air temperature
- Meter-specific mean water consumption per billing period
- "Intervention" measures of the date of participation and the program phase

Data and Methods

Of the 1465 activated meters (661 early participants and 804 later participants) approximately 144 accounts were excluded from the sample based upon prior participation in other landscape conservation programs such as computer controlled irrigation system retrofits and weather based irrigation timer retrofits. Accounts could also be excluded if the consumption records were of insufficient length or quality. Thus, meter reads containing a negative number of days in the meter read or more than 120 days were omitted. To keep other data inconsistencies from corrupting statistical estimates of model parameters, this modeling effort employed a sophisticated range of

outlier-detection methods and models. Appendix A documents the technical background on the data and methods used to estimate the landscape customer water demand model. Table A.1 of Appendix A presents the descriptive statistics of the sample used for modeling.

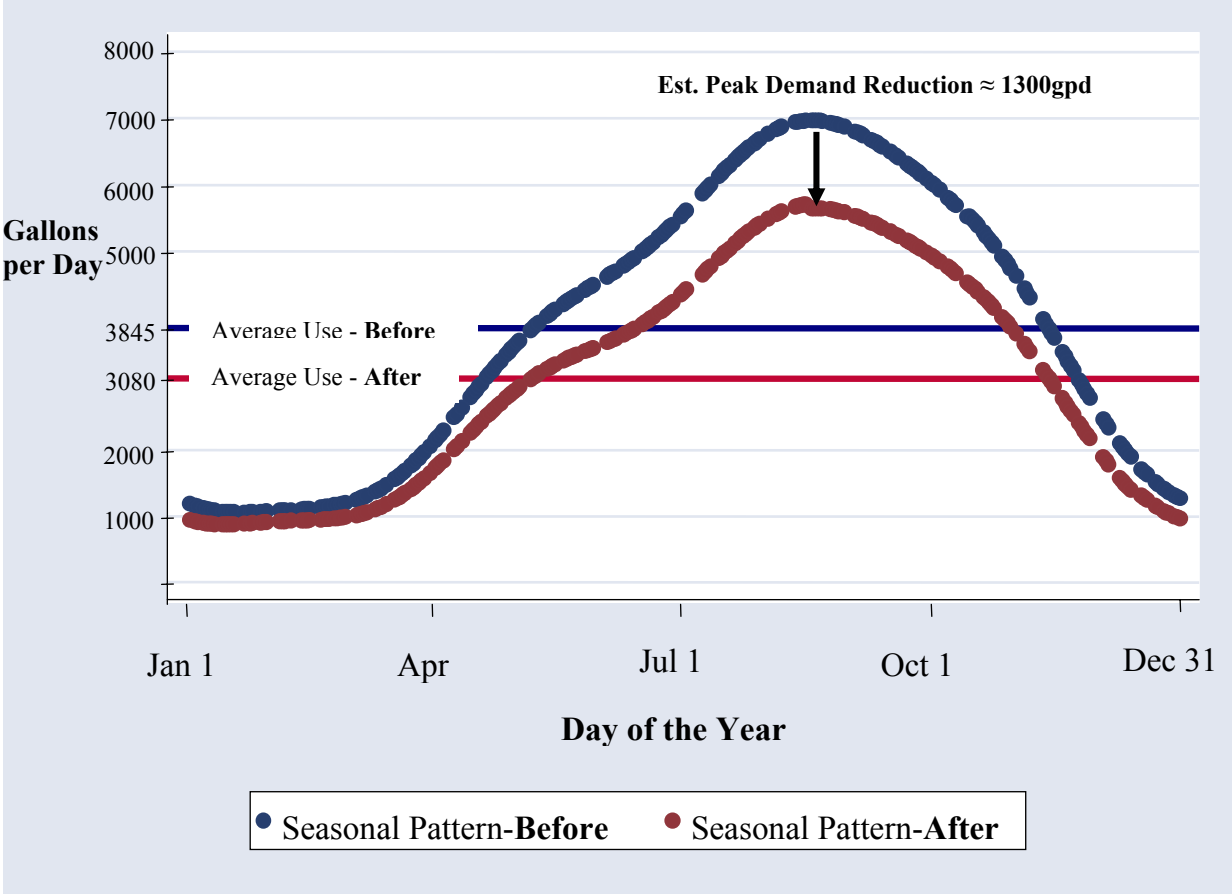
Estimated Average Water Savings

The estimated parameter for average water savings among Phase III and IV participants implied a mean change in water consumption of -765 gallons per day (-540 gpd to -991 gpd bound the 95 percent confidence interval)., approximately 20 percent of the pre-intervention water use. The parameter for Phase I and II participants implied a mean change in water consumption of -367 gallons per day (-251 gpd to -512 gpd bound the 95 percent confidence level), approximately 9 percent of mean water use. The reader is urged to note that these results summarize the findings that can be inferred within the sample of customers analyzed. The same program, implemented in other water agencies or areas, may produce different levels of water savings. For example, inland water agencies or water agencies with a lower retail water rate could experience higher net water savings. Contrariwise, coastal water agencies or water agencies with a higher retail water rate could experience lower net water savings. Your mileage may vary.

How Program Participation Affects Peak Demand

The estimated water demand model in Appendix A was also used to infer the seasonal shape of demand before and after participation in the Landscape Performance Certification Program. Figure 1, on the following page, graphically depicts the change in water demand for recent participating customers (Phases III and IV).

Figure 3.1 Load Shaping Effect of Performance Certification on Large Landscape Demand



For the consumption data within our sample, the water savings were not constant. The Landscape Performance Certification Program saved considerably more water in the peak summer period, about 1307 gallons per day (18.7%) of the maximum day demand (August 18th within the observed sample).

Caveats and Conclusions

This modeling effort focused on developing the best depiction of net changes in water consumption due to participation in the Landscape Performance Certification Program. The empirical effort has quantified the change in mean water consumption and the shift

in seasonal consumption. The models have not been extended to document how water savings vary across customers.

- How do savings change across customers of lower or higher water use?
- How do water savings vary as a function of landscape area?
- Since the sample only contains limited post participation data, the statistical models can say little about the persistence of water savings.
- The error component of the estimated models could be improved by specifying a function form to explain the variance.

Customers participating in these programs saved significant amounts of water. Participation in the program changed both the level and shape of water demand.

Chapter 4 - Process Evaluation: Implementation Assessment

The impact evaluation seeks to measure the program impacts—in this case the net water savings produced by the Landscape Performance Certification Program (LPCP). The process evaluation of this chapter seeks to define *how* the LPCP produced its impacts. In order to increase the benefits produced by the LPCP, one needs to understand these processes, define what works, and point to areas that need improvement.

Process Evaluation - How did the Program Succeed or Fail?

A summary measure of a program's success or a failure is its cost effectiveness. However to improve a program's overall value, the program design and operation must be thoroughly analyzed. Key performance indicators for this program are summarized in *Table 4.1 – Performance Indicators* on the following page.

The key methods of this process evaluation—an assessment of program processes, review of the program website and reports, and interviews with key stakeholders—there were clear indications regarding successes and weaknesses in the program. As with many qualitative projects, the reader is cautioned that these findings are subject to limitations. The relatively small sample of individuals interviewed was necessarily nonrandom. The interview method sought to exhaust the population of potential respondents. Snowball sampling methods were also employed—"Who else could speak knowledgably about this program?" Even with a small sample size of interviewees, program strengths and areas of opportunity were consistently identified with surprising regularity.

Table 4.1 – Performance Indicators:

Agency Participation:	*How do the agencies perceive the program? Why did an agency choose to participate? What is the reason for other agencies to forego participation? What would cause these agencies to change their decision?*
Customer Participation:	*Is the marketing effort effective at attracting customers to participate? How was the customer approached and what motivated it to participate? Why did other targeted customers fail to enroll?*
Customer Services and Ease of Process:	*Is it easy for customers to get started with the program? How demanding is it for them to participate over time? Do they like the design of the program and the web services? What caused some customers to drop out of the program?*
Transferability of the Program:	*Can this program be easily replicated by other non-MWDOC water agencies? What are the major hurdles to overcome? What types of costs must these agencies budget? Does the program have value to the industry?*

The research team developed several quantitative and qualitative methods to assess these performance indicators. These include the following methods and tasks:

1. Created questionnaires for each stakeholder: water agency, participating customer and non-participants
2. Conducted telephone interviews with each stakeholder
3. Reviewed customer reports, program web site, progress reports, and marketing pieces
4. Summarized and assessed results
5. Identified major program issues and developed recommendations

Interview Results by Stakeholder Category

Interviews were conducted in order to obtain each stakeholder's overall perception of the program. Stakeholders were queried about ease of process, reasons for participation, value of the program to them, and aspects of the program they would like to see improved. Prior to conducting interviews an interview protocol was developed to

improve consistency across interviews. One of the questions asked of all interviewees was a general question… "How would you rank the program on a scale of 1 – 10 with 10 being the highest?" Though the response to this question reflects the subjective assessments of the interviewees, a summary of their responses is provided to convey differences in responses across interviewee types. (Copies of the questionnaires have been provided to the sponsors.)

Although the sample size in each category is small attitudes and recommendations tracked consistently forming strong conclusions. Described below are summary results of the interviews broken out by stakeholder category.

Metropolitan

Metropolitan has been funding the program year after year without a precise sense of the actual water savings. As a result, Metropolitan has been hesitant to fully support the program let alone endorse an expansion plan. This evaluation is considered critical to determine the cost effectiveness of the LPCP. Since this study includes a defensible savings analysis that shows considerable savings, this missing information hurdle has been addressed to permit Metropolitan's Board of Directors to make sound decisions regarding future funding. Below are highlights from the interviews with Metropolitan staff.

2 Interviews Conducted
Overall Rating: **5**

Pros	Cons
▪ Water budgets are helpful tools to improve water efficiency and landscape health	▪ Was not sure if it was cost effective
▪ Gets information simultaneously to all stakeholders; HOAs, property managers and landscape contractors on a timely (monthly) basis	▪ Level of service (web site, monthly e-mails) may come at too high a cost…might be able to get same results with less service and less cost.
▪ Program is meeting the objective of water budgets and BMP 5	▪ Volume of customers is too low

Pros	Cons
	▪ Not enough one-on-one marketing ▪ Haven't been able to get any contractors out of bronze certification ▪ Certification process has not created the competitive market it was intended to create

MWDOC

1 Interview Conducted
Overall Rating: **8**

MWDOC strongly supports this program and believes that the program will evolve into a highly valuable foundation for future landscape initiatives. Below is an assessment of the program from MWDOC's perspective:

Pros	Cons
▪ Program created "loop of accountability" for all three parties: HOA's, property managers, and landscape contractors ▪ Regional design provides for best quality ▪ Service level and program design is right ▪ Believes water budgets are required as a foundation of all landscape programs. Program educates customers on the "bell shaped curve" for landscape irrigation ▪ Program can meet objective of BMP 5 ▪ Good education platform of watershed management	▪ Needs more one-on-one marketing to HOA boards ▪ Cost and difficulty of getting accurate area measurements ▪ Needs additional promotion of certified companies ▪ Needs landscape and irrigation performance based contract language for customers to use

Participating Water Agencies

5 Interviews Conducted
Overall Rating: **7.7**

The participating water agencies are highly supportive of the program. They participated because of the regional design, to meet BMP #5, and because of the potential water savings. They especially like the regional design because without the support of MWDOC and Metropolitan they would be unable to provide this program to their customers. They believe that the retail agencies and MWDOC receive excellent public relations in that the customer is given a valuable service and all parties are saving water. Below is a snapshot of participating water agencies' feedback:

Pros	Cons
▪ The program design is on target	▪ Want more marketing
▪ Like it because once it's in place, it's automatic	▪ Customers having to get area measurements on their own is a barrier to participation
▪ Access to data on the web for all parties	▪ Getting customer data to contractor (ConserVision) on a consistent basis has been difficult
▪ Like regional design	▪ There is no regular assessment of landscape contractor's performance
▪ Like that program certification specifically recognizes landscape contractors' performance "without recommending" contractors	▪ Want more summary information on number of customers over budget
	▪ Want more consistent program meetings to sustain program momentum

Non-participating Water Agencies

3 Interviews Conducted
Overall Rating: **8**

Initially these water agencies had a strong desire to participate but lost their enthusiasm as program barriers and operational interruptions occurred. They like it in theory and would participate if program barriers were removed. Below are interview findings:

Pros	Cons
▪ Like it in theory	▪ Don't have many dedicated irrigation meters ▪ Can't get data out of billing system ▪ Not sure if it saves water

Customers: HOAs

4 Interviews Conducted
Overall Rating: **7.25**

With the water bill as their second largest line item, the HOAs elected to participate in order to save money. All interviewees heard about LPCP through one-on-one contact. All stated their water bills had gone down. Two of the four interviewees planned to overhaul their landscape and irrigation systems to further maximize water savings. They found the site measurement process cumbersome; however, all other aspects of the program are user-friendly. Below are summary findings from HOA interviews:

Pros	Cons
▪ Water bill has gone down significantly ▪ Finds program invaluable	▪ Area measurement data gathering is burdensome and most customers won't do it ▪ Took a while to educate everyone on HOA board

- Came up with three year plan to make landscape changes (1 customer)
- Web site is easy
- Everyone has access to information
- Wants more tangible (installation) programs

Customers: Property Managers

6 Interviews Conducted
Overall Rating: **8.3**

Property managers gave the program an overall high rating. They participated to save money and show their HOA client an ability to better manage the HOAs water usage. A couple of the interviewees led the participation process and directed their HOA clients to the program. Three property managers stated that the program information aided them in their request to the client for landscape improvements. All respondents heard about program through one-on-one contact. Below are highlights of property manager interviews:

Pros	Cons
▪ Used information to justify landscape and irrigation improvements (3 customers)	▪ Obtaining area measurements is costly and cumbersome
▪ Saved water and money	▪ Data can be intimidating to landscapers
▪ Used certification list to hire landscape contractor	

Landscape Contractors

5 Interviews Conducted
Overall Rating: **8.5**

Three of the five interviewees were landscape contractors with a higher than average level of landscape design and water efficiency knowledge. They personally championed participation in the program. Many felt that obtaining area measurements was a costly and time-consuming process. From the interviews it was unclear how often monthly reports reached the field worker. Again all

respondents heard about the program through one-on-one contact. Below is a summary of the Landscape Contractor interviews:

Pros	Cons
▪ Likes it because once it's in place, its automatic	▪ Obtaining area measurements is a problem
▪ Helps clients	▪ We were already irrigation and ET experts
▪ Boost image	
▪ Provides budget which should be the first thing you do otherwise it's like an open checkbook	

Customers: Non-participants

3 Interviews Conducted

The non-participants interviewed reacted favorably when the program was explained to them. They felt the services were valuable however they would not pay for these services if this were a requirement of the program. The interviewees stated they had the means to conduct the site measurements, but it was cost prohibitive. It appears this measurement constraint, coupled with the lack of a direct marketing approach are major obstacles to participation.

Pros	Cons
▪ Likes program	▪ Didn't know about program
▪ Would use reports	▪ Sort of understand program
	▪ Not willing to pay

What's Working?

The Water Budget

The water budget was intended to:

1. Educate customers about the irrigation "bell curve" seasonal pattern of water need
2. Show them where they presently are on this curve
3. On a monthly basis influence them to operate at the appropriate point on the curve
4. Save significant water for both the customer and the water agency

The water budgeting process is soundly meeting its intended purpose. Customers have seen a large reduction in their water bills and are pleased with the monetary savings. Customers are not only using this information to save water today, but are utilizing this as a resource tool for future landscape planning. As a direct result of this program, several customers stated they have plans in place to retrofit their entire landscapes and irrigation systems to further optimize efficiency. The program is truly changing customers' attitudes and actions.

Program Operation

The program operates smoothly and the participating customers give the program overall high ratings. Customers state that the website and the reports are easy to access, straightforward and contain valuable information

Loop of Accountability

Typically, landscape programs struggle to get the HOA, the property management company, and the landscape contractors working together to oversee landscape maintenance in a water efficient manner. The Landscape Performance Certification Program effectively pulls the 3 stakeholders into the process and creates a "loop of accountability."

This is achieved by the inclusion of all three parties in the marketing, training, certification, and water budgeting process. More importantly, all three parties are given

access to the monthly irrigation performance reports. The program strives to position the property owners as the drivers since they pay the water bills and have the ultimate authority over the property managers and landscape contractors.

Despite the strengths of the overall program process and the loop of accountability the program creates, there are several impediments, hurdles and barriers affecting the overall quality of the program.

Agency Data Limitations

Unfortunately, data limitations have removed a number of agencies from participating in the program. The data issues fall into three categories:

1. Several water agencies in north Orange County have very small numbers of dedicated irrigation meters. Due to their large number of non-dedicated, mixed use meters, these agencies find the program less attractive despite a high number of large landscape sites.
2. A number of agencies cannot locate existing dedicated irrigation meters within their agency's information systems, again making access to the program more difficult.
3. The most far reaching data issue is the ability for an agency to automatically run monthly data transfers of customer usage data to ConserVision. Some agencies with older billing systems forgo the program because of this problem.

Site Measurement Data

A major stumbling block to participation is the task of gathering site measurement data. Presently this responsibility lies solely with the customer. Typically, customers simply do not have the time or resources to initiate the data gathering process. As a result, the data is often wrong or the customer elects not to participate.

Current Marketing Strategy

Over the past several of years, the program has relied heavily upon letter mailing campaigns and word of mouth to solicit participation. This current marketing approach is not enough to bring in the desired volume of customers for the participating water agencies.

Advertising Frequency of Top Performing Customers

The program advertises the names of the most water efficient customers, the Bronze Level customers, once a year. This inexpensive marketing vehicle needs to be increased dramatically in order to heighten program awareness and provide better motivation to strive for the bronze, silver, or gold medal status.

These top-performing customers should be printed in the local papers on a monthly basis with highlight stories placed on an alternating basis for various companies including HOAs, property management firms and landscape contractors.

Top Customer Performance Stuck at Bronze Level

The bronze, silver, gold certification program is intended to create incentives for customers to reach for higher efficiency and, hence achieve a more prestigious medal ranking. To date, without one customer earning higher than a bronze rating, the rating system fails to drive performance higher. Program staff needs to work with clients and aid them in achieving higher certification levels. Once there are customers in the higher performance silver and gold levels, the certification program will provide better motivation for the overall pool of participating customers.

Additional Benefits

The Landscape Performance Certification Program comes at the beginning of our industry's landscape efficiency evolution. Its true economic value will not be known for some years to come because too many other landscape efficiency solutions have yet to be developed. Dedicated irrigation meters; internal data issues; weather sensitive controllers; and plant retrofit programs are all in the early stages of implementation at this time. This program will become one step in a series of actions (equipment upgrades, plant upgrades and behavioral change) that will finally allow the industry to effectively deal with the elusive customer landscape and irrigation market. When this occurs, the cost effectiveness of this customer education program will increase because the bundled

services will show significant and cost effective savings for the customer and water agencies.

Weather Sensitive Controllers

When Weather Sensitive Controller technology becomes available via rebate and grant programs for mass the market, the Landscape Performance Certification Program is a good gateway to controller installations. This sister program relationship could help to defray the cost burden of both programs (landscape performance certification and controller distribution) by providing shared overheads and reduced marketing expenses. An additional benefit of a sister program is that the water savings from the Weather Sensitive Controllers will be higher than if the Weather Sensitive Controllers were offered as a stand alone program with minimal customer education.

Run-off/Non-point Source Pollution Reduction

Run-off or non-point source pollution has recently become a heightened environmental issue. Improving the efficiency of outdoor irrigation often results in significantly less water running off landscapes and down through the storm drains. As this environmental issue escalates in importance, this program can provide more value to additional parties. Cities are now required to police non-point source pollution and could become potential funding and marketing partners.

Chapter 5 - Cost-Effectiveness Analysis: Retrospective and Prospective

Introduction

The impact evaluation of Chapter 3 empirically estimated the additional water savings attributable to participation in the LPCP. The magnitude of net water savings was statistically and practically significant. Further, the process evaluation of Chapter 4 documented the generally positive response to the program. This chapter systematically compares the costs of the program to its benefits—this can help determine whether the program makes sense to implement from an economic point of view.

The economic methods used in this chapter include standard methods of cost-benefit and cost-effective analysis.[1] With cost-effectiveness analysis, the focus of the analysis is on estimating the cost of the program per volumetric unit of savings. This is also known as the "unit cost" of the program and will be denominated in dollars per acre foot ($/AF). This metric allows comparison of the cost-effectiveness of the LPCP program to the cost-effectiveness of other conservation programs. With cost-benefit analysis, the costs of the program (in dollars) are compared to the benefits of the program (water savings and other benefits measured in dollars). The cost-benefit analysis expresses its results in net present value (NPV) terms--the present value of benefits minus the present value of costs.

Both NPV and cost per acre-foot are calculated in this chapter for both retrospective and prospective analyses. The *retrospective* analysis looks back at the costs already incurred and at the stream of benefits that will result from this expenditure. In this way, the retrospective analysis supports the body of this document in its primary role in program evaluation.

[1] See, for example, Pekelney, D. and T. Chesnutt, *A Guide to Data and Methods for Cost-Effectiveness Analyses of Urban Water Conservation Best Management Practices*, A report for the California Urban Water Conservation Council, March 1999

In contrast, the *prospective* analysis looks forward to ask questions such as: "Will the program be cost effective moving forward?" "How can the cost effectiveness be extended or improved?" The prospective economic analysis supports the secondary role in this study by estimating the costs and benefits of the recommendations, including ongoing program support.

Savings

Table 5.1 summarizes the estimated average water savings determined from the sample of meters analyzed in Chapter 3. Each of the early participants averaged 365 gallons per day (gpd) savings or .41 acre-feet per year (AFY) equivalently. Summing across the entire sample of 393 early participants, total annual net savings are 161 AF. For the 498 later participants, the net water savings total 427 AFY based on the average daily savings of 765 gpd. The table also reports the average peak savings for the later participants.

Table 5.1 - Sample Water Savings

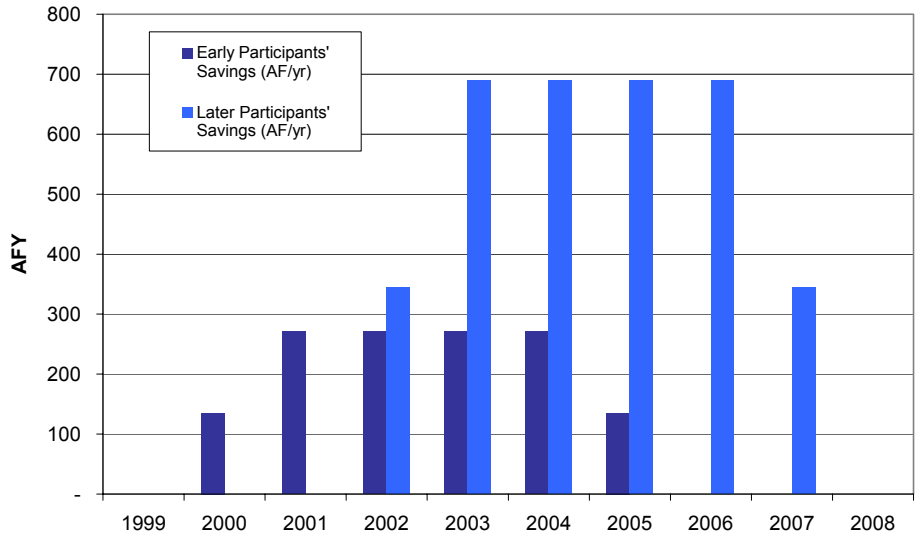
Statistical Sample	Sample Size (n)	Average Savings per Meter (gpd)	Annual Savings per Meter (AFY)	Sample Annual Savings (AFY)	Average Peak Savings (gpd)	Sample Peak Savings (cfs)
Early Participants	393	365	0.41	161		
Later Participants	498	765	0.86	427	1,300	1.00
Total	891			588		

Table 5.2 shows the net water savings for the whole population of participating meters, if all participants share the average water savings observed within the sample. Thus, the total program savings is estimated as 960 AFY. Peak savings are 1,300 gpd per meter, which is equivalent to 1.62 cubic feet per second (or 1.05 million gallons per day) peak capacity.

Table 5.2 - Population Water Savings

Program Population	Population Size (n)	Average Savings per Meter (gpd)	Annual Savings per Meter (AFY)	Population Annual Savings (AFY)	Average Peak Savings (gpd)	Population Peak Savings (cfs)
Early Participants	661	365	0.41	270		
Later Participants	804	765	0.86	689	1,300	1.62
Program Total	1,465			960		

Figure 5.1 - Water Savings Over Time



To estimate the total lifetime water savings expected from the LPCP activated meters, assumptions are needed regarding the life span of savings and the decay in savings over time. Given the dearth of research results on the persistence of large landscape conservation savings, and that the results from this study are from a program just now in full operation, this chapter uses the simplifying assumption that average annual savings last 5 years. (Note that the area under rectangle of five years of constant savings is equivalent to an assumption of a more gradual decay over a longer period—e.g., a 20 percent savings decay over 20 year life.) We believe the assumption of a 5-year water

savings lifetime is conservative, especially for the LPCP that is characterized by ongoing information feedback. Given this assumption and the estimated annual savings volume, the total water savings yield from the LPCP is shown in Figure 5.1. The graphs shows the average annual water savings expected based solely on the existing set of activated meters.

Benefits

The approach used to value the water savings — that is, the dollar benefits of the program — involves estimating the avoided costs of water to Orange County. Table 5.3 shows the current wholesale water rates for Tier 2 water purchased from MWDSC.

Table 5.3 - Avoidable Water Rates

Category		Rates
Tier 2 Supply $/AF	$	154
System Access $/AF	$	141
System Power $/AF	$	89
Water Stewardship $/AF	$	23
Treated Surcharge $/AF	$	82
Total $/AF	$	489

The analysis uses these current rates and their projected increases for the near future from the Metropolitan Draft Long-Range Financial Plan. Likewise for the estimation of the additional peaking benefit, the analysis defines peaking benefit in dollar terms as the reduction in the Capacity Reserve Charge, currently set at $6,100 per cfs. Table 5.4 contains a sample calculation of peak capacity rate savings for a recent year.

Table 5.4 - Peak Capacity Rate Savings

Summer conservation (gpd per meter)		1,300
Summer conservation (cfs per meter)		0.002
Number of landscape meters in program		1,465
Summer peak savings for program (cfs)		2.95
Capacity Reservation Charge ($/cfs peak, annual)	$	6,100
Rate savings for program ($/year) [1]	$	17,975
Savings per meter ($/year)	$	12.27

(1) Potential savings to agency if summer peaking reduced 1 to 1 with landscape reduction

Costs

Table 5.5 shows the costs incurred by agencies to develop and support the program to date. A total of $785,000 has been invested in the program over time. Considerable amounts of these funds have gone to development of the curriculum materials for the workshops, development of the database, and other start-up costs.

Table 5.5 Budgeted Program Costs To Date

Program	Program Implementation				Proposed Phase IV		Totals
Phase	Phase I	Phase II	Program Hiatus	Phase III	Implement-ation	Evaluation	Phases I – IV
Period	3/15/99 - 3/15/00	3/15/00 - 3/15/01	3/15/01 - 12/01/01	12/1/01- 3/31/03	03/31/03 - 03/31/04		Total
Totals	$179,000	$175,778	$ 7,000	$160,222	$ 141,000	$ 85,900	$ 748,940
These figures are take from a budget summary report (Agr No 19140 - Chronological Summary.xls) with a slightly different labeling of program Phases consistent with Chapter 2. Phase IV evaluation budget has been revised upward from the original spreadsheet value.							

These direct program costs were annualized according to historical budget estimates and combined with the direct annual costs of the Protector del Agua (PDA) program in the MWDOC service area[2]. Table 5.6 depicts these annual program costs.

Table 5.6 Total Annualized Direct Costs To Date

Year	Direct LPCP Program Cost	Protector del Agua Program Costs	Total Annual Program Costs
1999	$179,000	N/A	$179,000
2000	$175,778	N/A	$175,778
2001[1]	$18,444	$20,691	$39,135
2002	$148,778	$36,485	$185,263
2003[2]	$226,940	$41,114	$268,054

(1) Includes hiatus period plus one month of Phase 3.
(2) Includes $85,940 in evaluation costs that are not ongoing program costs.

[2] Though we include all costs of the PDA program in the total costs, a strong case could be made that the LPCP should not bear all these costs. It should be noted that the inclusion of PDA costs in the LPCP cost analysis also illustrates an interesting phenomena on the benefit analysis—the case of spillover benefits. This is conceptually the opposite of a "Free-rider effect. Training of landscape contractors in the PDA program conveys knowledge and skills that benefit customers that do not participate in the LPCP program. The training of contractors through the PDA can increase the level of ongoing conservation, even among customers not participating in the LPCP.

Future costs are most likely to involve ongoing programmatic costs with relatively less database development and more routing maintenance—potentially reducing the unit cost of implementation. At the same time, future costs are likely to increase as the market becomes more saturated and search costs begin to rise for new customers. Thus, for the *prospective analysis*, we assume three program years at costs similar to the total annual cost of the most recent year of the program including PDA—$182,000 per year.

Cost-Benefit Analysis

Table 5.7 summarizes the main results of the cost-benefit and cost-effectiveness calculations. For the retrospective analysis, the present value benefits well exceed the present value costs, resulting in a positive $1.3 million net present value. The cost per nominal acre-foot of water is $165. The hypothetical prospective analysis also has a positive net present value. The cost per nominal acre-foot of water is $178.

Table 5.7 - Economic Results

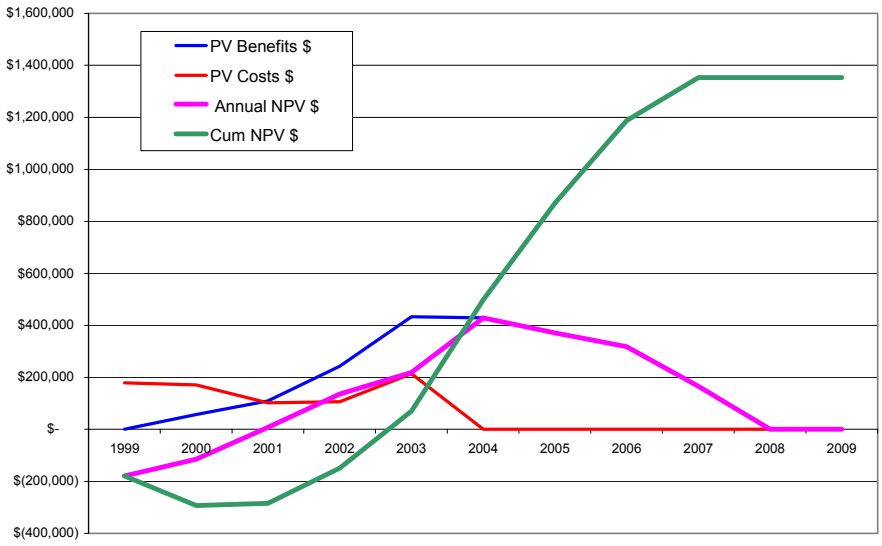
Item	PV Costs $	PV Benefits $	NPV $	Cost PV$/AF
Retrospective Analysis	$ 794,251	$ 2,125,040	$1,330,788	$ 165 /AF
Prospective Analysis (1)	$ 457,400	$ 1,191,933	$ 734,533	$ 178 /AF

(1) Prospective analysis includes $182,000 per year for three years and savings the same as the later participants, but no increased marketing costs. Clearly the cost-effectiveness would support an increase in marketing costs.
(2) The assumed annual discount rate is three percent.

Figure 5.2 shows the NPV results graphically. Their respective lines indicate the streams of costs and benefits over the period of analysis. Note that the costs are incurred in the early years, and benefits accrue beyond the end of the cost items due to the savings life span. The "Annual NPV" line is determined by subtracting costs from benefits. The "Cum. NPV" line indicates a primary result of the cost-benefit analysis — that after the first few years, the program not only pays for itself, but it results in significant economic savings.

Note that these results are based on the assumption that no additional costs are incurred—an assumption which clearly delineates the retrospective analysis. In practice, the program is likely to continue with ongoing costs that will help maintain the program and its savings for all participants, including early participants, for years into the future. Likewise, savings are likely to continue indefinitely as long as the program is maintained, rather than the assumed 5 years savings duration. In other terms, our retrospective analysis has answered the question, "Has the program benefits exceeded costs so far." The prospective analysis answers the question, "Will the benefits of continuing the program exceed the costs of continuing the program."

Figure 5.2 - Net Present Value Over Time



Conclusions and Caveats

The cost-benefit analysis indicates that the economic benefits outweigh the economic costs of the LPCP. This is indicated for both retrospective and prospective analyses.

Caveats to the analysis include:

- All of the direct costs to agencies so far have been included in the cost items, even though a considerable part of those costs went to start up and development.
- Some indirect costs have not been estimated — water agency staff time to monitor and market the program, incremental water agency costs to transfer consumption data, and any other category of water agency general and administrative cost or overhead. These indirect costs were not estimated because these costs are not, in general, estimated for other water resource alternatives.

- Customer costs have not been estimated because this analysis is specific to the agency involved.

- Uncertainty exists in economic parameters such as the discount rate and the future value of the benefit stream.

- The only benefits that have been included are the direct benefit of water savings. Benefit categories not addressed include urban runoff reduction benefits, wastewater benefits, and any esthetic improvements brought about by better irrigation management.

Chapter 6 – Recommendations for the LPCP

This report finds that the existing program delivers cost-effective water savings among existing participants. As a result, the key focus of the recommendations is ***how to increase the number of water agencies and retail customers participating in the program to make it even more cost effective.*** Increased participation will deliver a higher volume of water savings to Metropolitan, MWDOC, and water agencies at a lower overall unit cost.

Overall Recommendations

Recommendations for increasing participation fall into two categories:

1) ***Expand the number of participating agencies***- This can be accomplished in two ways:

    a) Open the program to all Metropolitan member agencies.

    b) Maximize the number of participating agencies within the MWDOC region.

3) ***Expand the number of program participants*** – This can be accomplished in four ways:

    a) ***Create a solution for the area measurement problem***- Currently this burden for customers causes many to forgo participation in the program. Stakeholders need to create a short-term solution (staff assistance, sufficiently accurate approximations, etc.) until more consistent and universal solutions (such as aerial and/or satellite measurement) can be worked out.

    b) ***Resolve the data issues blocking agency participation***- There are two major data obstacles:

        i) Many agencies have difficulty identifying irrigation meters within their territory; and/or

ii) Agencies are incapable of performing, or leery of attempting to perform, regular monthly data transfers of customer water usage. Overcoming this hurdle may require direct assistance from Metropolitan/MWDOC or the assignment of this task as a priority by upper management of the retail agency. Staff championing upgrades in the information system capability required to provide monthly consumption reports should point to the avoided costs of additional purchased water and investments to handle peaking requirements. This will be easier for some agencies to tackle than others depending upon their information management capabilities, the degree of data limitations, and the priorities of upper management.

c) ***Create a production-based, one-on-one sales and marketing initiative***- take marketing from an intermittent activity to a standard and continuous component of the program. Presently the program relies heavily on a direct mail campaign with periodic one-on-one sales. This strategy should be reversed: because of its past success, the one-on-one sales approach should be the foundation of the customer outreach campaign. Program staff resources should be increased to make one-on-one sales/marketing a program priority.

d) ***Open the program to mixed use meter customers***- Expand beyond the limited universe of dedicated irrigation meter customers to increase the pool of potential participants.

To build on existing program success, each stakeholder has a role to play in continuing to improve overall program performance. As such, the recommendations are listed accordingly.

Recommendations for Metropolitan

1) **Fully support the program.** Now that the existing program has demonstrated cost-effective water savings, this program can become a foundation to augment existing and create future landscape water initiatives. The success of Weather Sensitive

Controllers, irrigation system upgrade programs, and landscape plant material retrofit programs all depend upon monthly customer interaction and maintenance. This program establishes that essential link with the customer and can be used to empirically evaluate and monitor incremental savings associated with additional incentive investments from Weather Sensitive Controllers, other system upgrades and plant replacement incentives.

2) **Communicate the message of demonstrated program success and potential to Metropolitan management.** It is important that the internal audience of decision-makers at Metropolitan be fully informed of the rigorously measured water savings of the existing program, its cost-effectiveness and its potential for scalable, high value water savings. This information is necessary for rational investment decisions in the future evolution of this program. (This program is complementary to other landscape programs promoted by Metropolitan including the Southern California Heritage Gardening campaign for native/arid climate plants, Irrigation Schedule Calculator and Irrigation Index.)

3) **Aggressively expand the program.** The first step in program expansion is to offer the program to all agencies including ongoing Conservation Credits Program funding. Newer communities (planned communities and water agency development standards) tend to have a higher percentage of dedicated irrigation meters, and would represent the "lowest hanging fruit." In some cases, requiring an area measurement when new service is established (i.e. for reclaimed planning purposes) could ensure the highest accuracy and lowest costs.

4) **Solve the "area measurement problem."** As the leading regional water agency, MWD should continue its leadership role by identifying and implementing a feasible solution to this major program obstacle. Any consistent technical solution—such as that offered through satellite or aerial measurement—lays the groundwork for rapid customer response and more rapid adoption of this program.

5) **Open the program to customers with mixed-use meters,** thereby allowing more agencies to participate in the program. This will require development of a feasible plan for implementing mixed meter water budgets.

6) **Solicit watershed agencies for program co-funding and cross advertising.** Agencies responsible for watershed management would receive direct benefit from reduced irrigation since reduced irrigation results in reduced run-off.

Assuming Metropolitan's Board of Directors approves a recommendation for continued funding and expanding this program there are a number of design and operational decisions that need to occur. Below are listed the major critical decision points to review:

1) **Consider how Metropolitan will pay agencies for landscape certification/water budget programs.** It's recommended that Metropolitan consider a payment plan based upon performance; either 50% of project cost, or contributions per meter or per acre. This choice is possible now that the cost effectiveness has been determined. For the long term Metropolitan should evaluate a market-based approach for implementation contractor compensation based on realized water savings. There are several different options on how to do this. These options must be analyzed in greater detail before the most viable option can be identified and selected.

2) **Determine best method for expansion of program web site and software to support multiple agencies**. In order for this program to maintain and improve overall cost effectiveness, economies of scale need to be maintained. The program web site and software costs can be shared beneficially by multiple agencies driving down per unit costs. There are several possibilities on how to accomplish this:

   a) MWDOC/ConserVision could provide Metropolitan with operational software and codes. Metropolitan could provide program disks to participating agencies. Agencies would then install system and customize the program to their agency

needs. Customer data entry and routine support and maintenance would be the responsibility of the local agency. The limitations of this option are that customized software is complicated and difficult for another company to further develop and maintain. Many agencies may not be able to support the software effectively, thereby compromising program performance.

b) Another option is that ConserVision could create a licensing agreement to be offered to participating agencies along with a menu of services from which to select those items that are most appropriate for them. Services would range from the minimum set-up and support to data entry and customer reporting. Agencies would pay ConserVision directly depending on the level of service selected. This is a highly practical option if Metropolitan wants limited involvement. There may be a sole source issue with this approach, but it would be the most cost effective and is readily available.

c) A third option is that Metropolitan hire ConserVision to provide centralized program support. Participating agencies would use the centralized web site and system under the umbrella of their own program. Again there could be different levels of service such as ConserVision providing set-up and on-going maintenance and agencies doing their own data entry and reporting or ConserVision providing all computer related services. This is a practical option if Metropolitan is willing to provide direct involvement and a turnkey program for its agencies.

3) **Decide upon level of Metropolitan involvement and support for program roll out**. As with the software system Metropolitan must determine their level of involvement in regards to the field aspects of the program, i.e. marketing and sales, site measurement and general administration. There are essentially three options for Metropolitan to consider:

a) Metropolitan could remain hands-off on the program implementation, providing funds and computer software only.

b) Metropolitan could provide limited centralized services, i.e. web site and support.

c) Metropolitan could carry responsibility for full program implementation similar to the Region-wide CII Rebate Program

4) **Metropolitan should present findings of this program at the next member agency meeting and informally solicit agency feedback** and attitudes towards further expansion and format of this program. Feedback can be utilized in the refinement of Metropolitan's plan.

5) **Future Water Use Efficiency funding from the state creates a role for Metropolitan in defining appropriate regional solutions**. Statewide WUE funding creates an opportunity for Metropolitan to define regionally effective solutions to some of the practical constraints on expansion of WUE programs targeting landscapes. Such solutions might include (1) satellite-based area measurements of landscape that build on the recent experiences of other water agencies or (2) development of a regional database that builds on county-level public information on parcels to attach identifiers for landscape water end-uses.

Recommendations for MWDOC

With the Landscape Certification Program well underway and Metropolitan's support solidified MWDOC has the opportunity to further maximize program performance and cost effectiveness. The following are recommendations for MWDOC's consideration.

1) **Renegotiate program funding with Metropolitan**. Metropolitan could provide funding based on participating meters or acres. Extensions of the estimated empirical model measuring water savings are both possible and germane to this question.

2) **Renegotiate contract with ConserVision**. Contract would include new payment structure possibly aligned with Metropolitan funding structure. New price should include costs for direct salesperson. Contract could include performance criteria such as number of sales visits conducted per month, number of customers enrolled per month, number of customers that utilized site measurement service, timeframe for uploading water agency data and e-mailing customer reports.

2) **Hold annual but separate kick- off meetings for all MWDOC agencies, landscape contractors, and property managers for each successive phase of the program.** The purpose of the meeting would be to re-energize the program by showcasing certified companies; solicit additional agency (etc) participation, and assist in gaining momentum on local marketing.

3) **Oversee monthly agency/ consultant meetings during the re-initiation period.** The agencies lack a forum to discuss program problems and exchange ideas or solutions. A monthly meeting would open up the channels of communication between regional players and help to maintain or even increase program momentum.

4) **Support agency staff in selling program to agency management**. This could be done most effectively now that program performance is documented in a report/presentation. Steps or requirements for participation along with anticipated benefits could be clearly defined and presented to agency management creating a

clear path for participation. Whenever possible, MWDOC should participate in a joint presentation (MWDOC and agency staff) to agency upper management. This would show strong regional support and help to validate the program and its value to that agency. (Could also include presentations to elected officials at appropriate forums focusing on water use efficiency and watershed management benefits)

5) **Require that ConserVision hire and train a high level salesperson**. This salesperson should be given performance objectives that would regularly be reviewed with ConserVision and MWDOC managers. This person would promote participation from all parties including HOAs, property managers, and landscape contractors.

6) **Establish the site measurement support service.** There are two options for MWDOC to consider. MWDOC could select one or both of the following options:

   a) Require that ConserVision hire and train a Site Measurement Specialist. This Specialist would be available "for hire" by customers needing assistance. The customer billing rates should be affordable It will also be necessary to create an accounting process for customer collections and reporting.

   b) Develop an incentive for irrigation consultants to promote the program and provide area measurement data to the program. Several program participants were brought into the program by irrigation consultants. These individuals have already had the "ear" of their client and are a valuable marketing avenue to bring on new customers. With their high level of landscape knowledge these firms could provide the program with quality measurement information.

7) **Work with ConserVision to develop model landscape maintenance contract language** to facilitate performance based irrigation management. This language would be provided to HOAs in order to aid the customer in establishing an incentive for their landscape contractors and property managers to use water more efficiently.

Utilizing the program resources (web site and reports) the HOA, property manager and landscape contractor would have established water use goals with monetary awards for meeting or exceeding those goals and penalties for failing to achieve them.

8) **Elevate the importance of the bronze, silver, gold certification program** by providing meaningful promotion of those customers that attain a metal status. Creating a strong advertising campaign can do this. MWDOC should require ConserVision to develop a more dynamic and detailed advertising plan. This plan should include a more comprehensive list of advertising outlets and a monthly calendar. In addition to increased advertising frequency the ads themselves need to be eye-catching and contain a strong message.

9) **Keep delivering the message to the landscape professionals and customers**. Most of the companies and customers that were interviewed under this evaluation stated that they were sold on the program by one-on-one discussions with MWDOC staff. MWDOC's marketing initiative is highly effective and directly feeds the program response.

10) **On a regional and local level, solicit watershed agencies for program co-funding and cross advertising.**

Recommendations for Participating Agencies

1) **Provide as much one-on-one marketing as possible**. The retail agency name provides a formidable marketing impact on a local customer. Agencies need to aid the marketing initiative with breakfast seminars; association networking and other direct contact opportunities with their customers. (Agencies could require participation for all new connections as service is requested and for existing connections by a date certain)

2) **Resolve data and staffing issues** that are causing the time lag in getting customers real-time reports on their water management performance. This area has seen tremendous improvement but still needs advancement. Consider possible new resources for solutions such as billing system software companies and consultants.

3) **On a local level, solicit watershed agencies (specifically municipalities) for program co-funding and cross advertising.** At a minimum, customers that violate watershed restrictions could be fed into the program.

Non-Participating Agencies

1) **Work to resolve the internal data issues that are blocking program participation.** Non-participating agencies that want to participate need to escalate the internal data issues to the attention of upper management. Staff should present the successes of their sister agencies to upper management in order to redirect internal resources to overcome this problem and gain access to the program.

2) **Inform Metropolitan and MWDOC on the types of assistance that is most needed.** Staff at the water wholesalers find it easier to deliver assistance when it is requested.

3) **Work with Metropolitan and MWDOC on opening the program to mixed-use meters.**

Recommendations for the Program Consultant (ConserVision)

1) **Add a dedicated field sales person.** A one-on-one sale is the most effective method of gaining response. The program offer is complicated and not conducive to a direct mail format. The industry is beginning to understand that the commercial marketplace requires a direct sales dialog with the customer to build program response. This new individual would be an experienced salesperson spending 80% of their time in the field pitching the program one-on-one to all potential customers. They would be required to follow a production schedule and be paid on an incentive or commission basis.

Overcome the area measurement barrier by providing a field specialist for the customer to hire at a reasonable rate. The area measurement process can be tackled by a mid level field specialist who is appropriately trained. For less than $25 an hour, the customer could hire the area measurement specialist to complete this portion of the work on their behalf. The customer would be relieved of this burden and the program would receive higher quality information than typically seen.

3) **Design and implement incentive system for irrigation consultants to promote the program and provide area measurement data.**

4) **Work with MWDOC to develop model landscape maintenance contract language** to facilitate performance based irrigation management.

5) Implement revised marketing campaign for bronze, silver, gold certification program.

Appendix A—Impact Evaluation: Data, Methods, Statistical Results

Introduction

The purpose of this work is a statistical analysis of water savings among large-landscape customers who participated in the Landscaper Performance Certification Program in Orange County, California. This report documents a careful statistical analysis of historical water consumption data to derive estimates of the net water savings from this program.

Approach

Historical water consumption records (July 1999 to August 2002) for a sample of participants and for a sample of nonparticipating customers were examined statistically. The hypothesis was that better management of existing equipment would reduce the observed water consumption of customers participating in this program. This study empirically estimates the water savings that resulted from the initial implementation of this program (Phases 1 and 2, before November 2001) and the more recent implementation (Phases 3 and 4, after November 2001).

Since participation in this program required the voluntary agreement of the customer to participate, this sample of customers can be termed "self-selected." While this analysis does quantitatively estimate the reduction of participant's water consumption, one may not directly extrapolate this finding to nonparticipants. This is because self-selected participants can differ from customers who decided not to participate.

The explanatory variables in these models include

- Deterministic functions of calendar time, including
    - The seasonal shape of demand
- Weather conditions
    - measures of air temperature
    - measures of precipitation, contemporaneous and lagged
- Meter-specific mean water consumption per billing period
- "Intervention" measures of the date of participation and the program phase

Data and Methods

Consumption records were compiled from the customer billing system by the implementing vendor for all landscape customers in the study areas. Billing histories were obtained from meter reads between January 1999 and July 2003. The current implementing vendor also attached the data at which participating meters were activated in the program. This "meter activation date" was not available for the early participants in Phase 1 and 2 of the program. Though the specific activation date for Phase 1 and 2 participants is not known, it is known that these meters were active and participating after November 2001. This study will not be able to conduct formal tests on the "pre-intervention" water use of Phase 1 and 2 participants since the pre-intervention period cannot be identified.

To get a cleaner definition of "nonparticipants," records were complied of accounts that participated in other regional landscape water conservation programs. Of the 1465 activated meters (661 early participants and 804 Phase 3 and 4 participants) approximately 144 accounts were excluded from the sample based upon prior participation in other landscape conservation programs. Accounts could also be excluded if the consumption records were of insufficient length or quality. Thus, meter reads

containing a negative number of days in the meter read or more than 120 days were omitted. Table A.1 presents descriptive statistics—mean water use per year, activated meter count per agency, and the total irrigated area per meter—on the remaining sample containing usable consumption records.

Table A.1: Landscape Accounts Descriptive Statistics

	Early Participant, Phase 1, 2 (Before 11/2001)	**Recent Participant, Phase 3, 4** (After 11/2001)	**Non-Participant** (in known conservation programs)
Annual Average Water Consumption (in gallons per day)			
Calendar Year 1999	5208	4890	4448
Calendar Year 2000	4839	5463	4500
Calendar Year 2001	4018	4017	3919
Calendar Year 2002	4779	3917	4326
Number of Meters by Participating Agency			
Mesa Consolidated WD	0	120	9
Mouton Niguel WD	85	25	2461
Newport Beach	0	38	654
San Clemente	0	127	524
Santa Margarita WD	308	188	1733
Total Number of Usable Meters	393	498	5381
Mean Area Irrigated by Meter(sq. ft)			
Mesa Consolidated WD		34,408	N.A.
Mouton Niguel WD	91,948	75,375	N.A.
Newport Beach		62,342	N.A.
San Clemente		77,262	N.A.
Santa Margarita WD	88,642	99,436	N.A.
Overall Mean Irrigated Area	89,126	86,924	N.A.

Daily weather measurements—daily precipitation, maximum air temperature, and evapotranspiration—were collected from the CIMIS weather station No. 75 located in Irvine. The daily weather histories were collected as far back as were available (January 1, 1948) to provide the best possible estimates for "normal" weather through the year.

Thus we have at least 55 observations upon which to judge what "normal" rainfall and temperature for January 1^{rst} of any given year.

The first major issue with using meter-read consumption data is the level and magnitude of noise in the data. The second major issue is that records of metered water consumption can also embed non-ignorable meter mis-measurement. To keep either type of data inconsistencies from corrupting statistical estimates of model parameters, this modeling effort employed a sophisticated range of outlier-detection methods and models. These are described next.

Robust regression techniques were used to detect which observations are potentially data quality errors. This methodology determines the relative level of inconsistency of each observation with a given model form. A measure is constructed to depict the level of inconsistency between zero and one; this measure is then used as a weight in subsequent regressions. Less consistent observations are down-weighted. Other model-based outlier diagnostics were also employed to screen the data for any egregious data quality issues.

Specification

A Model of Water Demand

The model for customer water demand seeks to separate several important driving forces. In the short run, changes in weather can make demand increase or decrease in a given year. These models are estimated at a meter level and, as such, should be interpreted as a

condensation of many types of relationships—meteorological, physical, behavioral, managerial, and chronological. Nonetheless, these models depict key short-run and long-run relationships and should serve as a solid baseline for estimating the delta change induced by participation in the Landscape Performance Certification Program.

Systematic Effects

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

The general form of the model[1] is:

Equation 1

$$Use_{i,t} = \mu_i + S_t + W_t + E_{i,t}$$

where $\boldsymbol{Use_{i,t}}$ is the quantity of water demand for meter i within time t, the parameter $\boldsymbol{\mu_i}$ represents mean water consumption per meter i, $\boldsymbol{S_t}$ is the seasonal component, $\boldsymbol{W_t}$ is the

[1] The general form of this continuous time model was developed and explained further in Chesnutt et al., *Continuous-Time Error Components Models of Residential Water Demand*, A report for the Metropolitan Water District of Southern California, June 1992.

weather component, $\boldsymbol{E_{i,t}}$ is the effect the landscape interventions for meter *i* at time period *t*. Each of these components is described below.

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

Equation 2

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

where $T = (1,...365)$ and *j* represents the frequency of each harmonic.[2] Because the lower frequencies tend to explain most of the seasonal fluctuation, the higher frequencies can often be omitted with little predictive loss.

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

[2] If measures of water demand are available on a daily basis, the harmonics defined by Equation 2 can be directly applied. When measures of water demand are only observed on a monthly basis, two steps must be taken to ensure comparability. First, water demand should be divided by the number of days in the month to give a measure of average daily use. Otherwise, the estimated seasonal component will be distorted by the differing number of days in a month. The comparable

To compute the entire seasonal effect, one simply sums the multiplication of each seasonal coefficient with its respective value. This seasonal effect will explain how demand changes due to seasonal fluctuations. The model will also be used to test for possible changes to the seasonal shape of demand.

Weather Component: The model incorporates two types of weather measures into the weather component–maximum daily air temperature and rainfall.[3] The measures of temperature and rainfall are then logarithmically transformed to yield:

Equation 3

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

where *d* is the number of days in the time period. For monthly aggregations, *d* takes on the values 31, 30, or 28, ignoring leap years; for daily models, *d* takes on the value of one. Because weather exhibits strong seasonal patterns, climatic measures are strongly correlated with the seasonal measures. In addition, the occurrence of rainfall can reduce expected air temperatures. To obtain valid estimates of a constant seasonal effect, the seasonal component is removed from the weather measures by construction.

Specifically, the weather measures are constructed as a departure from their "normal" or expected value at a given time of the year. The expected value for rainfall during the

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measures of the seasonal component are given by averaging each harmonic measure for the number of days in a given time period.

[3] Specifically it uses the maximum daily air temperature and the total daily precipitation at the Irvine weather station. This station was selected due to its proximity to the study area.

year, for example, is derived from regression against the seasonal harmonics. The expected value of the weather measures ($\hat{\boldsymbol{A}}=\boldsymbol{Z}\hat{\boldsymbol{\alpha}}$) is subtracted from the original weather measures:

Equation 4

$$W_t \equiv (R_t - \hat{R}_t) \cdot \beta_R + (A_t - \hat{A}_t) \cdot \beta_A$$

The weather measures in this deviation-from-mean form are thereby separated from the constant seasonal effect. Thus, the seasonal component of the model captures all constant seasonal effects, as it should, even if these constant effects are due to normal weather conditions. The remaining weather measures capture the effect of weather departing from its normal pattern.

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

Effect of Landscape Interventions: Information was compiled on the timing of customer participation. The account numbers from these data were matched to meter consumption histories going back to 1999. All raw meter reads were converted to average daily consumption by dividing by the number of days in the read cycle. Using these data,

relatively simple "intervention analysis" models[2] were statistically estimated where, in this case, the intervention is participation in the Landscape Performance Certification program. The form of the intervention is:

Equation 5

$$E_{i,t} \equiv I_{1,2} \cdot \beta_{1,2} + I_{3,4} \cdot \beta_{3,4}$$

The indicator variable $I_{1,2}$ takes on the value one to indicate participation in Phase 1 or 2 and is zero otherwise. The indicator variable $I_{3,4}$ takes on the value one to indicate participation in Phase 3 or 4 and is zero otherwise.

The parameter $\hat{\beta}_{1,2}$ represents the mean effect participating in Phase 1 or 2 and is expected to be negative (participation reduces water consumption.) The parameter $\hat{\beta}_{3,4}$ has a similar interpretation for Phase 3 and 4 participants.

This formulation also permits formal testing of the hypothesis that landscape interventions can affect the seasonal shape of water consumption within the year. The formal test is enacted by interacting the participation indicators with the sine and cosine harmonics.

Stochastic Effects

To complete the model, we must account for the fact that not every data point will lie on the plane defined by **Equation 1**. This fundamental characteristic of all systematic

[4]See Box and Tiao, "Intervention Analysis with Applications to Economic and Environmental Problems" *Journal of the American Statistical Association*, Vol 70, No. 349, March 1975, pp. 70-70.

models can impose large inferential costs if ignored. Misspecification of this "error component" can lead to inefficient estimation of the coefficients defining the systematic forces, incorrect estimates of coefficient standard errors, and an invalid basis for inference about forecast uncertainty. The specification of the error component involves defining what departures from pure randomness are allowed. What is the functional form of model error? Just as the model of systematic forces can be thought of as an estimate of a function for the "mean" or expected value, so too can a model be developed to explain departures from the mean—i.e., a "variance function" If the vertical distance from any observation to the plane defined by **Equation 1** is the quantity **ε**, then the error component is added to **Equation 1**:

Equation 6

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

The error structure is assumed to be of the form:

Equation 7

$$\varepsilon_{it} = \mu_i + \xi_{it}$$
where
$$\mu_i \sim N(0, \sigma_\mu^2)$$
$$\xi_{it} \sim N(0, \sigma_\xi^2)$$

Note: Once again, I'd suggest including a footnote that refers people to earlier work in which decomposition of the error term is discussed in greater detail.

The X and ξ are assumed to be independent of each other and of μ. The individual component μ represents the effects of unmeasured household characteristics on household

water use. An example of such an unmeasured characteristic might be the water use behavior of household members. This effect is assumed to persist over the estimation period. The second component ξ represents random error. Because μ and ξ are independent, the error variance can be decomposed into two components:

Equation 8

$$\sigma_{\varepsilon}^2 = T \cdot \sigma_{\mu}^2 + \sigma_{\xi}^2$$

This model specification is accordingly called an error components or variance components model. The model was estimated using maximum likelihood methods.

Estimation Results

Estimated Landscape Customer Water Demand Model

Table A.2 presents the estimation results for the model of landscape (irrigation-only) customer water demand in the participating MWDOC member agencies. This sample represents water consumption among 6272 accounts between January 1999 and July 2003. This sample contains 498 water meters that were activated in Phases 3 and 4 (after November 2001), 393 water meters that were activated in Phases 1 and 2 (prior to November 2001), and 5381 unactivated water meters (non-participants).

The constant term (1) describes the intercept for this equation. (A separate intercept is estimated for each of the 6272 meters but these are not displayed in Table 2 for reasons of brevity.) The independent variables 2 to 8—made up of the sines and cosines of the Fourier series described in Equation 2—are used to depict the seasonal shape of water demand. The predicted seasonal effect (that is, $Z \cdot \widehat{\beta}_S$) is the shape of demand in a normal

weather year. This seasonal shape is important in that it represents the point of departure for the estimated weather effects (expressed as departure from normal). We will also test to see if the landscape interventions have any effect on this seasonal shape.

The estimated weather effect is specified in "departure-from-normal" form. Variable 10 is the departure of monthly temperature from the average temperature for that month in the season. (Average seasonal temperature is derived from a regression of daily temperature on the seasonal harmonics.) The reader should also note that the contemporaneous temperature effect is interacted with the harmonics to capture any seasonal shape to the temperature elasticity (Variables 11 and 12). Thus, departures of temperature from normal produce the largest percentage effect in the spring growing season. Rainfall is specified analogously in "departure from normal" form (Variable 13). One month lagged rainfall deviation is also included in the model (Variables 14).

The effect of the landscape conservation program interventions is captured in the following rows. The parameter on the indicator for Phase 3 and 4 participants (15) suggests that the mean change in water consumption is -765 gallons per day, approximately 20 percent of the pre-intervention water use. The variable testing for differences in pre-intervention use cannot distinguish any differences between the recent Phase 3 and 4 participants and nonparticipants (Variable 21).

The parameter on the indicator for Phase 1 and 2 participants (18) suggests that the mean change in water consumption is -367 gallons per day, approximately 9 percent of mean

water use. Because we cannot cleanly distinguish pre-intervention use for the early Phase 1 and 2 participants, we cannot perform this formal test for preexisting differences. Thus, one should be careful in interpreting the estimated mean change in water consumption for Phase 1 and 2. Specifically, it is incorrect to interpret 9 percent as the long term water savings of the current implementation of the Landscape Performance Certification program. The early participants may differ from the more recent participants, the implementation of the program differed, and there were different implanting agencies. Even though the interpretation of the water savings of early participants must proceed with more caveats, it is an encouraging sign to observe meaningful water savings even among these very early participants.

Table A.2: Landscape Customer Water Demand Model
Dependent Variable: Average Daily Metered Water Consumption
(in gallons per day)

Independent Variable	Coefficient	Std. Error
1. Constant (Mean intercept)	3938.5990	43.8258
2. First Sine harmonic, 12 month (annual) frequency	-1374.2230	18.3938
3. First Cosine harmonic, 12 month (annual) frequency	-2625.8170	16.7367
4. Second Sine harmonic, 6 month (semi-annual)frequency	239.5262	13.0504
5. Second Cosine harmonic, 6 month (semi-annual) frequency	-281.5594	13.5826
6. Third Sine harmonic, 4 month frequency	-83.0898	14.7469
7. Third Cosine harmonic, 4 month frequency	69.4731	15.4047
8. Fourth Sine harmonic, 3 month (quarterly) frequency	202.0835	17.1809
9. Fourth Cosine harmonic, 3 month (quarterly) frequency	38.0282	16.9349
10. Deviation from logarithm of 31 or 61 day moving average of maximum daily air temperature	10073.170	280.6154
11. Interaction of contemporaneous temperature with annual sine harmonic	1242.9110	355.6203
12. Interaction of contemporaneous temperature with annual cosine harmonic	1284.9020	426.5038
13. Deviation from logarithm of 31 or 61 day moving sum of rainfall	-897.2015	24.4000
14. Monthly lag from rain deviation	-397.4304	21.6044

15. Average effect for recent Phase 3,4 participants in the post Nov. 2001 period (498 activated meters)	-765.4730	115.2420
16. Interaction of Phase 3,4 participation with annual sine harmonic	191.7932	122.2208
17. Interaction of Phase 3,4 participation with annual cosine harmonic	528.6346	114.0177
18. Average effect for Phase 1,2 participants in the post Nov. 2001 period (393 activated meters)	-366.8083	61.16293
19. Interaction of Phase 1,2 participation with annual sine harmonic	-202.0787	73.60319
20. Interaction of Phase 1,2 participation with annual cosine harmonic	-383.6452	67.57704
21. Recent participants, test for difference in pre-intervention use	-93.7152	155.2680
Number of observations		204,144
Number of customer accounts		6,272
Standard Error of Individual Constant Terms		3054.05
Standard Error of White Noise Error		3646.77
Time period of Consumption	January 1999 - July 2002	

How Program Participation Affects Peak Demand

The question of how this program affected the seasonal shape of water demand can be interpreted from the remaining interactive effects—the indicators interacted with the first sine and cosine harmonics. For example, the seasonal shape of demand can be derived before and after participation in the Landscape Performance Certification Program:

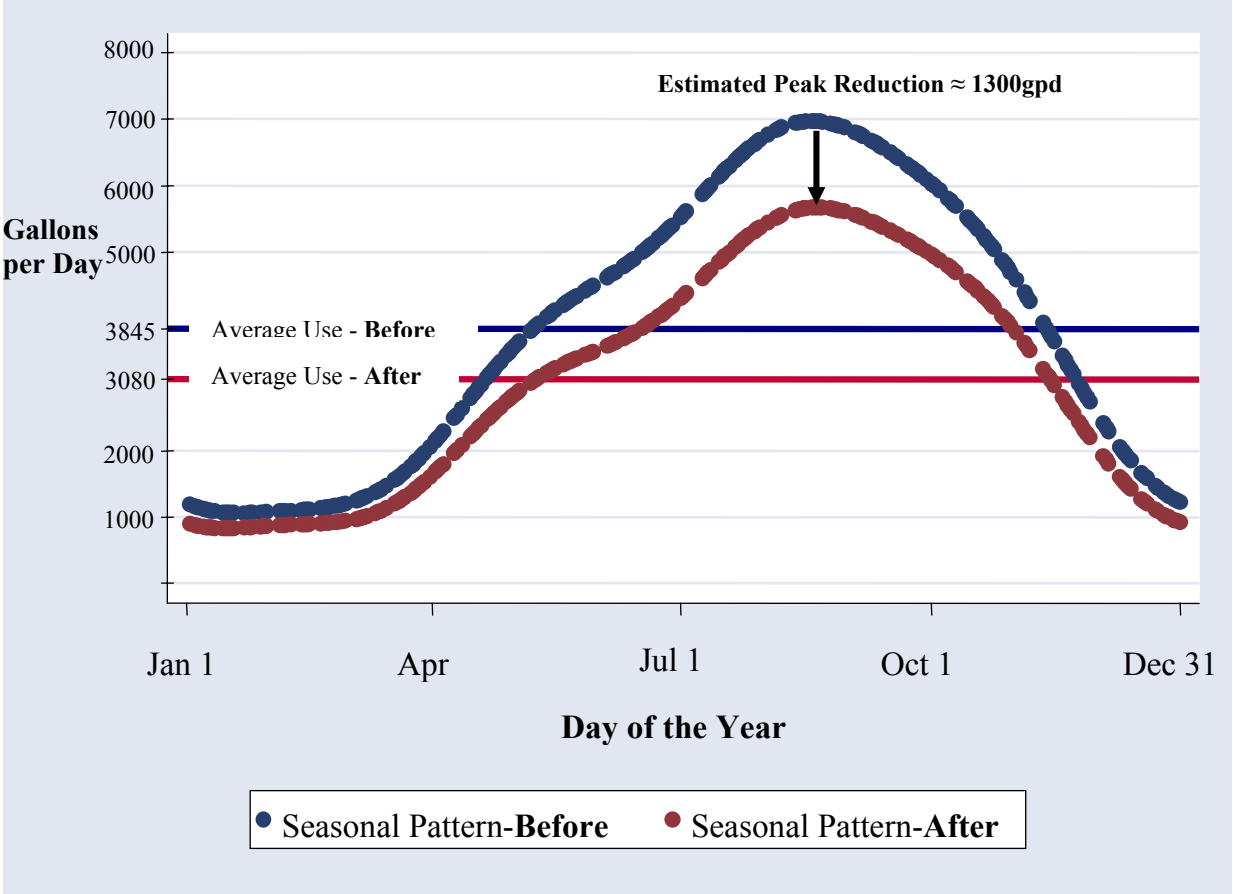
$$\text{Pre\_Intervention}: S_t = Z \cdot \hat{\beta}_S \approx -1374 \cdot \sin_1 - 2625 \cdot \cos_1 + 239.5 \cdot \sin_2 + \ldots + 38 \cos_4$$

$$\text{Post\_Intervention}: S_t^{'} = Z \cdot \hat{\beta}_S + 191.8 \cdot I_{3,4} \cdot \sin_1 + 528.6 \cdot I_{3,4} \cdot \cos_1$$

When the pre/post seasonal patterns are combined with their pre/post mean water consumption, the following before and after picture can be seen throughout the year

In Figure A.1, several observations should be made. First, the difference between the two horizontal lines corresponds to the estimated mean reduction of approximately 765 gallons per day. Second, the assumption of a constant 765 gallon per day effect does not hold true throughout the year. The reduction is much larger during the peak summer period.

Figure A.1 Load Shaping Effect of Performance Certification on Large Landscape Demand



The reduction in peak demand—though dependent upon how the seasonal peak is defined[3]—is greater than the average reduction.

[3] This is the issues of "coincident" versus "noncoincident" peak demand: the extent to which the peak load of a customer coincides with the system peak. Water systems by

The estimated peak day demand, occurring on August 18, is reduced by approximately 1300 gallons. This "load-shaping" effect of the ET controller intervention can translate into an additional benefit to water agencies. The benefits from peak reduction derive from the avoided costs of those water system costs driven by peak load and not average load—the costs for new treatment, conveyance, and distribution all contain cost components driven by peak capacity requirements.

Caveats and Additional Work

This modeling effort focused on developing the best depiction of net changes in water consumption due to participation in the Landscape Performance Certification program. Much of the modeling effort was expended on data cleaning, diagnosis, and validation. We believe that the most serious data issues were identified and appropriately handled. To the extent that future data quality can be improved, future work could provide several statistical refinements in model specification:

- The empirical effort has quantified the change in mean water consumption and the shift in seasonal consumption. The models have not been extended to document how water savings vary across customers.
    1. Is there remaining conservation potential among participants?
    2. How do savings change across customers of lower or higher water use?
    3. How do savings vary across climate zones?
    4. How do water savings vary as a function of landscape area?
    5. How do savings change across agencies with lower and higher water rates?

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their nature have a strong and predictable tendency to peak seasonally—for Southern California, this occurs in the summer. Given the predictability of system peaks, and the attendant costs, the empirical case for the contribution of load shaping to the reduction of systems cost is relatively straightforward. The additional value of peak reduction--over and beyond reductions in average consumption--requires careful specification of the additional incremental costs necessitated by peak flow requirements.

- Since the sample only contains limited post participation data, the statistical models can say little about the persistence of water savings. Additional follow-up quantification of water savings in subsequent years would yield critical information about the long term water savings.
- The modeling effort to date has *not* attempted to estimate the effect of self-selection. Thus, we make no attempt to extend the inference from the existing sample of participants to (1) the remainder of the nonparticipating accounts in these service areas or (2) to other service areas.
- The error component of the estimated models could be improved by specifying a function form to explain the variance. This should only be attempted after all major data issues have been resolved.

Conclusion

This report documents the shape of water savings achieved by participation in the Landscape Performance Certification program. Customers participating in these programs saved significant amounts of water. Participation in the program changed both the level and shape of water demand.

Appendix B—Interview Protocols

Landscape Service Providers, Property Managers and Owners, and Home Owner Associations Interview Protocol

Interviewee Name:	☐ Landscape Service Provider ☐ Property Manager ☐ Property Owner ☐ HOA ☐ Other
Service Address:	City and Zip:
Company Name:	Day Phone
Water Agency:	Evening Phone

1. How did you hear or learn about (or get involved with) the program?

2. Why did you choose to participate?

3. When did you participate?

4. How do you typically receive new product/program information? How would you like to receive information on program like this in the future? Where do you think this program should be advertised?

5. Was the participation process easy to understand and straightforward? If it wasn't, how could it be improved?

6. Who from your organization attended the training? When? Is that person still with your organization? Was the information on the program and your organization's responsibilities for participation in the program transferred to another person? (consider breaking into two 1) marketing workshops and 2) irrigation management training workshops for questions 6-10)

7. Was the training valuable? If "Yes", in what ways was it valuable. If "No", why was it not valuable. (need to make sure the person who attended the workshops answers this question)

8. Was it hard to commit to the training time requirements?

9. Did the training help in calculating the area measurement for each landscape meter for implementation of the Landscape Irrigation Budget? Managing your landscape? Implementing your water saving strategy? If "Yes", how did it help?

10. Training improvement recommendations…

11. When did you receive your first Landscape Irrigation Budget report update notice and produce/print/review your first budget report?

12. Is the Landscape Irrigation Budgeting website easy to use, access and the information easy to understand?

13. How would you rate the value of the initial report? On-going reports? (1-10, 10 being highest)

14. Who from your organization has access to the reports? Who uses the reports? How do they use the reports?

15. Do all necessary parties in your organization have access to a computer?

16. Was the budget helpful in making decisions about how to implement a water saving strategy?

17. Do you feel the budgeted amount was reasonable?

18. How was your initial performance vs. budget? How is it now? If it has not changed significantly, what are the limiting factors that are making it difficult to increase performance (i.e., watering closer to budget)?

19. Did you take steps to implement a water saving strategy? If so, what did you do and when did you do it?

20. How much did you pay to make the improvements?

21. Who performed the improvements? Was the process easy?

22. Are you getting reports consistently? Monthly? Bimonthly? Quarterly? Every once in a while? Not at all?

23. Are you using the information to manage your irrigation usage? How?

24. Are you giving the information to anyone else in your organization?

25. Is the newsletter informative and useful?

26. Is e-mail the best communication method? If no, what method would be best?

27. *(property owner, manager, or home owners association)* Do you have a written agreement with your landscape service contractor? Did you have one before this program? Did you put it in place because of this program? Has it been useful? What terms of the contract relate to water use versus water budget?

or

27. *(landscape contractor*) Do you have a written agreement with the property owner or manager? Did you have one before this program? Did you put it in place because of this program? If so, has the contract been altered because of the program objectives? Has it been useful?

28. Who pays the water bill?

29. Are you incentivized or penalized based on the amount of water used?

30. Have you seen a reduction in your water bill?

31. Have you seen any changes in your landscape aesthetics/health?

32. Do you feel the recognition and rewards offered through the program are sufficient?

33. Did you gain additional business because of the recognition?

34. Did your customer's appreciate your efforts?

35. Are there any other improvements to the program you would recommend?

36. If you had it to do all over again would you participate in this program again?

37. Overall how would you rate this program (1-10, 10 being highest)

38. Currently, this program is provided at no cost as a result of grant funding from the Municipal Water District of Orange County and Metropolitan Water District of Southern California. Should that grant funding no longer exist, would you be willing to pay a monthly fee for this service and how much?

Water Agency Interview Protocol

Interviewee Name:	Title:
Address:	City and Zip:
Water Agency::	Day Phone
Number of Dedicated Irrigation Meters:	Number of Total Customers:

1. Why does your agency participate/not participate in the program?

2. What benefits does this program provide your agency and the local community you serve?

3. What was your general marketing campaign?

4. How did you determine which customers/sites to target for participation?

5. Did you market to customers, property management companies, or landscape service providers?

6. How did you obtain or generate your target lists?

7. Which group yielded the highest success or participation rates? Why?

8. Which marketing method yielded the highest success (direct mail, telephone, one-on-one direct visits)?

9. Do you have sample materials to distribute to potential participants in your service area?

10. How long was the marketing/sales cycle to get a customer, property management company or landscape service provider to participate?

11. Marketing improvement recommendations…

12. How well did you feel the program contractor (Conservision/CTSI) implemented the program?

13. What improvements would you recommend for the program contractor?

14. Which training option was the most valuable (Protector del Agua classes) or /Conservision/CTSI presentations)?

15. Training improvement recommendations…

16. Did you provide all of the data on your dedicated irrigation accounts?

17. What method was used to provide landscape area measurements? Direct measurements? Site plans? Estimates, customer provided data?

18. What process do you utilize for transferring data to the contractor? Did it work?

19. What process did you implement for meter changes and notifying the contractor? Did it work?

20. Data transfer improvement recommendations…

21. Do you use the Landscape Irrigation Budget reporting web-site?

22. Do you think the Landscape Irrigation Budget reporting web-site works adequately (excellent, good, fair, poor)?

23. Have you had problems with the web-site? If so, have those problems been resolved and how?

24. Is overall program and web-site user friendly from an agency perspective? From a customer, property manager, landscape service provider perspective?

25. Web-site improvement recommendations..

26. Do you think the actual Landscape Irrigation Budget allotments are fair to the customer?

27. Are the Landscape Irrigation Performance reports readable, valuable, customer friendly?

28. Once the customer is in the system receiving updates does the process work? (*What does this mean?)*

29. How would you rate the value of the initial report? On-going reports?

30. Do you think customers use the reports? The customer/HOA, property manager, or landscape service provider?

31. Do you think the communication with the customer is consistent enough?

32. Do you think e-mail is the best communication method?

33. Budget, report and communication improvement recommendations…

34. Do you believe/observe that customers are changing their water use habits as a result of this program?

35. Who is driving that change? The customer/HOA, property manager, or landscape service provider?

36. What changes are you seeing being made?

37. If you had it to do all over again would you participate in this program again?

38. Overall, how would you rate this program (1-10, 10 being highest)

39. What is the biggest success of this program?

40. What is the biggest failure?

41. Currently, this program is provided at no cost as a result of grant funding from the Municipal Water District of Orange County and Metropolitan Water District of Southern California. Should that grant funding no longer exist, would your agency be willing to pay for this program?