# Water Budget-Based Rate Structures – Powerful Demand Management Tools

Peter Mayer, P.E.
Aquacraft, Inc.
2709 Pine St.
Boulder, CO 80302

January 2009

Author Biography:

Peter Mayer is a professional engineer who has dedicated his career to advancing the science of water efficiency and demand management. For the past 14 years Peter's work has focused on studying urban water use patterns and determining the impacts of water conservation measures and programs. He was the lead author for the American Water Works Association Research Foundation "Residential End Uses of Water" study and a key contributor to the companion "Commercial and Institutional End Uses of Water" study. More recently Peter has completed studies on the impacts of submetering and third party billing programs in multi-family housing, water budget-based rate structures, and he has helped develop the US EPA's new WaterSense program. Peter has also assisted with the creation of the Alliance for Water Efficiency organization and is currently working to develop content for their new clearinghouse web site.

Peter is a trustee of the AWWA Water Conservation Division and served as chair of the WaterWiser Steering Committee. He also edits a bi-monthly on-line water efficiency newsletter. He lives in Boulder with his wife Amanda, two sons (Zach and Miles), and dog Meena. His hobbies including playing electric and acoustic guitar, skiing, mountain biking, movies, and reading.

## INTRODUCTION

Water budget-based water rates—also known as individualized, goal-based, and customer specific rates—are inclining block rates where the block size 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. Once thought to be impractical because of technological constraints, water budgets tied to an increasing block rate structure have been successfully established in more than 20 water utilities in the United States. As utilities continue to build advanced customer and geographical information systems, customer-specific rate structures can be more easily developed and implemented.

Water budget rate structures are attractive to water providers seeking stable revenue generation, a high level of customer acceptance, water use efficiency, affordability of nondiscretionary use, and effective drought response. Water budgets appear to offer real and tangible benefits for effectively and equitably managing water scarcity and rising costs.

Water budgets have been implemented in North America for nearly 20 years, but until recently had only been used by a handful of utilities. In 2009, more utilities are considering innovative tools for water conservation and drought response to help cope with population increases and climate change. Water budget-based rate structures are an effective tool that can be used to provide a meaningful price signal to customers, reduce water waste, increase efficiency, and manage drought response sensibly and fairly.

This article presents the results of a research study funded by grants from the EPA, the American Water Works Association Research Foundation, and a consortium of water utilities that was completed in 2007 (Mayer et. al. 2007, 2008). The full report which contains much

greater detail and useful case studies is available from the American Water Works Association at www.awwa.org.

## DEFINITION OF A WATER BUDGET

A water budget is the quantity of water that would be required by an efficient level of water use (Mayer, et. al. 2007). Determining the specifics of "efficient level" of use is an important decision that must be based an a number of factors including cultural expectations and the available water supply. From the perspective of the water provider, water budgets must be clearly and specifically defined so that customers understand how the budget allocation applies.

The City of Boulder, Colorado defines water budgets as follows: "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 frequently implemented form of a water budget. A landscape water budget is usually a volume of water that is calculated from: the landscape area of the property and the water requirement of plants in that region typically represented by the evapotranspiration (ET) rate.

Indoor water budgets are often a fixed volume provided each month based on the anticipated needs of the customer or a benchmark use level established for the customer class. Indoor water budgets can be adjusted 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.

Water budget-based water rates have been implemented in California by diverse communities like Irvine, Oakland, Santa Barbara, Los Angeles, and San Juan Capistrano. The water providers in these cities are all confronted with limited water supplies or frequent supply shortages. Field evidence from their implementation reveals both advantages and disadvantages of water budget-based rates.

Advantages: These rates have been considered an equitable way to share limited water supplies while preserving some amount of customer choice. Both customers and water utility staff believe a key strength is their perceived fairness (Pekelney and Chesnutt, 1997). Implementing water budget-based rate structures can result in closer working relationships between providers and customers while coping with water supply constraints.

Modern utility billing systems that are database-driven are often easily adapted to include water budgets. Water budget rate calculations are not complex and usually only require the inclusion of a few additional fields and calculations in a utility billing database.

Disadvantages: Water budget-based rates may have higher implementation costs including a billing system that can accommodate the rate structure and customer level information that must be obtained. Additional staff time may be required for implementation. Customer service representatives must be prepared to handle questions and problems that may

arise as customers may be unfamiliar with the billing methodology. 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 Budget-Based Rate Structures Differ for Each Provider**

Utilities and their rate structures are unique. In this study, the water budget-based rate structures examined were different for every example the researchers identified. Only a few water budget utilities developed a unique water budget for each customer. Most utilities opted to use water budgets for only certain customer classes (such as single-family residential or dedicated irrigation) and some use water budgets only for informational purposes in which the budget is not linked to the rate structure.

Most water providers offer a process to alter water budgets for specific unique cases such as large families, medical needs, extra irrigated area, or other factors.

**Landscape Water Budgets**

The original formulation of these rate structures was the landscape water budgets. These remain the foundation of most implementations studied. The concept of calculating the volume of water required to adequately irrigate a plot of land is not new. In agriculture, water budgets have been used for many years. Evapotranspiration measurements are typically used to determine the required irrigation applications to maximize plant growth. For municipal providers, water budgets are created to establish irrigation efficiency for city parks and large irrigated parcels. Water budgets have been used since 1989 in concert with inclining block rate structures to deliver a customized price signal based on actual the irrigation needs of the site.

Landscape water budgets are usually based on two factors:

- Landscape area
- Irrigation requirement

In Douglas County, Colorado, the Centennial Water and Sanitation District bases their outdoor water budgets on these two factors. Budgets are based on 27 inches of water (the historic average) applied across 45% of the measured total lot area for an entire year. The budget allotment is distributed through the irrigation season (April – October in Colorado) based on the historic evapotranspiration curve.

More elaborate water budget formulations that include factors such as effective precipitation are also utilized. 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 aerial photographs or GIS mapping. Other agencies use tax assessor records. The Los Angeles Department of Water and Power (LADWP) has five lot size groups that customers are based on tax assessor records. LADWP also uses the postal code to place each customer into one of three temperature zones used to adjust the allocation.

Critics argue that landscape water budgets encourage excessive use by those with large lots. The City of Boulder, Colorado addressed this 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. In Boulder. 10 gpsf, 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 can use as much water as they want, but if they exceed their budget the price increases steeply.

Evapotranspiration provides adjustment factor in the formulation of landscape water budgets. Providers often use the historic average ET rate to calculate water budgets. This approach has the potential to allot an excessive volume in wet years and an insufficient volume in dry years. Real-time ET measurements provide an alternative. The Irvine Ranch Water District (IRWD) and the Capistrano Valley Water District, two of the originators of the utility water budget-based rate structure concept use prevailing ET data to adjust the irrigation allotment for their customers. It is customary to inform users of the volume of water allocated to the upcoming billing cycle on each water bill, and both IRWD and Capistrano provide an estimate of this value and then adjust the actual budget based on prevailing conditions.

**Indoor Water Budgets**

Indoor water budgets are typically formulated by customer class such as single-family residential, multi-family residential, commercial, etc. Creating indoor budgets for the residential sector is relatively easy, but the commercial, institutional, and industrial (CII) sector poses a challenge.

***Residential – Single-Family.*** Single-family water budgets are often based on the average volume consumed by the customer class in that particular agency. Single-family indoor budgets range from 5 to 7 kgal per month depending upon the agency.

***Residential – Multi-Family.*** Multi-family water budgets are developed like single-family budgets, but on a per unit basis. Creating a water budget for multi-family customers

requires the data on the number of units at each multi-family property. Multi-family indoor budgets range from 4.4 to 5 kgal per unit per month depending upon the agency.

***Commercial, Industrial, and Institutional (CII).*** Only a handful of agencies include CII customers in their water budget rate structure program. CII budgets often rely on historic usage patterns to establish a baseline budget. This approach is problematic as it rewards customers whose use is historically inefficient with a generous water budget. 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 data intensive and impractical. As water budget rate structures develop over time, alternative methods for creating CII water budgets will be developed.

## CONCLUSIONS AND RECOMMENDATIONS

### *Does a Water Budget-Based Rate Structure Make Sense for the Utility?*

Water budget-based rate structures require more customer level data and implementation may be more expensive than an more standard increasing block rate structure. If water conservation is not a goal of the water provider then water budgets will be much less attractive. For those serious about water conservation and sending a fair and effective price signal, water budgets are an excellent option to consider.

### *Commit, Educate, Implement*

The entire water agency must support the implementation process. A water budget-based rate structure involves all levels of a water agency from governing board and general manager to information systems, public affairs, and of course the customers. Coordination, communication, and education with all involved is essential. A thorough understanding of the motivation and operation of the water budget system by all levels of the utility organization will increase effectiveness and allow the program to be improved over time.

***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. 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.

***Information is Essential***

Educating customers about the water budget-based rate structure is essential. Customers need to understand not only how the rate structure works and will impact them, but also why it is being implemented.

***Address Customer Concerns***

The water utility should be prepared to make adjustments to the water budget 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 a customized rate structure, customers expect to be treated as individuals. Budget adjustments and variances with reasonable cause are important for achieving customer acceptance and buy-in to the program.

***Establish Budgets Objectively***

Water budgets 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.

***Implement 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.

***Water Budgets Can Enhance Drought Response***

Water budgets have tremendous potential to assist with supply shortages such as drought. They provide an easy means of 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.

**Comparison of water rates and charges at selected water providers 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 |
|---|---|---|---|---|---|---|---|
| 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<br>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 | | |
| 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 |

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