Water Budgets and Rate Structures – Innovative Management Tools

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ABSTRACT

"Water budgets"—volumetric allotments of water to customers based on customer-specific characteristics and conservative resource standards—are an innovative means of improving water use efficiency. Once thought to be impractical because of technological constraints, water budgets linked with an increasing block rate structure have been implemented successfully in more than 20 utilities. As utilities develop advanced customer information systems and geographical information systems these rate structures are expected to be applied more broadly. Water budget rate structures are attractive to water agencies searching for stable revenue generation, improved customer acceptance, increased water use efficiency, augmented affordability of nondiscretionary customer water consumption, and improved drought response. A growing number of utility managers are finding that water budgets offer potential benefits to water utilities and their customers in coping with increasing water scarcity and rising costs.

INTRODUCTION

"Water budgets"—volumetric allotments of water to customers based on customer-specific characteristics and conservative resource standards—are an innovative means of improving water use efficiency. Once thought to be impractical because of technological constraints, water budgets linked with an increasing block rate structure have been implemented successfully in more than 20 utilities. As utilities develop advanced customer information systems and geographical information systems these rate structures are expected to be applied more broadly. Water budget rate structures are attractive to water agencies searching for stable revenue generation, improved customer acceptance, increased water use efficiency, augmented affordability of nondiscretionary customer water consumption, and improved drought response. A growing number of utility managers are finding that water budgets offer potential benefits to water utilities and their customers in coping with increasing water scarcity and rising costs.

Water budget-based rate structures are probably not for everyone. This rate structure form requires more customer level data than traditional rate structures and may be more expensive and labor intensive to put in place. Utilities without a pressing need to encourage water conservation are not good candidates for water budgets because implementation costs might exceed any non-conservation benefits. For utilities that wish to supplement water conservation efforts, and send a fair and effective price signal about usage to their customers, water budgets appear to be an excellent option to consider.

The objective of this research project, (funded by grants from the EPA, AwwaRF, and a consortium of water utilities) was to examine water budgets and their potential value to North American water utilities and the varying applications of the water budget concept that have been adapted to different conditions. Key issues identified include: different practical approaches to

water budget rate structures, the benefits and challenges of these approaches, the potential uses of water budgets during drought, and important steps in the water budget implementation process.

The research team used a variety of methods to obtain and analyze the information and data presented in this article. An extensive literature review was conducted using bibliographic and web-based searches. Water budget rate structure programs were identified through researcher knowledge, web searches, conversations, and interviews with water professionals.

Survey instruments were developed by the research team and reviewed by the project advisory committee (PAC). The researchers conducted numerous structured interviews with water agencies that have already implemented water budgets. Participating water agencies provided detailed information about their water budget programs including rate schedules, memos written during the implementation process, in-house research studies, billing data analysis, customer satisfaction surveys, sample water bills, customer information pamphlets, local newspaper articles, and other pertinent information. Case studies on implemented water budget programs were developed by the research team and reviewed by agency personnel to ensure accuracy.

Although water budgets have been implemented by water providers in North America for nearly 20 years, until recently they had only been used by a handful of utilities. As populations increase and climate uncertainties place heightened demand and stresses on water systems, more utilities are seeking new tools for water conservation and drought response. Water budget-based rate structures are an effective tools available to water providers to provide a meaningful price signal, reduce water waste, increase efficiency, and manage drought response in a sensible and what many view as an equitable manner.

WHAT IS A WATER BUDGET?

A water budget is the quantity of water that would be required by an efficient level of water use. Exactly what constitutes an "efficient level" of use (particularly as it relates to outdoor irrigation) is often a community decision and must be based upon public expectations as well as water supply realities. Water providers tend to define water budgets in more specific terms so that their customers can easily understand how the budget (or allocation as it is often called) applies. For example, the City of Boulder, Colorado defines the concept for customers in the following way: "A water budget is the amount of water you are expected to need for a specific month. Each customer's water budget will be different based on their water needs. Water budgets may vary monthly based on seasonal outdoor watering needs."

Landscape water budgets are the most common form of a water budget. A landscape water budget is typically a volume of water that is calculated from two parameters: the landscape size (usually in square feet) and the water requirement of plants in that geographic area which is usually represented by the evapotranspiration (ET) rate.

Indoor water budgets are typically a fixed volume provided each month based on the historic use of the customer class or a calculated volume based on the anticipated needs of the customer. Indoor water budgets may vary based on the number of people in a household, the type of manufacturing processes used in an industry, the size of a business, or other factors.

WATER BUDGET-BASED RATES

Water budget-based water rates—also known as individualized, goal-based, and customer specific rates—are block rates where the block is defined by using one or more customer

characteristics. Water budget-based rate structures can be thought of as an increasing block rate structure where the block definition is different for each customer based on an efficient level of water use for that customer. A diagram of a simple water budget rate structure is shown in Figure 1.

Water budget-based water rates have been implemented in communities like Irvine Ranch Water District (IRWD), East Bay Municipal Utility District (EBMUD), Santa Barbara, and Capistrano Valley, California, and the Los Angeles Department of Water and Power (LADWP) - all facing limited water supplies or shortages. Field evidence from their implementation sheds some insight on the advantages and disadvantages of water budget-based rates. On the plus side, these rates have been considered an equitable way to share limited water supplies while preserving some amount of customer choice. Indeed, the largest strength identified with water budget-based rates—by both customers and water utility staff—is their perceived fairness (Pekelney and Chesnutt, 1997). If the basis of the water budget-based rate and the supply constraint situation are communicated well, then the rate is seen as an intrinsically more equitable way of charging water rates than rate structures that do not include individual customer characteristics. Water utilities that have implemented water budget-based rate structures have developed closer working relationships with their customers while coping with water supply constraints.

The implementation of new information technologies (especially AMR and geospatial parcel measurement applications) hold the prospect of broader, less costly, application of water budget based rates. Many water agencies have already developed information systems that contain sufficient information and data for the development of water budgets. Modern utility billing systems that are database-driven are often more capable and easily adapted than older

billing technologies. Typical water budget rate calculations are not particularly complex and often only require the inclusion of a few additional fields and a calculation or two in a utility billing database.

The disadvantages of water budget-based rates include potentially higher implementation costs including a billing system that can accommodate the rate structure and customer level information that may not be readily available. More upfront effort to implement the rate structure may be required of utility personnel. Water budget-based rates are a departure from the billing methods most customers are familiar with and customer service representatives must be prepared to handle questions and problems that may arise. Successful water budget implementation requires a level of commitment from decision makers, staff, and citizens. Many agencies have opted to implement water budgets for irrigation only accounts to gain experience with the concept before tackling a utility-wide program.

Water budgets can meet cost of service requirements. According to the AWWA M1 Manual, "the basic premise in establishing adequate rate schedules that are equitable to different customers is that rates should reflect the cost of providing water service" (AWWA 2000). After revenue requirements have been established, costs are allocated among different types of water users, and then rates are designed to reflect the cost of providing water service. Although the concept of cost of service is central to public utility rate setting, most rates reflect historical pricing regimes and local political imperatives. Legal precedents require that rates be "fair and reasonable." Public utility practice often uses a cost-of-service study to assess the reasonableness of rates.

A water budget-based rate structure is inherently no more or no less cost-based than a similar increasing block rate structure without a water budget component. There is little dispute

that increasing block rate structures can be properly designed to meet cost-of-service requirements. The same is true for a water budget-based rate structure. The research team could find no report or publication that identified cases where water budget rate structures failed to meet cost of service criteria. Given that more than 20 utilities are actively implementing some form of these rate structures, it appears that properly designed water budget-based rate structures can meet these important criteria.

Water budgets are being used across the USA. During the 1990s, water budget rate structures were only implemented by a few water agencies in California, most notably in Capistrano Valley, IRWD, and the Otay Water District. By 2007, water budget rate structures have diversified and expanded throughout California and across the United States to Utah, Nevada, Colorado, North Carolina, and Florida. The researchers were able to identify 25 water providers that are using some form of a water budget for billing and informational purposes. Table 1 provides a list of the utilities using water budgets.

While still primarily a California and western states phenomena, water budgets have found support in a broad range of agencies from small systems like Marco Island, Florida to the Los Angeles Department of Water and Power (LADWP). Water budgets are no longer an exclusive "boutique" rate structure for select technologically savvy providers. These rate structures have been adopted by a broad range of providers, each adopting their own version of the water budget concept.

Water budget-based rate structures, like utilities, are unique. Utilities are unique and so are their rate structures be they water budget-based or not. The formulation of water budgets and implementation within the utility context was unique for every example the researchers identified. Only three of the identified water budget utilities developed a water budget for all

customers in the service area. Most of the water budget utilities opted to use water budgets for only certain customer classes (such as single-family residential or dedicated irrigation) and some only use water budgets for informational purposes in which the budget is not linked to the rate structure. Single-family residential and dedicated irrigation accounts were the most common customer categories to be included in a water budget program. Table 2 summarizes the type of water budget program implemented in the identified water agencies. Details on the formulation of water budgets at all identified agencies are presented in Table 3. A comparison of the rates and charges for single-family customers at selected water budget agencies is shown in Table 4.

Many (but not all) agencies provide a process to appeal or adjust water budgets for specific extenuating circumstances such as large families, special medical needs, unaccounted for irrigated area, or other factors.

Landscape Water Budgets. Landscape water budgets were the original basis for the formulation of these rate structures and are the foundation of the majority of implementations examined in this report. The idea of calculating the volume of water required to adequately irrigate a plot of land is hardly a new concept. Farmers and agronomists have been developing water budgets for agriculture for many years using evapotranspiration measurements to determine the required application depth to maximize plant growth. In the urban context, water budgets have been used for years to determine irrigation efficiency for parks and large irrigated parcels. They have been used at least since 1989 in conjunction with inclining block rate structures to provide a tailored price signal based on the water requirements of the landscape.

Landscape water budgets are typically based on two fundamental factors:

- Landscape area
- Water application requirement

The Centennial Water and Sanitation District in Douglas County, Colorado bases their outdoor water budgets on these two factors. Customers' budgets are calculated based on 27 inches of irrigation water applied across 45% of their measured total lot area for an entire year. The value of 27 inches was selected based on the historic evapotranspiration rate for typical landscapes in the service area. For example, a 10,000 square foot lot in Centennial would receive an annual outdoor water budget of 75.7 kgal (10,000 sf x 0.45 x 27 inches ÷ 12 inches/ft x 7.48 gal./cubic foot ÷ 1,000 gal/kgal). The water in the annual budget is distributed through the irrigation season (April – October in Colorado) based on the historic evapotranspiration curve in the area.

More complex water budget formulations are also practiced and include additional factors such as effective precipitation and different landscape water requirements. In Redwood City, California the landscape material is taken into consideration and 100% of ET is provided for turf and 80% of ET for non-turf areas. In Santa Rosa, California, landscape water budgets are calculated by subtracting effective precipitation from the reference evapotranspiration (ET) thus creating a measurement of Net ET and then providing 100% of Net ET for high water use landscaped area and 60% for medium water use landscaped area.

Some agencies develop their outdoor water budgets using a physical measurement of the lot size or landscaped area taken from aerial photographs or GIS mapping. Other agencies use local tax assessor records of lot size to fix their customers into water budget bins. The Los Angeles Department of Water and Power (LADWP) for example has five lot size bins that customers are placed into for the creation of water budgets. LADWP also uses the customer zip code to place them into one of three temperature zones which is also used to adjust the allocation. A wide variety of formulations is possible and the method chosen by each agency is

often determined by the availability of data and the desire to further customize the water budget to fit the characteristics of each landscape.

One of the criticisms frequently leveled against landscape water budgets in the residential context is that they encourage profligate use by customers with large lots by providing them with enormous water budgets based on lot size. The rate structure implemented in Boulder, Colorado tackles this issue by providing 15 gallons/square foot (gpsf) for the first 5,000 sf of landscaped area; 12 gpsf for the next 9,000 sf; and 10 gpsf for everything above 14,000 sf. Ten gpsf in Boulder is the water requirement for low water use native plants, so this approach is designed to discourage wall to wall turf on large landscapes. With all of the rate structures examined in this study, customers may use as much water as they want, but if they exceed their budget the price increases steeply.

The calculation of evapotranspiration provides another wrinkle in the formulation of landscape water budgets. Many agencies have chosen to use the historic average ET rate to calculate water budgets. This approach could potentially provide excessive budget volumes in wet years and insufficient budget volumes in dry years when the ET rate is higher than average. Using real-time ET measurements is a way around this issue and this is the approach used by the Irvine Ranch Water District (IRWD) and the Capistrano Valley Water District. In both cases, prevailing ET data is input into the billing system software and the ET for each customer's billing period is used to calculate their water budget for that billing cycle. Since it is customary to provide customers with the volume of water allocated to the upcoming billing cycle on each water bill, both IRWD and Capistrano must provide an estimate of this value and then adjust the actual budget based on prevailing conditions. Other agencies have shied away from this

approach because of the perceived complexity of dealing with real-time weather data and the uncertainty this brings to the formulation of an annual landscape water budget.

Several electronic landscape water budget calculators are available on the internet for utilities to review and consumers to utilize. Typically these calculators are not associated with a water agency rate program.

Indoor Water Budgets. Indoor water budgets are formulated by customer class such as single-family residential, multi-family residential, commercial, etc. Developing indoor budgets for the residential sector is fairly straight forward, but the commercial, institutional, and industrial (CII) sector poses a greater challenge. As with landscape water budgets, a variety of different approaches to developing indoor budgets has been developed at different water agencies. Each customer class is addressed separately below.

Residential – Single-Family. Single-family water budgets are typically set based on the average amount used by these customers in that particular agency. Single-family indoor budgets range from 5 to 7 kgal per month depending upon the agency. Only IRWD uses a daily per capita value of 75 gcd to develop indoor water budgets for single-family customers. A family of four in IRWD would receive a monthly budget of approximately 9 kgal per month.

Residential – Multi-Family. Multi-family water budgets are developed similarly to single-family budgets, but on a per unit basis. Creating a water budget for multi-family customers requires the water utility to have valid information on the number of units at each multi-family property. This information is often available from tax assessor records and is occasionally maintained by the water provider. Multi-family indoor budgets range from 4.4 to 5 kgal per unit per month depending upon the agency. As with single-family customers, IRWD

uses a daily per capita value of 75 gcd to develop indoor water budgets for multi-family customers.

Commercial, Industrial, and Institutional (CII). The CII sector presents a greater challenge for the development of water budgets. Only a handful of agencies have included CII customers in their water budget rate structure program. Approaches to developing CII budgets usually include relying on historic usage patterns to establish a baseline budget. The problem with this approach is that it rewards customers whose use is historically inefficient with a water budget that "grandfathers" in that in-efficiency. Alternative approaches include using site-specific factors such as the number of seats in a restaurant or the number of employees in an office building to develop the water budget. This approach is impractical for many water providers who simply don't have the staff and data resources to develop water budgets in this manner.

IRWD has the most developed program of water budgets for CII customers. The IRWD CII budget program purports to be site specific and based on productivity, the number of employees, water efficiency practices at the site and other factors. In practice IRWD's CII budgets are based on historic average demands that are occasionally scaled up or down as appropriate. When a new CII customer is added to the system they are given a six month grace period from the water budget rate structure, then the next six months are used to develop a demand index (baseline budget) for the rate structure. It is anticipated that CII customers will request a budget review promptly if their usage changes because the penalty rates are significant and kick in if the water budget is exceed by more than 10%.

It is anticipated that as water budget rate structures develop over time, alternative methods for creating CII water budgets will be developed.

CAPABLE UTILITY BILLING SYSTEM REQUIRED

The implementation of water budget-based rate structures has been made possible by the advent of computerized utility billing systems that can incorporate specific customer-level information into a billing calculation. None of the water budget formulas or calculations studied by the research team was particularly complex or complicated. Most modern, database centered, utility billing systems can probably be adapted to incorporate water budgets without significant effort. Billing systems based on older technology may not be capable of handling water budgets. At least one utility billing software company has developed a module specifically for incorporating water budget-based billing.

The development of most water budgets examined in this study requires some customer level data such as lot size or irrigable area. Many water utilities have invested in geographical information systems that provide parcel (or customer) level data such as lot size and pervious/impervious area measurements. If these parcel level data can be linked to the customer billing system, then much of the data required to implement a landscape water budget program are already in place. Utilities that do not have a GIS may be able to use local tax assessor records to obtain lot size information and other data that could be used to develop water budgets.

IMPLEMENTATION COSTS VARY

The costs associated with implementing a water budget-based rate structure vary tremendously depending upon the circumstances of the water agency involved. Most water budget systems have been implemented “in-house” using utility staff and limited outside expertise. Often the existing customer billing system can be modified to accommodate the new

rate structure. In these situations, the implementation costs amount to the staff time required to develop the program. IRWD, San Juan Capistrano, Otay, and Centennial Valley all implemented their water budget programs in under 12 months with most labor coming from existing staff resources.

Some water budget implementations are more expensive. The City of Boulder spent nearly three years studying and then implementing their water budget rate structure. Boulder first spent several hundred thousand dollars on a study to investigate the feasibility of water budgets. Boulder's antiquated billing system (hardware and software) was replaced as part of the water budget implementation at a cost of more than $1,000,000. It should be noted that Boulder intended to replace this system anyway and had budgeted money for the project prior to the decision to implement water budgets. Boulder also commissioned a cost of service study as part of the rate implementation which increased the overall cost of the project, but also helped to ensure its fairness to customers.

WATER BUDGETS SPUR WATER SAVINGS

Many of the utilities that have implemented water budget-based rate structures have experienced substantial conservation savings attributable to the rate structure and accompanying customer outreach programs. Analysis by Irvine Ranch Water District (IRWD) staff concluded that the program increased outdoor efficiency by 60 percent. In 1992 shortly after the rate structure was implemented IRWD customers irrigated approximately 3,600 acres in the service area and applied roughly 4.4 acre-feet of water per acre (52.8 inches of water applied). The typical ET requirement for turf grass in the area is 48 inches per year. In 2005 IRWD customers irrigated 11,768 acres of landscape and applied only 1.7 acre-feet of water per acre (20.4 inches).

This represents a 61% reduction in the outdoor application rate since the introduction of the water budget program. An independent evaluation in 1997 documented a 37% decline in water consumption as a result of IRWD's rate structure and customer outreach (Pekelney and Chesnutt, 1997). At the same time IRWD has found that the water budget rate structure has improved revenue stability as customers have adjusted to their allocations and demand has stabilized, making it easier to the utility to set rates and meet revenue requirements.

The same 1997 study found that two other water budget rate structures and conservation programs in California also achieved substantial conservation savings. San Juan Capistrano's water budget rate structure and customer outreach reduced consumption by 35% between the pre- and post-program periods; while the Otay Water District experienced a 20% decline in usage, after controlling for weather (Pekelney and Chesnutt, 1997).

Staff from the Centennial Water and Sanitation District in Colorado documented an average 25% reduction in demand after implementing their water budget program. Even though Centennial continues to add customers at a fairly steady rate, its demand has decreased 18 – 31% since 2003 when the water budget-based rate structure was implemented.

FAIRNESS: A KEY ISSUE

One of the fundamental benefits of water budgets identified by the implementing water agencies studied for this project was their greater perceived "fairness". Most of the agency staff involved said the additional complexity of customer-specific water budgets was more than outweighed by the increased customer acceptance of the customized rate structure. Staff found that once customers understood the system they preferred to have their rates based on the characteristics of their site rather than on an arbitrary or average value. Variance programs have

also been used to increase the accuracy of both indoor and outdoor water budgets since the water agency cannot know about every circumstance of each individual customer.

Penalty rate structures are less successful. Landscape water budget systems based on a penalty rate structure, such as the one implemented by Otay in 1992 and rescinded in 2000, are more problematic than the water budget-based rate structures implemented in other cities. The Otay system relied on self reported landscape information and issued first a warning and then penalties for exceeding budgeted allotments. Although this approach resulted in 20% reduction in demand among the budgeted customers, the rate penalty system proved problematic with some customers. The system generated numerous customer complaints and the use of self-reported landscape area data allowed some customers to inflate their area estimates and defeat the intent of the system.

To be successful, water budgets must be based (to the extent possible) on measured customer level data, not self-reported information. Water budgets are also more likely to gain acceptance if they are connected with a well designed and communicated rate structure rather than a penalty structure.

WATER BUDGETS AND DROUGHT RESPONSE

Water budgets and water budget rate structures offer water utilities powerful tools for reducing demand during drought and for monitoring customer compliance with drought restrictions. Historically drought has been considered an unpredictable natural disaster, and in response to drought water system managers have typically relied on predictable response mechanisms. Water managers have viewed droughts as low water supply events of unknowable and uncontrollable duration. In response water utilities typically invoke some form of water use

restrictions on customers that limit outdoor use, often using somewhat arbitrary baselines such as the previous year's use. The strategy for drought management has been expanded in recent years to put more emphasis on drought planning instead of mere drought response. The emphasis has changed to a more pro-active rather than reactive mode of thought (Billingsley, 2004).

Drought management plans may vary from place to place, but progressive drought plans generally include four main elements (Lampe, et. al., 2003). Each of these four elements contains sub-elements that must be taken into account in order to formulate a successful drought response plan.

1. An analysis of how water supplies are likely to vary for a range of droughts;
2. An understanding of local water requirements and the ability to reduce them;
3. Establishing measures for reducing demands in an equitable manner;
4. Creating a modern system designed for flexibility to match the conditions of the drought.

A water budget rate structure is a sword that cuts both ways during drought. First it establishes an empirical and quantifiable limit to the amount of water that a customer is entitled to use at a given price from a given tap. Second, it theoretically reserves a volume of water that is set aside for the customer to use as he sees fit. Water budgets have the potential to protect the utility from overuse and to protect the customer from having her water allocated to other uses or micromanaged by the utility. In time of shortages, water budgets allow a water provider to quickly and easily identify excess use and even penalize it if necessary. By summing all water budgets, utilities can quickly understand the amount of water likely to be required to meet customer demands in any given month. During a drought, water budgets have the potential to assist water utilities in more fairly apportioning demand reductions among customers with

different needs and among different customer classes since the reference point for reductions is based on the water required by each customer in normal times. Historically, when customers are asked to reduce their use from the previous year, justified complaints arise from customers who are already conserving, and don't have as much room for additional curtailments.

Water budget rate structures can help with drought plan enforcement in the area of communications. The water budget rate structure, with its billing system, informs all customers on a regular basis of the required use reductions. The water bill can show each customer how much water they are allocated during the drought. This information can be developed well before the drought occurs as part of the budgeting process. This is a far more reliable and effective way to implement drought related conservation since it is pre-planned rather than improvised. The billing system is already in place and the bills can provide the public with the information needed to respond to the drought.

Another way that water budget rate structures aid with drought plan implementation is in the enforcement of mandatory demand curtailment. A simple query of the billing database can inform the utility each billing period which customers have complied with drought restrictions and remained within budget and which have not. If the higher water rates being charged are not sufficient to elicit cooperation then additional fines and penalties can be considered. This is a highly reliable system. Unlike the "water cop" approach where customers are ticketed if they happen to be observed violating the drought restrictions, a water budget drought enforcement program automatically identifies every customer who is not complying, thus enabling fair and uniform enforcement. Water enforcement patrols are costly and can only catch violators "in the act" of violating a watering restriction. A water budget, however, provides a regular and automatic check on which customers are in or out of compliance with drought response.

BARRIERS TO IMPLEMENTATION OF WATER BUDGET-BASED RATES

Water budget-based rates are probably not for everyone. Although the basic idea for these rate structures has been around for nearly twenty years and interest has been steady, until recently only a handful of agencies had ever successfully implemented a water budget-based rate structure. Even if a water utility is interested in implementing this type of rate structure, a number of real and perceived barriers may delay or block implementation from moving forward. The extent to which these barriers pose real or imagined impediments to implementation depends greatly upon the utility, the staff, the public, the water supply situation, and the local decision makers. The examples of successful implementation of water budgets described here show that implementation is possible and that all of these barriers can be overcome with the right combination of know how, exigent circumstances, and political will[1]. Understanding potential barriers to implementation can be helpful when developing a strategy for moving forward with a new rate structure concept.

Some of the perceived barriers to adopting and implementing a water budget-based rate structure include:

- Complexity
- Data requirements
- Software requirements
- Lack of local precedent
- Equity concerns
- Cost of service concerns
- Revenue requirements

[1] The authors were not able to identify any investor-owned utilities that have implemented water budgets. It seems likely that the regulatory environment of investor-owned utilities will pose additional barriers to implementing water budget rates.

- Institutional resistance
- Political resistance

In some cases these barriers can be overcome, in others they cannot. A brief discussion of some of the important barriers noted above follows in Table 5. The extent to which each of these barriers may present a problem depends entirely on the situation present at each local agency. A more extensive discussion of the barriers to implementing water budgets is presented in the project final report available from AwwaRF.

CONCLUSIONS AND RECOMMENDATIONS

Although the water budget concept is not new, over the past five years the number of agencies implementing water budgets has grown from five to twenty-five. In the coming years it is likely that more water providers will move toward this type of conservation-oriented rate structure. This research study represents the beginning of objective analysis into the implementation and performance of water budget-based rate structures. This project was conceived, developed, and implemented in the hope of improving understanding of water budget-based rates and how they can be implemented by water utilities.

RECOMMENDATIONS

The recommendations from this research project are divided into two categories: (1) recommendations for water agencies considering water budgets; and (2) recommendations for future research.

Recommendations for Water Utilities Considering Water Budgets

Decide if a Water Budget Rate Structure Makes Sense for the Organization

Water budget-based rate structures are not for everyone. This rate structure form requires more customer level data than traditional rate structures and depending upon the implementation circumstances may be more expensive and labor intensive to put in place. Agencies with little or no interest in water conservation are not good candidates for water budgets since this rate structure form has been shown to be an effective conservation tool. For utilities that are serious about water conservation and sending a fair and effective price signal about usage to their customers, water budgets appear to be an excellent option to consider.

Commitment, Coordination and Education are Essential

Designing and implementing a water budget-based rate structure involves all levels of a water agency including the governing board, general manager, rates staff, conservation staff, accounting and finance staff, computer and information systems, public affairs, and the customers. To maximize the potential for success, coordination, communication, and education with all of those involved in the project is required. A thorough understanding of the motivation and operation of the water budget system by all levels of the organization will increase effectiveness and allow the program to be improved over time.

The board and staff must be firmly convinced the water budget rate program is a good idea if they are to stand behind it. The concept should be well developed and adjusted until it is well understood and supported. Changes in rate structure almost always generate grumbling from some segments of the customer base. With sustained commitment to the water budget program, leaders of the agency can successfully support and defend the effort and will be prepared and motivated to fix problems when they are identified.

Identify Information System Requirements Early

The implementation of water budget-based rate structures requires computerized utility billing systems that can incorporate specific customer-level information into a billing calculation. Most modern, database centered, utility billing systems can probably be adapted to incorporate water budgets without significant effort, but it is important to identify data and billing system requirements early on. This will enable the utility staff to develop or purchase any necessary hardware and software and to obtain the data necessary to implement the program in time for the launch date. A number of agencies studied in this project stated that the critical ingredient for success with a water budget system was not hardware or software; it's "peopleware" – i.e. the people who make the program happen.

Educate and Inform

When implementing a water budget rate structure, educating and informing customers about the rate structure and how it works is essential. Customers need to understand not only how the rate structure works and will impact them, but also why it is being implemented. The City of Boulder sent out at least four mailings to customers in advance of implementing the new water budget rate structure. In addition there were articles in local newspapers and extensive information on the City's web site.

Respond to Customer Concerns

No water budget program is perfect. The water utility and its board should be ready and willing to make adjustments to the program based on good suggestions from customers. Many suggestions will likely come when the program is first implemented, but others will come through the fullness of time and experience. Adaptation through years of implementation has been a hallmark of the successful water budget programs in San Juan Capistrano and IRWD.

Budget adjustments and variances with reasonable cause are important for achieving customer acceptance and buy-in to the program. In a customized rate structure, customers expect to be treated as individuals. The water utility should be ready with staff and information to respond to customers' questions and concerns right from the outset of the program.

Use Scientific Basis for Water Budgets Whenever Possible

Water budgets should be objective and must make sense to customers. To the extent possible they should be based on empirical data (indoor budgets) and horticultural science (outdoor budgets). Be explicit about the formulation of the allocations and be up front about areas where agency discretion enters into the allocation formula.

Time Program Implementation Strategically

New rate structures are usually best implemented during off-peak season. This allows customers to adjust to the new rate structure for several billing periods before encountering the potential "sticker shock" in the peak season.

Take Advantage of the Information Provided by the Water Budget System

Water budgets have tremendous potential as a tool to assist with supply shortages such as drought. They also provide an easy means for targeting water conservation programs to the customers who can most benefit from them. If budgets are set properly, then customers who grossly exceed their budget become prime candidates for targeted conservation measures. Standard increasing block rate structures don't provide this level of insight into customer demands.

Drought response may prove to be the most important benefit of water budgets. In order to make the most of the potential benefits, utilities must understand how to take advantage of the

rate structure to encourage and, if necessary, mandate demand curtailment. During a drought the utility can adjust the pricing tiers and the budget size as necessary to achieve the desired level of curtailment.

Target Additional Incremental Revenue to Incremental Water Efficiency Programs

IRWD uses all of the revenue from all tiers above budget allocation to fund additional water conservation measures, water reuse, and environmental programs. This has proved to be a strong selling point for its water budget program. Additionally IRWD's rates are among the lowest in Orange County, CA. Customers like the idea of the utility investing the high tier payments in cost-justified water efficiency programs. This revenue can go towards subsidizing the low tier rate, providing rebates for water efficient fixtures, hardware, and equipment, and for conservation staff. This in turn results in reduced water use and lower bills for customers. Because IRWD covers fixed costs on a separate part of the bill, reduced demand does not negatively impact utility revenue or operations. This linkage helps explain where the money for water conservation programs comes from and how the rate structure contributes to conservation beyond just sending an effective price signal.

Recommendations for Future Research

Advanced Tools for Water Budget Calculation and Implementation

Water agencies wishing to implement a water budget-based rate structure are essentially on their own when it comes to developing a customer billing system capable of handling the rate structure and when it comes to developing water budgets for diverse classes of customers. Future research could tackle these issues by specifying billing system requirements for implementing water budgets. This task was accomplished to a small degree in this project, but could be greatly expanded.

Establishing accurate and reasonable water budgets remains a challenge, particularly for the CII sector. Future research could explore methods for using GIS and other geospatial technologies for measuring irrigated area remotely. This could help automate the process for establishing landscape water budgets.

For the CII sector, additional benchmarking data are required to determine efficient usage levels from different classes of customers. Current CII budgeting methods that use historic consumption to set future budgets are ineffective at developing budgets that encourage efficiency. Benchmarking measures based on key usage parameters such as number of employees, meals served, cars washed per day, building area, etc. could be a more effective method for establishing water budgets. To accomplish this, additional data are required. Such an effort could be combined with an update of the AwwaRF *Commercial and Institutional End Uses of Water* Study, originally published in 2000.

Water Budgets and Drought Response

This project has identified drought response as an area where water budget-based rate structures offer tremendous potential benefit. However, utilities have only limited field experience with managing water shortages with the aid of water budgets. In the coming years this is very likely to change. An important area of future research will be to examine and evaluate the uses of water budgets during real water shortage situations.

New Implementations of Water Budget-Based Rate Structures

Although the water budget concept is not new, over the past five years the number of agencies implementing water budgets has grown from five to twenty-five. In the coming years it

is likely that more water providers will move towards this type of conservation oriented rate structure. This research study represents the beginning of objective analysis into the implementation and performance of water budget-based rate structures. As new ideas and concepts are put into place, this research should be updated and expanded in the hope of improving understanding of water budget-based rates and how they can be applied in the water utility context.

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Table 1: Utilities using water budgets

Utility	Location
California	
Capistrano Valley WD	San Juan Capistrano, CA
City of Rohnert Park	Rohnert Park, CA
City of Santa Barbara	Santa Barbara, CA
Contra Costa Water District	Contra Costa, CA
Eastern MWD	Los Angeles (region), CA
EBMUD	Oakland, CA
IRWD	Irvine, CA
LADWP	Los Angeles, CA
Lake Arrowhead	Lake Arrowhead, CA
Monterey District Tariff Area	Monterey, CA
Otay Water District	San Diego (region), CA
Redwood City	Redwood City, CA
San Clemente	San Clemente, CA
Santa Rosa	Santa Rosa, CA
SDCWA	San Diego, CA
Utah, Nevada, and Colorado	
Centennial Water & Sanitation District	Highlands Ranch, CO
City of Albuquerque	Albuquerque, NM
City of Aurora	Aurora, CO
City of Boulder	Boulder, CO
City of Castle Rock	Castle Rock, CO
Las Vegas Valley Water District	Las Vegas, NV
Salt Lake City Dept. of Public Utilities	Salt Lake City, UT
Southern Nevada Water Authority	Las Vegas, NV
North Carolina and Florida	
City of Morrisville	Morrisville, NC
Marco Island	Marco Island, FL
Town of Cary	Cary, NC

Table 2: Summary of identified water budget programs in US by customer class impacted

Type of Water Budget Program	Number of Utilities Implementing	Percent of All Water Budget Utilities ID'd
Complete (all/most customer accounts)	3	11.5%
SF Residential and Irrigation Accounts	7	26.9%
SF Residential Accounts	3	11.5%
Irrigation Accounts	4	15.4%
Golf Courses	2	7.7%
Informational	5	19.2%
In process/pending	2	7.7%

Table 3: Water budget rate structure implementation by agency

Agency	Location	Type of Water Budget Program	Indoor Budget Basis	Outdoor Budget Basis	Rate Structure	Program Description
Capistrano Valley WD	San Juan Capistrano, CA	Residential and irrigation accounts.	SF/condo - 6.7 kgal/month MF - 4.5 kgal/unit/month	Outdoor allotment is based on irrigable area, ETo, crop coefficient for turf grass, management coefficient, and effective rainfall.	3 tier, increasing block rate	Two separate water budget categories – (1) for residential lots under 7,000 square feet and (2) those greater than 7,000 square feet (irrigable area > than 3,636 square feet). Indoor allotment is 9,000 ccf/month. Outdoor allotment is based on irrigable area, ETo, crop coefficient for turf grass, management coefficient, and effective rainfall.
Centennial Water & Sanitation District	Highlands Ranch, CO	Residential and irrigation accounts.	Residential - 6 kgal/month	27" x lot size.	4 tier, increasing block rate.	Four block system. For SF residential - 6,000 gal/month indoor budget. Outdoor budget = 27" of irrigation per year per lot area.
City of Albuquerque	Albuquerque, NM	Irrigation only	NA	Annual irrigation budget . Golf courses – 37"/yr. Parks – 35"/yr. Athletic fields – 45"/yr.	Surcharge for use in excess of annual budget	Applies to existing golf courses, city owned parks, and city owned athletic fields. Two block structure. Excess of water budget = 50% increase in commodity rate. Planting restrictions, but not water budgets, apply to new development.
City of Aurora**	Aurora, CO	Complete - all customers	SF - 7 kgal/month Others - 70% of historic avg.	SF Outdoor = ET x 3,000 sf irrigated area. Appeals process available for larger lots		3 block structure. Indoor budget based on most recent winter quarter average. Outdoor based on 70% of 00-01 consumption. New accounts receive 7,000 gal/month indoor (3.2 people x 70 gcd). Outdoor = ET x 3,000 sf irrigated area.
City of Boulder	Boulder, CO	Complete - all customers	SF - 7 kgal/month MF - 5 kgal/month ICI - historic avg.	Lot size. 15 gal/sf for first 5,000 sf landscape area. 12 gal/sf for next 9,000 sf. 10 gal./sf for everything above 14,000 sf.	5 tier, increasing block rate	Full fledged water budget rate structure starting in 2007
City of Castle Rock	Castle Rock, CO	In process of implementing water budget rates.			In process of implementing	The City of Castle Rock is considering the use of water budgets as part of its Water Resources Strategic Master Plan, November, 2005 in an effort to decrease water consumption by 18% over the next 25 years.
City of Morrisville	Morrisville, NC	SF residential and irrigation			4 tier, increasing block rate	Water budget system that is the same as the one implemented in the Town of Cary; the only difference is the price of the lowest tier – up to 5,000 gallons. The cost for this tier is $3.75/Kgal; in the Town of Cary the price is $3.28/Kgal.

(continued)

Table 3 (Continued)

Agency	Location	Type of Water Budget Program	Indoor Budget Basis	Outdoor Budget Basis	Rate Structure	Program Description
City of Rohnert Park	Rohnert Park, CA	Informational - irrigation only	NA	Based on landscape area, ET	NA	Landscape water use report provided to dedicated irrigation meter sites each billing period.
City of Santa Barbara	Santa Barbara, CA	Irrigation only	NA	Annual allotment based on irrigated area.	3 tier, increasing block rate	Irrigation only accounts receive budget based on acreage. Budget fits into two tier system. Rates differ based on customer class.
Contra Costa Water District	Contra Costa, CA	Informational - irrigation only	NA	Based on landscape area, ET	NA	
Cottonwood Water and Sanitation District	Douglas County, CO	Residential.	SF - 6 kgal/month MF - 4.4 kgal/month	30" x 2,900 sf.	3 tier, increasing block rate.	Three tier rate structure with single-size water budget based on 2,900 SF of irrigable area. Appeals process available for large lots.
Cucamonga Valley Water District	San Diego, CA	Residential - pilot				Pilot program to create water budgets for 300 single-family customers.
Eastern MWD	Los Angeles, CA	In process of implementing water budget rates.			In process of implementing water budget rates.	
EBMUD (current)	Oakland, CA	Informational - irrigation only	NA		NA	Landscape water budget program since 2002. Informational only. Does not impact the water bill.
EBMUD (historic 1988-92)*	Oakland, CA	Irrigation only – drought response program	NA	Based on irrigable area, 80% of ET, goal was to achieve a 50% cutback from previous/baseline year	5 tier, increasing block rate	Customer submitted landscape area and the utility verified. 1,200 landscape accounts including public agencies and golf courses participated in program. Efficiency standard was based on 80% of ET. Rates were used to penalize. Rates were based on % cutback (50%). Exceeding target became expensive. Because of billing system constraints the system required manual data entry which was time consuming.
IRWD	Irvine, CA	Complete - all customers	SF/MF - # of res. x 75 gpd ICI - site specific based on historic use, productivity, employees, etc.	ET x Kc x 1.25 x landscape area	5 tier, increasing block rate – Res. & Lscape. 4 tier, increasing	Key example of rate structure implementation. Five tier block rate structure. Water budget based on standard indoor amount and outdoor on landscape area.

(continued)

Table 3 (Continued)

Agency	Location	Type of Water Budget Program	Indoor Budget Basis	Outdoor Budget Basis	Rate Structure	Program Description
					block rate - ICI	
LADWP	Los Angeles, CA	SF residential		Based on lot size and temperature zone. Five bins.	2 tier, seasonal rate	Two tiers: Tier 1 is based on lot size (5 blocks), temperature zone (3 zones) which is determined by zip code, and a 7 block household adjustment for households with 7 or more persons. Tier 1 rates are in effect from November 1 through May 31.
Las Vegas Valley Water District	Las Vegas, NV	Golf courses	NA			Currently applies only to golf courses. http://www.lvvwd.com/html/ws_drought_restrictions_golf.html
Marco Island	Marco Island, FL	Residential and irrigation accounts.	Residential - 6 kgal/month	Based on lot size. Five bins.	5 tier, increasing block rate	Home to 15,000 permanent residents and another 35,000 seasonal residents, Marco Island is located in southwestern Florida. On June 6, 2005 the city council adopted a 3 block rate structure with an allocation of 6,000 gallons/month for indoor use and a 5-tier system of lot size.
Monterey District Tariff Area	Monterey, CA	Residential and irrigation accounts.	Based on number of residents and large animals.	Based on lot size and temperature zone. Eight bins.	5 tier, increasing block rate	The water budget (also known as the ECU or equivalent consumption unit) for these areas is based on the number of people in the household, the size of the lot, an allotment for large animals, and a seasonal adjustment. The formula for determining the ECU can be found at http://www.calamwater.com/awpr1/caaw/pdf/Rates_MO-1_combined.pdf
Otay Water District	San Diego, CA	Informational - irrigation only	NA	Monthly information on application rate.	NA	Had water budget program until 2000. Currently have voluntary landscape water budget program.
Redwood City	Redwood City, CA	In-process. Budgets are being developed for residential, commercial, and irrigation accounts	SF/MF – per capita allocation CII – case by case	Based on surveyed irrigated area, 100% of ET for turf, and 80% of ET for non-turf.	To be decided. Will be 4 or 5 tier structure.	Transitioning to water budget rate structure as part of conservation and drought response programs. Water budgets designed to provide customers with adequate water for reasonable use. Charges for water use within the budgets are strictly based on the cost of service, but use for water above the budgets is charged at much higher rates (both marginal costs for new firm supplies or penalty rates) with the intention of discouraging wasteful use.
San Clemente	San Clemente, CA	Residential and irrigation accounts.	SF/condo - 6.7 kgal/month MF - 4.5 kgal/unit/month	Outdoor allotment is based on irrigable area, ETo, crop coefficient for turf grass,	Seasonal, three tier increasing block rate.	Single family residents are billed monthly using a 3-tier system based on lot size. Lot size is considered in customer classification with price break points at 7,000

(continued)

Table 3 (Continued)

Agency	Location	Type of Water Budget Program	Indoor Budget Basis	Outdoor Budget Basis	Rate Structure	Program Description
				management coefficient, and effective rainfall.		square feet, 9,000 square feet and 14,000 square feet. Allotments vary with summer and winter use in each of the 3 tiers for the different lot sizes.
Santa Rosa	Santa Rosa, CA	Irrigation only	NA	{(ET- Effective precip.) x (Landscape area high use + (Landscape area medium use x 0.6)) x conversion factor}	3 tier, increasing block rate.	
SDCWA	San Diego, CA	Informational	NA		NA	Businesses participating in irrigation controller incentive programs will be enrolled in a free water budget program that informs customers of their water use in relation to a water budget equal to 80 percent of reference evapotranspiration for the landscaped area. Sites may enroll in the free water budget program even if they do not participate in the incentive programs.
Salt Lake City Dept. of Public Utilities	Salt Lake City, UT	Irrigation only	NA	Water use target based on irrigated area, ET, landscape coefficients, and demand levels.	2 tier, increasing block rate	Water used within the target is billed per unit in tier 2; water consumption exceeding the target is billed per unit in tier 3. During declared water shortages, irrigation-only accounts may be called upon to make "measurable reductions".
Southern Nevada Water Authority	Las Vegas, NV	Golf courses	NA	Between 75" and 78"/year depending on drought alert status.	4 tier increasing block rate	Water budgets are calculated based on the number of acres irrigated. This includes all lakes and ponds within the course and those used all or in part as an irrigation reservoir. Budgeted acre-feet include potable, raw, reclaimed and recycled water.
Town of Cary	Cary, NC	SF residential and irrigation	SF - 5 kgal/month	Based on landscape area, ET, rainfall, efficiency factor	4 tier, increasing block rate	Four tier rate system for single family residents – the lowest block is for water use up to 5,000 gallons – with charges increasing fairly gradually for the first 3 tiers up to 23,000 gallons. The price for tier 4 more than doubles in price. The price for the tiers is based on an average lot size of 0.25 acres and an annual irrigation allotment of 15,000 gallons.

*First identified implementation of a water budget rate structures.

**No longer current. Rate structure modifications for 2007, not reflected in this table.

Table 4 Comparison of rates and charges at selected utilities implementing water budgets

Utility	Fixed Charges (per month)	Block 1 ($/kgal)	Block 2 ($/kgal)	Block 3 ($/kgal)	Block 4 ($/kgal)	Block 5 ($/kgal)	Sewer Rate if applicable
City of Boulder, CO	$ 8.55	$ 1.88	$ 2.50	$ 5.00	$ 7.50	$ 12.50	$3.50/kgal indoor
Centennial Water and Sanitation District	$ 12.50	$ 2.30	$ 3.25	$ 5.20	$ 7.80		$10.25/month fixed plus $2.29 per 1,000 gallons
Irvine Ranch Water District, CA	$ 6.75	$ 1.00	$ 1.22	$ 2.42	$ 4.87	$ 9.73	Residential: $9.80 - $13.05/month depending upon usage CII: $15 for first 7.5 kgal and $1.22 for each additional kgal.
Los Angeles DWP (seasonal rates)		$2.85 - $2.99	$3.40 - $4.27				$3.81/kgal indoor
Capistrano Valley Water District, CA	$ 11.42	$ 3.03	$ 3.89	$ 6.22			15.42/month
Town of Cary, NC	$ 2.76	$ 3.28	$ 3.75	$ 5.33	$ 10.83		$4.41/kgal
San Clemente, CA	$ 7.26	$ 1.63	$ 2.44	$ 3.66			$16.27/month (fixed)
Marco Island, FL	$ 24.11	$ 3.02	$ 4.53	$ 6.04			$19.67/month fixed plus $3.91/kgal (6 kgal max)
Monterey Area Tariff District, CA	$ 6.91	$ 2.19	$ 4.38	$ 8.76	$ 17.53		

Table 5 Barriers to implementing a water budget-based rate structure

Potential Barrier	Questions to answer	Implication
Data requirements for developing defensible water budgets	Do your conservation programs use water budgets for any outdoor water use efficiency programs? Do you have or can you obtain access to public information (tax assessor data) on lot size, home size, etc.? Can parcel-level data be obtained from your GIS?	Data required for water budgets may already exist in local databases or GIS. Consistent customer-specific data may be available at low cost.
Customer billing system requirements	Can the current customer billing system implement an increasing block rate structure? Is the current customer billing system using software capable of relational database functions?	Current billing system may have sufficient capability. Many customer billing systems do have functional capability. Typically only a few calculated fields are required for water budget-based rate structure implementation.
Compatibility of water budgets with cost-of-service principles	Does your utility have customer classes defined? Does the current rate structure differentiate by customer class? Does the current rate structure implicitly or explicitly allocate revenue requirements by customer class?	Customer class definitions are required for customer class-based rates. Cost-of-Service practices do not require cost allocation by individual customer, only customer class
Pre-implementation customer communication	Are any of your customers familiar with the concept of water budgets? What kind of customer involvement process has been used in the past for rate reform? Are citizen representatives part of the rate structure review process? Is the press covering the rate structure issue?	It is important to understand beginning level of customer understanding and community values Customers may already be familiar with the concept of water budgets. Public involvement in rates is increasingly important (See AWWA 2004 Avoiding Rate Shock)
Ongoing customer communication	Does your customer bill currently communicate information on appropriate levels of water use? What are your current staffing levels for answering and responding to customer queries?	Customer bill redesign is often required This is both a customer service issue (responding to bill complaints) and a conservation outreach issue.

Note: This table is predicated on the assumption that a need/desire for water budget-based rates has been established and that the prospective benefits can be greater than prospective costs. Early identification of potential barriers can speed the development of cost effective solutions and increase the effectiveness of water budget-based rates.