BMP Cost and Savings Study Update

A Guide to Data and Methods for Cost-Effectiveness Analysis of Urban Water Conservation Best Management Practices

Large Landscape Programs

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California Urban Water Conservation Council

Conducted By:

Western Policy Research

171 Pier Avenue
Suite 256
Santa Monica, California 90405

LARGE LANDSCAPE PROGRAMS: AN UPDATE ABOUT COSTS AND SAVINGS

1. BACKGROUND

Although reducing wasteful irrigation is a high priority in both the residential and non-residential sectors, the large landscape Best Management Practice (BMP) is largely meant for the non-residential sector. To promote water-use efficiency, water suppliers are required to establish water budgets for landscapes with dedicated irrigation meters. They are then also required to report discrepancies to the property owner between their water budget and actual use by billing period, and offer technical assistance and financial incentives to bring the two in line in case actual use exceeds the budget by more than 20%. For large landscapes on mixed-use meters, water suppliers are required to devise a strategy for first identifying such accounts, second offering them surveys to uncover irrigation-system deficiencies, and third offering them technical assistance and financial incentives to fix these deficiencies.[1]

Wasteful irrigation can result from many interlinked causes. These include bad hydro zoning of plant materials, improper pressure regulation, irrigation system leaks, unsuitable sprinkler heads, damaged (clogged, sunken, tilted or misaligned) sprinkler heads, poor distribution uniformity, improper irrigation scheduling leading to water loss due to runoff or deep percolation past the root zone, and finally improper horticultural practices.

Landscape experts agree that to eliminate wasteful irrigation requires a system-wide strategy. Simply retrofitting old hardware, such as sprinkler heads or irrigation controllers may not yield significant success without behavior modification. However, while the goal of large landscape programs is clear, it is difficult to advocate for a uniform, agreed-upon package of steps for getting there. Accordingly, water suppliers generally select and emphasize one or more of the following steps as a way of promoting water use efficiency in the large landscape sector. These include:

- Landscaper education and certification
- Education of property owners
- Establishment of water budgets[2] and tracking of actual use (that is, benchmarking of actual versus efficient use during each billing cycle)

[1] Whitcomb, J., Kah, G. and W.C. Willig, *BMP 5 Handbook: A Guide to Implementing Large Landscape Conservation Programs as Specified in Best Management Practice 5*, a report prepared for the California Urban Water Conservation Council, 1999.

[2] The analytic framework laid out in the Model Water Efficient Landscape Ordinance AB 1881 and associated budget calculator can aid water suppliers in establishing water budgets for their large landscapes (www.water.ca.gov/wateruseefficiency/landscapeordinance).

- Irrigation equipment retrofits (including sprinkler heads, irrigation controllers, pressure regulation, drip irrigation, etc.)
- Meter retrofits (advanced metering infrastructure (AMI) systems[3], etc.)
- Landscape re-design (promoting proper hydro-zoning, native vegetation, turf removal)
- Promoting recycled water
- Conservation-oriented rate structures (preferably tied to water budgets)

With respect to landscaper education and certification, landscape contractors are required to obtain a state contractor's license to operate in California if they wish to undertake projects exceeding $500 in labor and material costs combined (www.cslb.ca.gov). Applicants have to demonstrate adequate work experience as part of the application process, although the problem of unlicensed contractors remains significant. For more specialized tasks, such as, installation and repair of irrigation systems, landscape auditing, landscape water management, etc., clients often demand additional certifications. The key organizations that implement these additional education and certification programs in California include the Irrigation Association, the California Landscape Contractors Association, and the Sonoma-Marin Qualified Water Efficient Landscaper (QWEL) program. These programs are also WaterSense endorsed (www.epa.gov/watersense/outdoor/cert_programs). Water suppliers often leverage these programs to improve landscaper education in their service area.

2. WATER SAVINGS

Estimation of water savings from large landscape programs poses difficult challenges because of the interlinked nature of the various components that comprise these programs, which makes savings highly path dependent, that is, dependent upon the sequence in which various program components are rolled out. For example, the impact of equipment retrofit programs may differ if a conservation-oriented rate structure has been in place for many moons prior to the implementation of these retrofit programs, owing to the pro-efficiency behavioral change likely generated by the rate structure. Similarly, the impact of education programs will likely differ if they are run independently or concomitantly with other retrofit programs or with conservation-oriented rate structures, etc. While several studies have evaluated the impact of one or more components of a large landscape conservation program, virtually none have addressed the question of path dependence in a comprehensive way.

How then does one estimate savings from large landscape programs in the aggregate, unaffected by path dependence biases? An answer to this question perhaps lies in a key feature of all large landscape programs, namely, the requirement to establish water budgets. Since the large landscape BMP requires that water suppliers establish water budgets and track and inform property owners about how they are doing relative to their budgets, this then provides an approach for both managing and evaluating a large landscape program. Under this approach it is not necessary to quantify how a site achieved water savings, or to allocate these savings to the myriad steps that may have been taken under the auspices of a large landscape program. The alternative approach would be to aggregate savings across all program

[3] While AMI systems have broader benefits, they are particularly useful for implementing budget based programs. The early warning provided by AMI systems allows landscapers and property managers to be much more proactive.

components: This, however, is unlikely to yield reasonable program-wide savings estimates until they are trued-up with actual use and the water budget.

Given the difficulty in making a bottoms-up approach work, why then bother with such an approach at all? Well, if the goal is not limited to estimating overall savings but also includes questions about program design and maximization of program cost-effectiveness then it is important to have a rank ordering of large-landscape program components according to their level of effectiveness and cost-effectiveness. Therefore, in reality both the top-down (that is, budget based) and the bottom-up (that is, program component based) approaches are necessary. We review information pertinent to both approaches next.

Water Budgets: A Management and Evaluation Tool

Many water suppliers have adopted water budgets for their large landscapes, which provides an effective way for both managing and evaluating large landscape programs. We compiled information from four regions that were willing to share data about actual water use relative to water budgets for their (large-landscape) program participants (Figures 1 & 2). These data are only illustrative. They do not necessarily represent "typical" savings potential in a given region of the state. To develop such an estimate would require data from a representative sample of water suppliers which we do not have. Collection of such data would require a level of effort that exceeds this paper's limited scope.

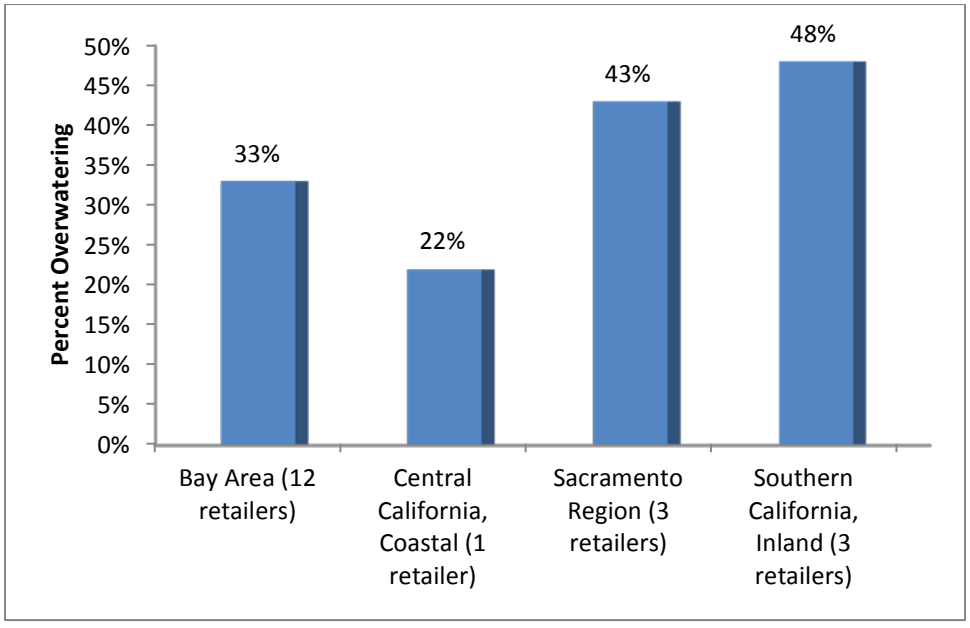

Figure 1 Overwatering Relative to Budget by Type of Water Supplier

These data convey two important points that most professionals involved with large landscape programs will find unsurprising. First, there is probably wide variation in the level of over-irrigation taking place across California's landscapes with hotter, inland regions exhibiting greater levels of inefficiency. If broadly true, this is especially worrisome since a great deal of future growth is expected to occur in these hotter, inland regions of California. Figure 1 also challenges conventional wisdom to some extent because the Bay Area, normally associated with low outdoor use, does not appear notably efficient. Second, over-irrigation is not equally prevalent across different types of large landscapes (Figure 2). Professionally managed sites such as golf courses and cemeteries are usually quite efficient. The most inefficiently managed landscapes are usually found in commercial properties and home owner associations (HOAs).

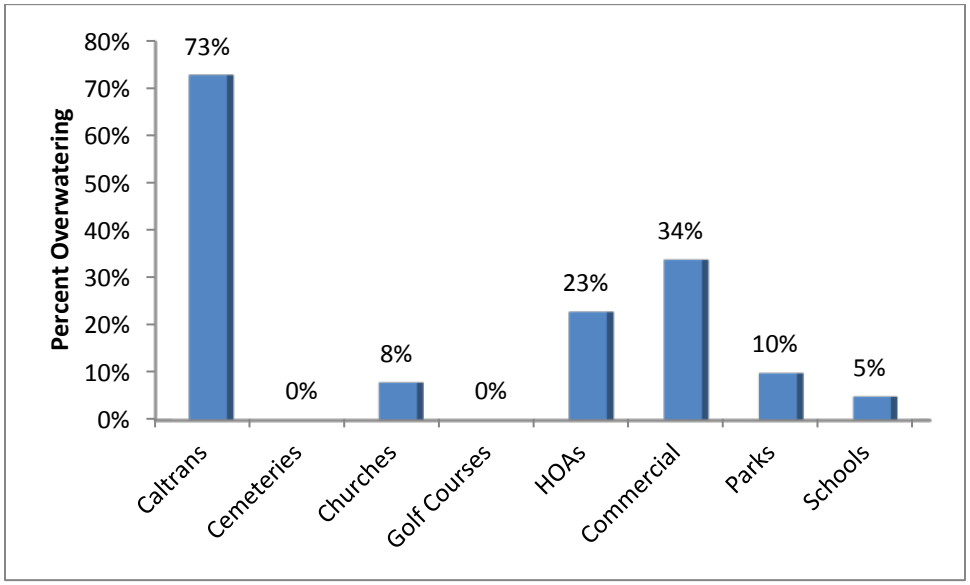

Figure 2 Overwatering Relative to Budget by Site Type (Central California, Coastal Supplier)

Water Savings Associated with Components of Large Landscape Programs

Several studies have evaluated the impact of landscape education, rates, horticultural practices, turf removal, and equipment retrofits on water use of large landscapes. We review the results of these studies next.

The impact of landscape education on compliance with water budgets was evaluated in Orange County, California in a 2004 study[4]. The education component was targeted at landscape contractors and

[4] Chesnutt, T.W. et al., *Evaluation of the Landscape Performance Certification Program*, a report prepared for the Municipal Water District of Orange County, Metropolitan Water District of Southern California, and the US Bureau of Reclamation, 2004

property managers at home-owner associations (HOAs). The results were based on the experience of 47 HOAs that had participated in the program up to that point. The impact evaluation concluded that early participants in the program reduced their water demand by 9%, later participants by 20% (the difference between early and later participants was not explained).

Several studies are available that examine the impact of budget-based rates on large landscape water use. An early study, published in 1997 showed that tiered rates tied to landscape water budgets can reduce irrigation demand by 20-37%[5]. More recent journal articles have fleshed out further how water agencies can go about setting budget-based tiered rates[6].

Another early 1997 study examined the relative impact of budget-based rates, education and outreach, and advanced horticultural practices on large landscape water use[7]. This study showed that education and outreach are critical components without which budget-based rates may only generate meagre savings. However, neither budget-based tiered rates nor outreach was able to completely eliminate inefficient irrigation until advanced horticultural practices were also introduced into the maintenance routines followed in the test landscapes. Prior to the evaluation these test landscapes were using over 100 inches of water per year. After all the interventions were put in place, irrigation was halved and wasteful irrigation was almost completely eliminated. This study showed that rates, education, and outreach caused irrigation demand to drop by roughly 30% relative to the baseline, and superior maintenance and horticultural practices, by an additional 20%.

Many studies in the past have evaluated the impact of turf removal. A relatively recent evaluation of Xeriscape in Nevada found that annual household water demand dropped by 30% after turf landscapes were replaced with Xeriscape[8]. Another evaluation in Southern California found that turf removal reduced annual water demand by roughly 24% in the participating commercial sites and by 18% in the participating residential sites[9].

With respect to equipment retrofits, several studies have evaluated the impact of weather-based irrigation controllers (WBIC) in commercial settings. For example, a study completed for Los Angeles Department of Water and Power estimated the impact of two different WBIC models: one model

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[5] Pekelney, D. and T. W. Chesnutt, *Landscape Water Conservation Programs: Evaluation of Water Budget Based Rate Structures*, a report prepared for the Metropolitan Water District of Southern California, 1997.

[6] Mayer, P., et al., *Water Budgets and Rate Structures: Innovative Management Tools*, Journal AWWA, Volume 100:5, 2008.

Hildebrand, M., et al., *Water Conservation Made Legal: Water Budgets and California Law*, Journal AWWA, Volume 101:4, 2009.

[7] Pagano, D.D., Barry, J. and Western Policy Research, *Efficient Turf Grass Management: Findings from the Irvine Spectrum Water Conservation Study*, a report prepared for the Metropolitan Water District of Southern California, 1997.

[8] Sovocool, K., *Xeriscape Conversion Study: Final Report*, a report prepared for the Southern Nevada Water Authority and the US Bureau of Reclamation, 2005.

[9] Metropolitan Water District of Southern California, *California Friendly Turf Replacement Incentive Program Southern California: Final Project Report*, 2013 (see Appendix E).

reduced irrigation demand by roughly 17%; the other by 28% in landscapes with dedicated meters[10]. A study completed in Irvine, California estimated that WBICs caused irrigation demand to drop by 22% in the commercial landscapes that participated in the retrofit program[11]. A large-landscape retrofit study completed in San Diego detected a drop in irrigation of between 24-48% after WBIC retrofits[12]. At present there are nozzle and pressure regulator retrofit evaluations underway that will add to our knowledge about yet another type of retrofit.

This quick review of the prior literature demonstrates the challenge of a bottoms-up approach. Many of these earlier studies are based on small samples, often samples exhibiting egregious levels of water waste. If a water supplier were contemplating designing a large-landscape program consisting of components such as, landscaper certification, conservation rates, water budgets and some hardware retrofits (e.g., WBICs) they would considerably overstate their program's savings potential if they simply aggregated each component's savings based on published research. It is therefore imperative that savings derived from a bottoms-up approach be trued up against actual water use and the water budget.

3. COSTS

Costing out a large landscape program is difficult because it depends on a program's overall size and on which components are included under its auspices.

Large landscape conservation programs can involve sizeable setup costs, such as designing a reporting system that delivers a comparison of actual and budgeted water use every billing period to large landscape property owners and/or their landscape contractors; setup of budget-based water rates; setup of education programs for landscape contractors and property owners, etc. By forming partnerships, water suppliers can help to reduce the impact of many of these setup costs.

Large landscape programs also involve costs that are more site specific, such as, the cost of hardware retrofits, the cost of landscape area measurement, the cost of site audits, etc. These costs can be expected to more or less scale with the number of landscape accounts included in a large landscape program.

Finally, the longevity of water savings may be directly related to ongoing education and outreach efforts undertaken by a water supplier. The churn in landscape contractors and property owners requires an ongoing commitment on the part of the water supplier to detect an unusual spike in water demand and then do something about it. Unless staff time is properly allocated for this purpose, savings may well erode over time. Maintaining efficient outdoor water use requires vigilance first and foremost, which boils down to behavior mainly. Large landscape programs generally continue to incur costs even for

[10] Bamezai, A., *LADWP Weather-Based Irrigation Controller Pilot Study*, a report prepared for the Los Angeles Department of Water and Power, 2004.
[11] Chesnutt, T.W. and D. Holt, *Commercial ET-Based Irrigation Controller Water Savings Study*, a report prepared for the Irvine Ranch Water District and the US Bureau of Reclamation, 2006.
[12] ECONorthwest, *Embedded Energy in Water Pilot Programs Impact Evaluation*, a report prepared for the California Public Utilities Commission, 2011.

sites already in the program, and these must be properly accounted for while testing for program cost-effectiveness and for estimating financial outlays required for implementing a large landscape program.

Anecdotal evidence suggests that to develop water budgets can cost anywhere between $200-300 per site, with roughly an ongoing $100 per year expense for transmitting the actual-versus-budget comparison for every billing cycle. Large landscape audits can cost up to $1,500 per site depending on the thoroughness of the audit, which may include one or more of the following elements: (1) review of consumption history; (2) interview of landscape contractor and/or property owner; (3) pressure testing; (4) examination of sprinkler heads; (5) distribution uniformity testing; (6) leak testing; (7) irrigation schedule review; and (8) suggestions about plant palette modifications.

Water suppliers also offer financial incentives to promote hardware retrofits. Data collected from the Metropolitan Water District of Southern California shed light on the current level of incentives being offered for the most common types of hardware retrofits. These include: (1) $25 per station for a smart irrigation controller; (2) $7 per large rotary nozzle; (3) $3 per rotary multi-stream nozzle, etc. These types of data can be utilized to cost out the hardware retrofit element of large landscape programs.

4. EFFECTIVE LIFE

The effective life of water savings generated by a large landscape program depends upon which particular programmatic component one is discussing. Certain components, such as turf removal and budget-based conservation rates are likely to have long lived, almost permanent effects. On the other hand, savings generated by water budgets, landscape audits, even hardware retrofits may erode over time because of the churn in landscape contractors and property owners. It is very important for water suppliers to maintain an ongoing education and outreach program to deal with this churn and thereby prolong the effectiveness of their large landscape programs.

Since water budgets are an integral component of most large landscape programs, water suppliers do not have to guess at their program's level of effectiveness. Tracking actual and budgeted use offers ample real-time information about how much water their large landscape program is generating and whether these savings are holding or eroding over time. With an effective education and outreach program, there is no reason in principle why these savings could not be long lived.

5. THE CHALLENGE AHEAD

Existence of water budgets presents a golden opportunity for addressing many questions about large landscape programs. If large landscape programmatic data could be collected from a representative sample of water suppliers several of the following questions could be addressed. These include:

- How much over irrigation is at present occurring in different parts of the state?
- How does over irrigation vary by site type?
- How long does it take for actual use to get ratcheted down to match budgeted use?
- What level of ongoing education and outreach is necessary to maintain program effectiveness?
- Which programmatic components appear to be the most effective?