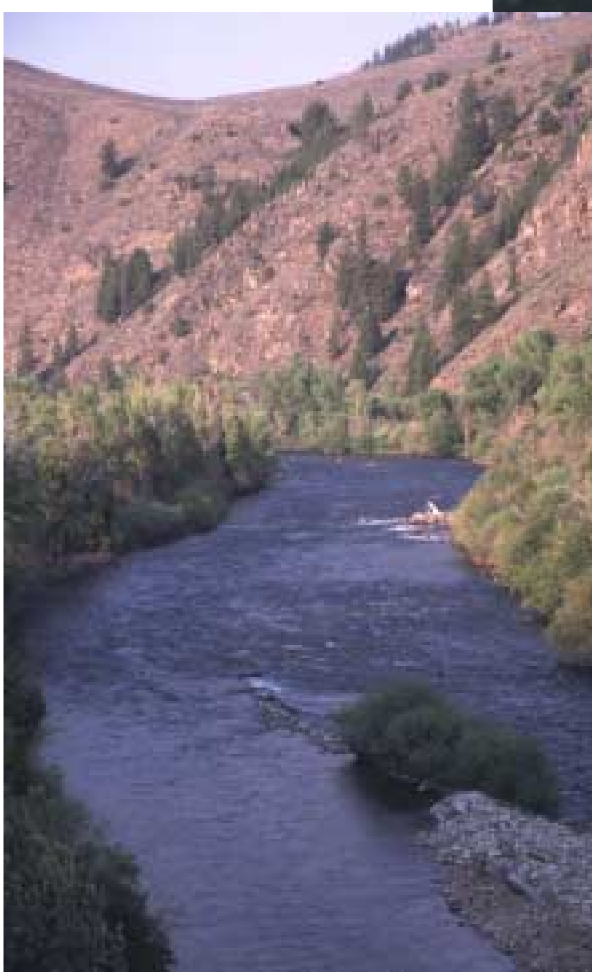
Water Rate Structures in Colorado:
How Colorado Cities Compare in Using this Important Water Use Efficiency Tool



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This report was prepared by Western Resource Advocates with cooperation from the Colorado Environmental Coalition and the Western Colorado Congress. Please contact any of these organizations for hardcopy or electronic versions of the report.

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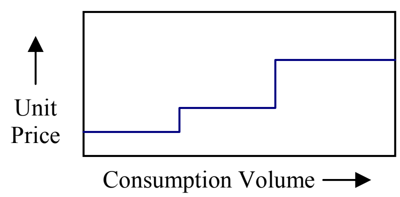
Executive Summary

In semi-arid Colorado, our precious rivers, streams, and aquifers sustain our cities and towns by feeding our urban water supply systems. With a finite supply, Colorado citizens, policymakers, and water utility managers must fulfill the dual role of ensuring water in our taps and water in our rivers, as Coloradans place a high value on both.

Water rate structures play an essential role in communicating the value of water to water customers, thus promoting long-term efficient use. The value of water includes: (1) the utility's operation and maintenance costs; (2) costs to procure and develop additional water supplies to meet growing demands; and (3) social and environmental "opportunity costs" of losing other benefits of the water and natural waterways.

Increasing block rate structures most effectively communicate this message and encourage efficient water use when compared to other types of rate structures. Through this increasing block rate design, the unit price for water increases as the volume consumed increases, with prices being set for each "block" of water use. Customers who use low or average volumes of water are charged a modest unit price and rewarded for conservation; those using significantly higher volumes pay higher unit prices. A variety of approaches can be applied to setting each block volume.



In a broader regional study, we found a close correlation between cities with dramatically increasing block rates and those with the lowest *per capita* consumption levels.[1] Along with other conservation and efficiency programs, effective rate structures can help stretch existing water supplies further and avoid much of the cost, delay, and controversy that result from large new water development projects. If designed appropriately, increasing block rates:

- Encourage efficient use by sending a strong conservation price signal;
- Reward conserving customers with lower unit rates for water;
- Assign water supply and development costs proportionately to the customers who place the highest burden on the supply system, and the rivers that feed the supplies;
- Provide water at low prices for basic and essential needs, so all customers can afford it; and
- Do all of the above while still maintaining a stable revenue flow to the utility.

Colorado communities use a wide variety of water rate structures, ranging from very aggressive, efficiency-based designs to rate structures that actually promote inefficient water use. Some have incorporated increasing block rate designs, but have set the block prices and volumes in ways that do not effectively promote efficient water use. Although many Colorado cities and towns have come a long way in developing and instituting efficiency-based rate structures, many still have a lot of room for improvement.

[1] Western Resource Advocates, *Smart Water: A Comparative Study of Urban Water Use Efficiency Across the Southwest*, December 2003, at 74-86.

Introduction

Water rate structures are becoming an important tool for encouraging the most efficient use of our precious water in the arid West. Many cities with water rate structures that accurately reflect the value of water and the costs of obtaining new water supplies have lower per capita water use and can stretch existing water supplies further. These cities are able to avoid much of the cost, delay, and controversy that accompany large new water development projects. As a result, they're able to preserve the natural river systems that support so much of our quality of life and outdoor experiences here in the West.

This paper offers a guide to the various pricing options that urban water managers and policymakers can use. It explains which options generate the strongest incentive for efficient water use and yield the fairest billing for consumers who place different levels of strain (demand) on water supply systems. It then compares water rate structures in communities along Colorado's Front Range and on Colorado's Western Slope.

What Is a Water Rate Structure?

Like retailers of commodities such as electricity, municipal water utilities sell their product (treated water) to their customers, and charge the customers to generate revenue to cover the cost of the product and the cost of the operation and maintenance of its supply and delivery system. Municipal water utilities set the prices for their retail water sales through their *water rate structures*. If designed appropriately, water rate structures communicate the true cost of water to the consumer. They can also play an important role in setting price incentives that promote indoor and outdoor water conservation. Unfortunately, many water rate structures in Colorado cities and towns do not yet effectively accomplish either of these objectives.

Water rate structures are extremely important in promoting efficient water use, since water consumption levels are directly related to the price signals sent by rate structures. Many people assume that establishing a conservation price signal in a water rate structure translates to higher water bills for most customers. However, this is not necessarily the case. In fact, under some structures, conserving households can actually save money. Innovative rate structures can promote efficient water use while maintaining an equitable and reasonable charge to customers. At the same time, well-designed rate structures can also provide the utility with a reliable revenue flow that covers its operation and maintenance costs.

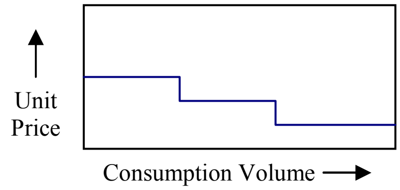
What Are the Different Types of Water Rate Structures?

Most water rate structures are made up of two charges. Both charges play a role in determining how effectively a water rate structure communicates an efficiency message to the customer.

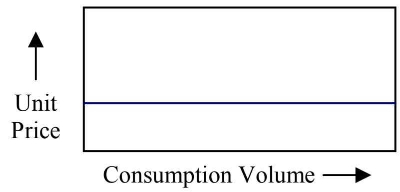
- **Service Charge** = The fixed service fee per billing period, regardless of consumption level.
- **Consumption Charge** = The price for each unit of water consumed.

With these two charges as a basis, the water supply industry uses four general types of water rate structures. However, many variations exist within some of the categories. In addition, some cities and utilities apply hybrid rate structures that combine different components of the four basic types. The unit prices discussed here refer to the consumption charges for water sold to each customer, and do not reflect the service charges. These consumption charges, or *marginal prices*, reflect the price for using the next measured amount of water, often set as dollars per 1,000 gallons or dollars per 100 cubic feet of water.[2]

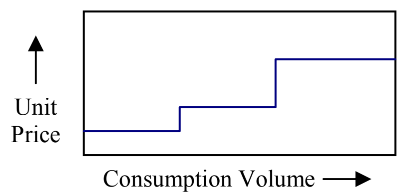
Decreasing Block Rates: The unit price for water decreases as the volume consumed increases. The structure consists of a series of "price blocks," which are set quantities of water sold at a given unit price. The unit prices for each block decrease as the price block quantity increases.



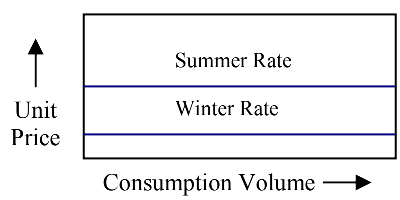
Uniform Rates: The unit price for water is constant, or flat, regardless of the amount of water consumed.



Increasing Block Rates: The unit price for water increases as the volume consumed increases. This structure consists of a series of price blocks, where the unit prices for each block increase as the block volumes increase. Those who use low or average volumes of water will be charged a modest unit price; those using excessive volumes will pay higher unit prices. A variety of approaches can be applied to setting each block volume.



Seasonal Rates: The unit price for water is set to vary from season to season. Summer water rates are typically higher than winter rates in order to reflect the fact that water is more valuable, and costs more to provide, in the summer.



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[2] Some smaller communities still use a flat consumption charge for all customers (i.e., not metered per unit of individual consumption), since individual metering systems are not adequate or in place.

How Do Water Rate Structures Relate to Efficient Water Use and Conservation?

To promote efficiency, water rate structures must communicate the true cost of water. Only if the price of water reflects the economic value of water will customers know whether it is "worth it" to conserve water. The true economic value of water includes: (1) the utility's operation and maintenance costs; (2) the costs to procure and develop additional water supplies to meet growing demands; and (3) the social and environmental "opportunity costs" of losing other benefits of the water in order to develop and consume the water (e.g., ecological and recreation values of river basins, local/community economies, values of river flows for diluting pollutants, etc.). Failing to integrate all of these social and environmental costs into a water rate structure is equivalent to subsidizing the cost of water. Furthermore, if the retail price of water is lower than its value, customers have an incentive to use too much of it.

Often a utility's "marginal" costs—the costs of meeting an increase in water demand with additional supplies—serve as a useful proxy for the value of water. If efficiency is a priority—and under conditions of limited water supply and increasing population, it should be—it is imperative that water rate structures send accurate signals about water's value. If a utility's rate structure accurately reflects its marginal costs, it should encourage efficiency. In other words, water use efficiency means saving water when doing so costs less than the value of the water saved. Although there are costs associated with saving or conserving water, these conservation costs are often lower than the total economic costs associated with developing and using water. Such factors usually include the cost of acquiring new water supplies, environmental costs, and social costs, among others.

Innovative rate designs can promote efficient water use and still assure revenue stability for the utility. Water utilities are confronted with the challenge of recovering supply costs with revenues from water sales. System maintenance, facility operation, and procuring and developing future supplies all contribute to the utility's costs. With the exception of tax-based subsidies in some districts, most of these costs are recovered via the water rate structure, tap fees, and other surcharges. Given this arrangement, utilities have an inherent disincentive to promote conservation, since utility revenues are driven by higher water sales. However, water rate structures can be designed in ways that yield relatively stable and sufficient revenue flows, while still promoting efficient water use.

Which Types of Rate Structures Promote the Most Efficient Water Use?

The *increasing block rate structure* most effectively encourages efficient water use. An increasing block rate structure is set up to charge higher unit prices to customers who place a higher demand or strain on the water supply system, and to charge lower unit prices to customers who use average amounts of water or, through indoor and outdoor conservation, use below-average amounts. This design is also fundamentally fair, since customers are charged on the basis of the costs or burden they impose on the utility. Because high-volume users expedite the need for infrastructure upgrades and new supply procurement, these high-volume customers are more expensive for the utility to maintain. It would be unfair to pass the costs generated by these relatively few customers on to those who use more moderate amounts. If designed correctly, increasing block rate structures reward customers for conservation.

Increasing block rate structures can maximize efficiency if the block volumes are individually customized to the specific water needs of each customer—this is called a *water budget rate structure*. Under this design, each customer is assigned a monthly allotment of water based on the customer's lot size, irrigable area, climate conditions, and household occupancy. In most cases, the monthly allotment, or budget, provides enough water for each customer to sustain normal indoor uses as well as basic landscape irrigation needs[3]. If the customer exceeds the monthly water budget, the excess water use is charged at notably higher unit prices (as with the standard increasing block rate structure).

The *seasonal rate structure* also provides a conservation price signal when moving from winter to summer. This design charges a higher unit rate in summer, when outdoor and other discretionary water uses are the highest. However, on a day-to-day basis within a particular season, the seasonal rate structure does not provide a price incentive for conservation because the unit price is constant regardless of the amount of water consumption each month. An exception to this rule occurs when the seasonal rate changes incorporate increasing block rates (e.g., uniform winter rate and increasing block summer rates).

The *uniform rate structure* and the *decreasing block rate structure* provide no price incentive for water conservation. Although a customer's overall bill will increase as water consumption increases in both of these rate structures, the unit price for water remains constant or decreases, respectively. Thus, the consumer has little or no price incentive to conserve, and in the case of the decreasing block rate structure, the consumer actually has a price incentive to use more water. This results in waste.

What Other Factors Affect a Water Rate Structure Design?

Equity for the Customers

Rate structures need to charge all customers equitably. This is often a challenge, given the wide variety of customers in any particular water district or service area. To meet this challenge, utilities must provide fairly and reasonably priced water to all customer types (i.e., from small volume users to large volume users) and across all customer sectors (i.e., residential, commercial, industrial, etc.). Increasing block rate structures meet the criteria for fairness: they charge customers on the basis of the amount of water they consume and also ensure that all customers can afford to pay for water to meet basic needs. This design is inherently fair and reasonable because customers are charged according to the strain they impose on the utility's water supply, which can eliminate the subsidy to the high-volume users.

Revenue Stability for the Utility

Rate structures must be designed to ensure that the utility recovers its costs from year to year. A rate structure that will not allow a utility to recover its operation and maintenance costs will require a subsidy to the utility, typically at the taxpayers' expense. This often occurs when the utility prices the water at or below its average cost of collecting, storing, treating, and delivering the water. Conversely, a utility generally is not allowed to raise revenues that exceed its *costs of service*. Therefore, setting fixed service charges and consumption charges must be coordinated with customer demand projections to generate a revenue flow consistent with utility costs, which include operation, maintenance, as well as conservation program costs.

[3] Maximum water budget allotment limits can be set to avoid excessive water allotments to large lot owners. This would minimize the inequity of allocating water based on wealth (measured via lot size ownership). It would also remove the indirect incentive of buying or creating larger lots to retain larger water allotments. However, the political palatability of allotment limits will vary from community to community.

What Factors Can Weaken the Effectiveness of a Water Rate Structure?

High Fixed Service Charges

High fixed service charges can weaken the intended conservation effect of an increasing block rate structure. Setting appropriate fixed service charges is as important as setting consumption charges. When compared to consumption charges, fixed service charges offer a much more consistent revenue stream for a utility to cover its operation and maintenance costs. As a result, water utilities often prefer setting higher fixed service charges. However, a high fixed service charge coupled with relatively low consumption charges can encourage wasteful consumption—much like a "pay by the plate" dinner buffet.

In combination, both the service charge and consumption charge directly affect the *average price* for the water. The average price, which is what consumers see reflected in their bills, is defined as the monthly service charge plus the total consumption charges, divided by the total consumption volume. The average price directly affects consumption patterns, because the consumer typically responds to the bottom lines on their bills. When fixed service charges are factored into an increasing block rate structure, a conflicting message can result. According to studies by the American Water Works Association Research Foundation, "fixed service charges can offset the conservation incentives of increasing marginal rates."[4] This phenomenon occurs quite often when relatively high fixed service charges are applied along with relatively small block price increases.

If the block price increases are too small and/or the fixed monthly service charges are too high, the average price curve often declines and eventually becomes uniform, or flat. From the perspective of the customer's pocketbook in this scenario, each additional unit of water purchased will more or less have a constant price attached to it, even if the block prices (marginal prices) are increasing. When this occurs, the consumer will not experience any noticeable conservation price incentive.[5]

Customer Price Insensitivity as a Result of Minimal Consumption Charge Increases

Increasing block rate structures can also be ineffective in promoting efficient water use if the block price increases are small. This is especially true in districts with an abundance of low-density, residential development, particularly areas with affluent neighborhoods and large, irrigated yards. Even a small population of "high-volume" residential water customers can consume more potable water than a large population of "low-volume" users combined. Excessive landscape irrigation and other discretionary water uses employed by high-volume residential customers account for this disparity. Unfortunately, a modest increase in block prices does not instill a strong enough price incentive for this customer class. For example, a $0.20 block increase (per 1,000 gallons) does not create the incentive to dissuade a high-volume residential user from being wasteful with lawn irrigation practices. This hypothetical consumer would only pay an additional $2.00 for using 10,000 more gallons in this block.[6]

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[4] Ari Michelsen, J. Thomas McGuckin, and Donna M. Stumpf, ***Effectiveness of Residential Water Conservation Price and Nonprice Programs***, American Water Works Association Research Foundation (AWWARF), 1998, at 13.

[5] "A rate structure with increasing marginal prices while the average price is declining sends mixed signals to consumers about their economic incentives to conserve water. Rate structures with any service charges, and in particular relatively large service charges in relation to the per unit cost and total water bill, are apt to create these mixed price signal conditions.", AWWARF at 13-14.

[6] The challenge that many water utilities face is setting block prices that will have a significant effect on high-volume use and high income brackets without creating an inequity, or regressive tax, on lower income brackets. An aggressive increasing block rate structure appears to be the most ideal tool for this socioeconomic conundrum. This design would charge substantially higher unit prices for high-volume use, while the low-volume use for basic needs would be charged at a much lower, more affordable rate.

Billing Frequency and Communication to Customer

Customers' response to water rates is also influenced by the billing cycle and the ability to track their use. For example, bi-monthly billing cycles can be counter-productive to water conservation efforts. Customers interested in conservation or saving money adjust their home water use on an incremental basis, in response to the consumption reported in each billing statement. This practice is particularly common during the summer irrigation months, when urban water use peaks. With a bi-monthly billing cycle, the summer can be half over by the time customers are notified of their recent consumption quantities. This may preclude many customers from making more efficient water use decisions earlier in the summer during the high water use months.

Customers are more likely to practice water conservation if they have easy access to their account information. Although billing statements typically summarize each household's water use during the previous month period, other opportunities could be made available on a more frequent basis. For example, as computerized utility accounting systems become more streamlined and modernized, it will be possible to provide real-time account access via the utility website. In-home remote meter-monitoring technology is also becoming available to the market. With these types of customer-interaction tools, customers will have the opportunity to monitor daily or weekly water use trends and adjust their water use accordingly.

What Should I Look for When I Evaluate My City's Water Rate Structure?

When analyzing water rate structures and billing policies, ask the following questions:

- Do the consumption charges, or marginal prices, send a conservation price signal that clearly demonstrates that water conservation yields lower water bills?
- Does a high monthly service charge decrease the customer's incentive to conserve?
- Are the consumption charge increases in an increasing block rate structure noticeable to all customers, or are high-volume water users insensitive to the modest block price increases?
- Do the water rates reflect the true value of water, incorporating system operation costs, social costs, environmental costs, as well as the costs for acquiring future supply sources?
- Does the billing frequency and statement summary enable the customer to effectively monitor water use and conservation?

As with most public affairs, local socioeconomic trends and variables must be considered when assessing appropriate water policy implementation. For example, an effective price structure in one community may be ineffective or regressive in another community, depending on the socioeconomic status and demographic makeup.

How Do the Water Rate Structures Compare Across Colorado's Front Range?

In late June of 2004, we gathered water rate data from twelve municipal water utilities on the Front Range of Colorado. This sampling provides a good cross-section of water providers along Colorado's Front Range, both in terms of geographic distribution and community size. Although the variation in rate structures used across Colorado can be seen as a rough indication of how each city prioritizes water conservation, each utility has a different water supply situation and different costs associated with these supplies. Therefore, rate structures can be expected to vary somewhat regardless of each city's commitment to conservation. Table 1 lists the components of each rate structure that was implemented by these water providers as of June 22, 2004 in these water service areas. Please note that some of these municipalities were in the process of reassessing their water rates at the time of this publication.

The majority of the water providers in the analysis sample applied some form of an increasing block rate structure (Aurora, Boulder, Colorado Springs, Denver, Fort Collins, Highlands Ranch, Longmont, Thornton, and Westminster). This widespread use was not the case just a few years ago when uniform rate structures were more common. We can be encouraged by the fact that many Front Range cities are taking steps towards promoting efficient water use through their rate structures. However, we do see significant variations in the design and aggressiveness of these increasing block rate structures. Given the issues raised in the previous section regarding marginal prices and average prices, take note of *both* the fixed service charge and the consumption charge for each municipal utility, and consider the potential effect of both of these charges on water consumption trends. Also, take note of the wide variation in block prices and block volumes in the cities with increasing block rates. You will also notice that Colorado Springs uses both a seasonal rate structure and an increasing block rate structure combined, with the increasing block rates only being applied from April through October.

Three water providers (Greeley, Loveland, and Pueblo) apply uniform rate structures that do not convey any conservation message to the customer since all customers pay the same unit price for water, regardless of how much they use.

Table 1
Water Rates for Residential Accounts (3/4"- 1" Services), as of June 22, 2004
Colorado - Front Range Municipalities

Municipality [Water Provider]	Rate Structure Type	Fixed Monthly Service Charge	Consumption Rate: Unit Rate per 1,000 Gallons of Water Consumed
Aurora (City of Aurora Utilities Dept.)	Uniform with Increasing Block Rate Drought Surcharge (Water Budget) *(a)	$3.79	Base rate: $2.69 *(a) $3.34 – up to MWB ($0.65 surcharge) $5.01 – from MWB to AHU ($2.32 surch.) $6.68 – over AHU ($3.99 surch.)
Boulder [City of Boulder Utilities Div.]	Increasing Block Rate (AWC) *(b)	$8.12	$1.65 – up to AWC *(b) $3.30 – from AWC to 350% AWC $5.50 – over 350% AWC
Colorado Springs [Colorado Springs Utilities]	Seasonal & Increasing Block Rate	$5.40	Nov.-March: $2.26 April-Oct.: $2.26 – up to 7,480 gal. $3.52 – from 7,480 to 22,440 gal. $4.13 – over 22,440 gal.
Denver [Denver Water]	Increasing Block Rate	$2.45 *(c)	$1.63 – up to 11,000 gal. *(c) $1.96 – from 11,000 to 30,000 gal. $2.45 – over 30,000 gal.
Fort Collins [City of Fort Collins Utilities Dept.]	Increasing Block Rate	$12.72	$1.78 – up to 7,000 gal. $2.14 – from 7,000 to 13,000 gal. $2.57 – from 13,000 to 20,000 gal. $3.07 – over 20,000 gal.
Greeley [Greeley Water & Sewer Dept.]	Uniform	$6.75	$1.91
Highlands Ranch [Centennial Water & Sanitation District]	Increasing Block Rate (Water Budget)	$12.50 *(d)	$2.00 – up to 100% water budget *(d) $3.00 – from 101 to 120% water budget $4.50 – from 121 to 140% water budget $6.75 – over 140% water budget
Longmont [City of Longmont Water & Wastewater Dept.]	Increasing Block Rate	$2.30	$2.53 – up to 10,000 gal. $2.91 – from 10,000 to 20,000 gal. $3.41 – over 20,000 gal.
Loveland [Loveland Water and Power Dept.]	Uniform	$5.43	$1.50
Pueblo [Pueblo Board of Water Works]	Uniform	$7.15 (incl. 2,000 gal.)	$1.64 – over 2,000 gal.
Thornton [City of Thornton Water Dept.]	Increasing Block Rate (AWC) *(e)	$2.88	$3.00 – up to AWC *(e) $3.00 – from AWC to (AWC + MOA) $4.50 – from (AWC+MOA) to (AWC + 2 x MOA) $9.00 - over (AWC + 2 x MOA)
Westminster [City of Westminster Dept. of Public Works & Utilities]	Increasing Block Rate	$4.70	$1.95 – up to 4,000 gal. $2.95 – from 5,000 to 20,000 gal. $4.25 – over 21,000 gal.

Notes: (a) AHU = Average Historical Usage (avg. monthly use in 2000 and 2001)
MWB = Monthly Water Budget (equivalent to 70% of AHU)
Also note, Aurora's water budget rate structure is considered a "Drought Surcharge", so its long-term application is in question.

(b) AWC = Average Winter Consumption (on a monthly basis). Individual blocks are calculated for each customer, based on their AWC. In Boulder, the average residential AWC is roughly 5,000 gallons per month. AWC is typically measured from December through March.

(c) Denver Water implements a bi-monthly billing cycle with a bi-monthly service fee of $4.91 (June 2004). To maintain consistent analysis, Denver Water's fixed charges and block volumes in this table have been converted to monthly figures. These rates are for "in-city" customers.

(d) The Centennial Water and Sanitation District (CWSD) implements a bi-monthly billing system with a bi-monthly service fee of $25.00. To maintain consistent analysis, CWSD's fixed charge and block volumes in this table have been converted to a monthly figure. CWSD assigns an individual bi-monthly water budget to each customer based on household occupancy and lot size. For the average residential account (three person household, with a 7,500 square foot lot), CWSD allocates 6,000 gallons per month for indoor use and between 500 and 13,500 gallons per month for outdoor use (with outdoor allotment variation depending on the irrigation needs of each bi-monthly billing period).

(e) AWC = Average Winter Consumption (November through February). In Thornton, the average residential account AWC is 5,000 gal./month. MOA = Monthly Outdoor Allowance (allowance usage in June is set at 20,000 gal. for residential customers in Thornton)

The variations in the nine increasing block rate structures can be broken down into two categories:

(1) Price blocks based on fixed or uniform consumption volumes (Colorado Springs, Denver, Fort Collins, Longmont, and Westminster); and
(2) Price blocks based on some form of water budget volume allotment or previous customer use volume (Aurora, Boulder, Highlands Ranch, and Thornton).

The increasing block rate structures that apply to the first category set unit prices for each fixed volume of water in each block. Water is charged at a higher unit rate as consumption volumes increase, regardless of a customer's lot size, household size, or previous water use patterns. The customers that place a higher strain or demand on the supply system pay a higher unit rate for their water. In turn, this increase sends a conservation price signal to the customers….use less, and pay less per unit.[7]

The cities in the second category above use designs that are also based on an increasing block rate system. However, instead of using fixed, city-wide consumption volumes to partition each block rate for all customers, individual block volumes are established for each customer depending on that customer's particular use patterns or needs. Cities in this category use varying degrees or derivatives of a water budget rate structure. These types of rate structures serve two price incentive objectives. First, as with standard increasing block rate structures, efficient and/or low-use customers pay a lower unit rate, while inefficient and/or high-use customers pay higher unit rates. Secondly, the use of a water budget baseline builds an additional incentive into the water pricing. This approach provides an estimate of a customer's average or essential water use volume per month and sets the consumption charges according to how a customer consumes relative to their normal or essential needs. In essence, each account has its own water rate structure attached to it.

Aurora, Boulder, and Thornton apply simplified derivatives of water budget rate structures. For example, Aurora uses Average Historical Use (AHU) to establish a baseline monthly use volume for each customer. Aurora's consumption block volumes are then based on a percentage of the AHU. To promote conservation, Aurora sets its first "Monthly Water Budget" volume at 70% of the AHU. The next two blocks capture the volume of use up to and exceeding the AHU volume, respectively. Another variable for setting block volumes is Average Winter Consumption (AWC), as applied by Boulder and Thornton. The AWC for each individual account is intended to measure a customer's monthly water use in winter, the time of year when the vast majority of consumption is for basic and essential indoor uses. Then as the irrigation season carries on from spring through fall, the difference between the irrigation season monthly water use and the AWC establishes a rough estimate of this customer's outdoor or discretionary water use. The block volumes are established accordingly, with the AWC as the base variable. Since indoor uses are typically more essential than outdoor uses, water utilities in these cities are attempting to apply increasing block rates to customers who use larger amounts of outdoor water use.

Highlands Ranch (Centennial Water and Sanitation District) uses a true water budget rate structure as the basis for its increasing block rates. As described in previous sections, a "true" water budget rate structure not only establishes individual block volumes for each customer, but also sets these volumes according to a reasonable amount of water needed by each individual customer for basic indoor and outdoor water

[7] Using Westminster as an example of an increasing block rate structure, a customer pays $4.70 for the monthly service charge, in addition to paying $1.95 per 1,000 gallons for the first 4,000 gallons used, $2.95 per 1,000 gallons for the next 15,000 gallons used (between 5,000 and 20,000 gallons total), and $4.25 per 1,000 gallons for any water use that exceeds 21,000 total gallons. Cutomers who don't use much water or conserve significant amounts of water will rarely pay more than $2.95 per 1,000 gallons in Westminster. Whereas, customers who use a significant amount of water will pay $4.25 per 1,000 gallons for their excessive use water (i.e., anything over 21,000 gallons per month).

needs (which relates to lot size, vegetation evapotranspiration rates, household occupancy, and other factors). In Highlands Ranch, the consumption charge is relatively low for customers using up to their individual budget allotment ($2.00 per 1,000 gallons). However, once a customer's water use surpasses his/her bi-monthly allotment, the consumption charge rises substantially, with the exact consumption price relating to how much the water use exceeds the allotment volume. For example, $3.00 per 1,000 gallons would be charged for use between 101-120 percent of the budget allotment; $4.50 for use between 121-140 percent of the budget allotment; and $6.75 for use over 140 percent of the allotment. In winter months, the average residential customer in Highlands Ranch would start paying the higher unit block prices for bi-monthly use beyond 13,000 gallons.[8] During the high-water-use months of June and July, the same customer would start paying the higher unit prices for bi-monthly use beyond 39,000 gallons.

Very few cites across the West apply this type of rate structure. The Centennial Water and Sanitation District in Highlands Ranch is one of the exceptions. However, some Colorado cities such as Boulder and Greeley are also considering the adoption of a true water budget rate structure in the future.

How Do the Front Range Marginal Prices for Water Compare? (Consumption Charges)

The consumption charges billed by a water utility relay the *marginal price* of the water, or the price for the next unit of water consumed. By analyzing the marginal price curves of the various water rate structures, the differences in efficiency incentives become apparent. The water providers in this analysis used several different types of rate structures as of the summer of 2004, ranging from uniform rate structures to a variety of increasing block rate structures. Each of these pricing designs has a unique marginal price curve. Plotting all of these marginal price curves on one graph exposes the significant distinction in economic effect of each price structure. Figure 1 illustrates this effect. The following two marginal price curve characteristics are especially important to consider when viewing Figure 1:

- Differences in curves between the uniform and increasing block rate marginal price curves; and
- Significant variations in block prices and block volumes amongst the water providers that use increasing block rate structures.

The most noticeable observation that can be drawn from Figure 1 is the wide range of marginal price curves (or consumption charges) being used in cities across the Front Range of Colorado. In some cities (Greeley, Loveland, and Pueblo), water is sold at relatively low unit prices with no conservation price signals. On the other end of the spectrum, Aurora, Boulder, Highlands Ranch, and Thornton have built in consumption charges that increase aggressively with use volume. Other cities apply increasing block rates that send a more modest price signal to customers.

The cities with increasing block rates all use individual strategies for setting their block prices and block volumes. For example, although cities such as Fort Collins, Longmont, Colorado Springs, and Westminster increase the block prices by smaller amounts, these increases begin at lower volumes and occur more frequently. This design strategy sends moderate conservation price signals to average water

[8] For the average Highlands Ranch residential account (3.0 people per household), the Centennial Water and Sanitation District (CWSD) allots 12,000 gallons bi-monthly for indoor use (year-round). The CWSD's bi-monthly outdoor allotments for the average residential account (7,500 sq. ft. lot) are as follows: Dec./Jan.=1,000 gallons; Feb./Mar.=2,000 gal.; Apr./May=17,000 gal.; June/July=27,000 gal.; Aug./Sept.= 14,000 gal.; and Oct./Nov.=1,000 gal. When these bi-monthly indoor and outdoor water budget allotments are summed, the following total water budget volumes result for the average Highlands Ranch residential customer: Dec./Jan.=13,000 gallons; Feb./Mar.=14,000 gal.; Apr./May=29,000 gal.; June/July=39,000 gal.; Aug./Sept.= 26,000 gal.; and Oct./Nov.=13,000 gal.

users who use between 8,000 and 25,000 gallons per month. Conversely, cities like Thornton apply noticeably higher block price increases, but at much higher volume thresholds. This design strategy targets water users who use much larger volumes of water per month (over 25,000 gallons). Boulder, Highlands Ranch, and Aurora apply relatively high price increases at lower volume thresholds. This strategy yields the most effective conservation price signal to the most customers.

The remaining cities on the graph (Denver, Greeley, Pueblo, and Loveland) use rate structures that send little or no conservation price signal to their customers. Greeley, Pueblo, and Loveland use a uniform rate structure design, which inherently sends no conservation price signal. Denver, though technically using an increasing block rate structure, sends a very weak price signal to customers due to the negligible unit price increases and the large volume block thresholds. The effect of Denver's water rate structure isn't much different from that of a uniform rate structure, particularly to the high-volume water users.

The Denver example[9]

The highest block price in Denver is $2.45 per 1,000 gallons (for use over 30,000 gallons per month), which is only $0.49 higher than the price of the previous block (for use between 11,000 and 30,000 gallons per month). Denver customers who use over 30,000 gallons per month—a significant amount—are not sufficiently affected by this minimal price increase. To illustrate this, assume a Denver customer has already used 30,000 gallons in a particular billing month. This customer is now deciding how much more water he/she will use in this month. Under Denver's rate structure, the customer will pay a consumption charge of $17.93 for the first 11,000 gallons (at $1.63 per 1,000 gal.) and an additional $37.24 for the next 19,000 gallons (at $1.96 per 1,000 gal.). This totals to $55.17 for the first 30,000 gallons.[10]

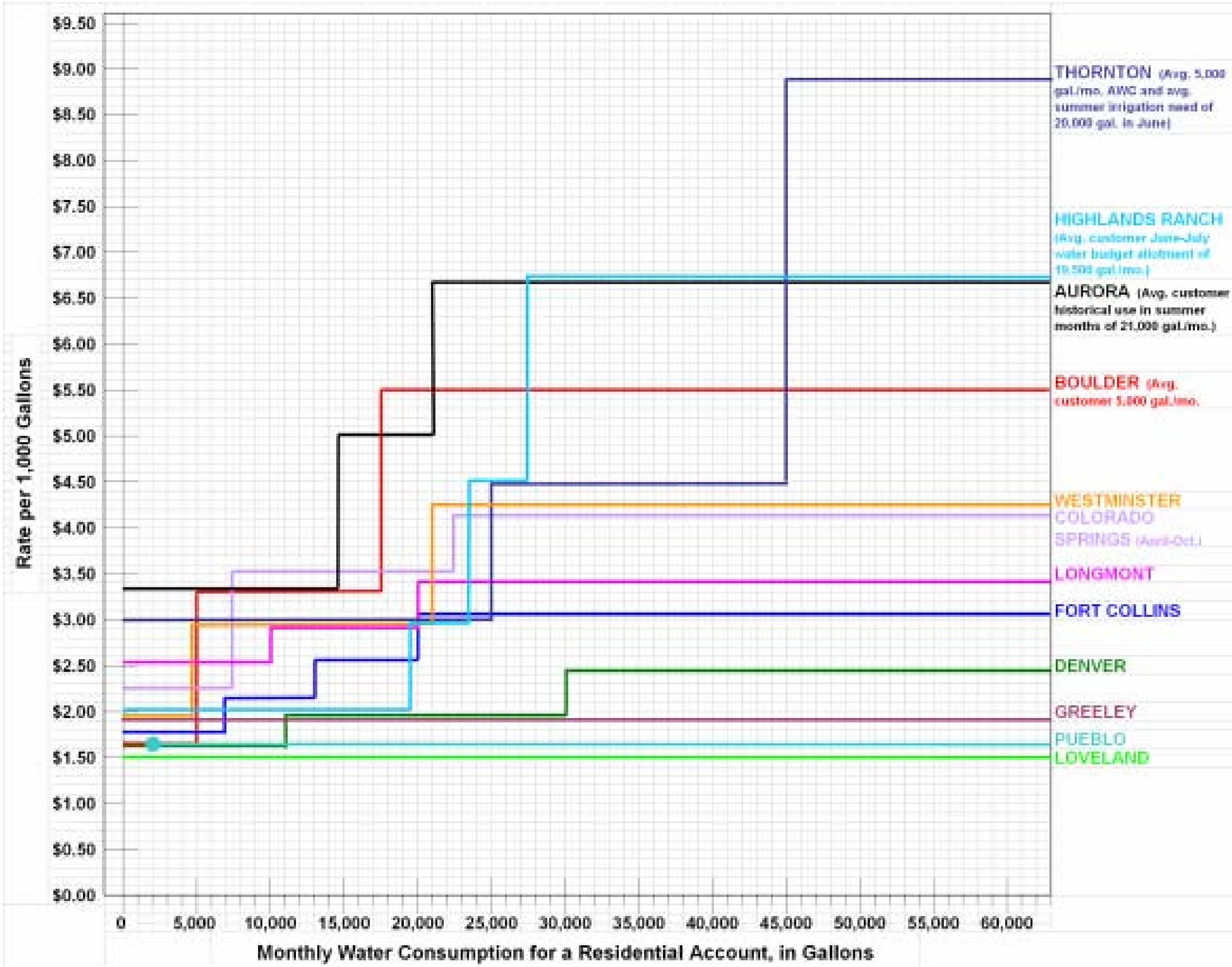
Now, the customer is deciding if he/she should use an additional 10,000 gallons in this month (i.e., 40,000 gallons total). Under Denver's rate structure, this customer would pay an additional $24.50 for the next 10,000 gallons, instead of $19.60 if he/she were still using water at the price of the second/previous block. This $4.90 difference is most likely not enough to encourage conservation, especially if the customer has disposable income (which can be expected of customers who generate water bills upwards of $75 per month, as in this example).

This example perfectly illustrates the phenomenon of "price insensitivity," as described earlier. The end result is an increasing block rate structure that sends a very weak conservation price signal in Denver.

[9] Denver Water applies a bi-monthly billing cycle to most of its customers. To maintain consistency with other water providers in the analysis and report, the block volumes in Table 1 and this example have been converted to per month figures.
[10] This hypothetical $55.17 cost does not include the fixed service charge that appears on every bill.

Figure 1

Marginal Price Curves (Consumption Charges) of Water Rate Structures along Colorado's Front Range (as of June 22, 2004)



Notes: (1) Customers in Denver and Highlands Ranch are billed on a bi-monthly basis. To maintain consistency with all other cities in the analysis sample, the block volumes for Denver and Highlands Ranch have been adjusted to monthly volumes on this graph.
(2) Aurora's rate structure was considered a "drought surcharge" at the time of this publication.

How Do the Front Range Average Prices for Water Compare? (Consumption Charges + Fixed Service Charges)

Generally, water customers respond to the overall water bill, which is reflected in the average price. The average price of water is the fixed service charge (fixed price) plus the consumption charge (marginal price(s) multiplied by consumption volume), divided by the total consumption volume. Therefore, both the fixed service charge and the consumption charges combine to determine the resulting conservation price signal that is sent to customers.

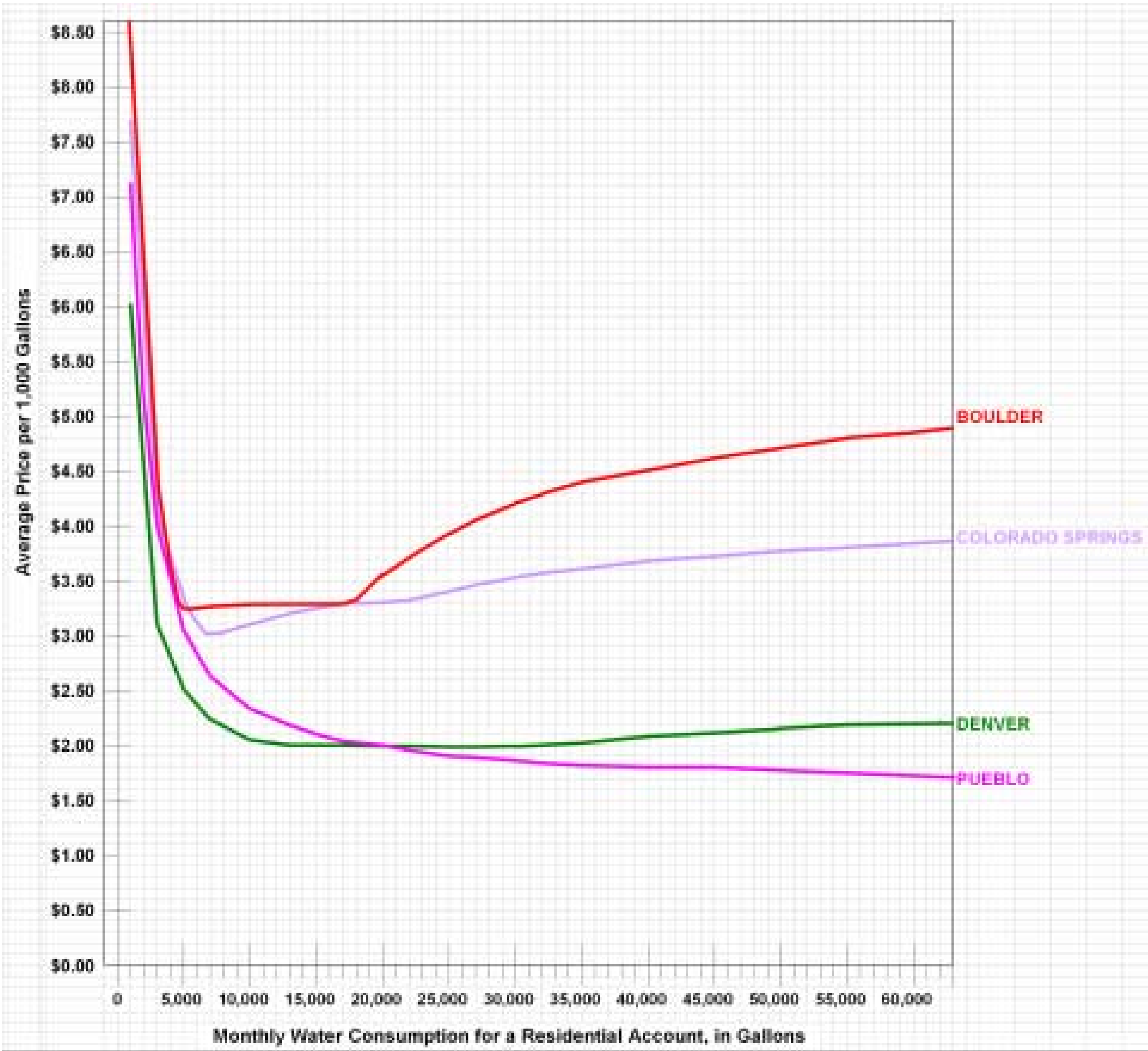
Figure 2 illustrates a small sampling of average price curves in four cities and displays how the average price for water can be significantly affected by an overall rate structure. The distinct differences in these four average price curves should be noted, with the general trends applied to rate structures in other cities.

To maintain a noticeable price signal for the consumer, the average price needs to rise as consumption volume increases. If the average price curve is relatively flat or declines as the consumption volume increases, there is little price incentive to conserve water, as the unit price for water remains relatively constant no matter how much water the customer uses.

Boulder's average price curve ascends relatively quickly once the average customer uses approximately 17,000 gallons. Customers that exceed this use level continue to receive a price signal as their consumption increases—the more they use, the higher the average price per unit. The steepness of Boulder's increasing block rate structure (as shown if Fig.1) is responsible for this trend. Colorado Springs' increasing block rate structure yields a similar effect. However, since the consumption charges in Colorado Springs do not jump up as quickly or as high, the resulting effect on the average price curve is much less significant than in Boulder.

Although Denver technically applies an increasing block rate structure and Pueblo applies a uniform rate structure, the average price curves for both of these cities are very similar. Pueblo's uniform rate structure and its flat marginal price, result in an average price curve that sends no conservation price signal. Similarly, because Denver's block volumes are large and its block price increases are negligible relative to the overall water bill, Denver's average price curve is not much different than Pueblo's and offers very little incentive for efficiency.

Figure 2
Average Price Curves (Fixed Service Fees plus Consumption Charges) of Water Rate Structures along Colorado's Front Range (as of June 22, 2004)



How Do the Water Rate Structures Compare on Colorado's Western Slope?

In late June of 2004, we gathered water rate data from fourteen municipal water utilities on the Western Slope of Colorado. This sampling provides a cross-section of water providers in western Colorado, both in terms of geographic distribution and community size. Although the variation in rate structures might be used as a rough indication of how each municipality prioritizes water conservation, we must consider the varying water supply situations and the different costs associated with these supplies. Table 2 lists the components of each rate structure implemented by these Western Slope water providers as of June 22, 2004 in these water service areas. Please note that some of these municipalities were in the process of reassessing their water rates at the time of this publication.

Durango, Glenwood Springs, the City of Grand Junction, the Ute Water Conservancy District (Grand Junction), Hotchkiss, and Nucla use increasing block rates with notable variations in their design and aggressiveness. Please take note of both the fixed service charge and the consumption charge for each municipal utility, and consider the potential effect of both of these charges on water consumption trends. Of this Western Slope sample, the Ute Water Conservancy District and Hotchkiss apply the most aggressive increasing block rates. The rate structures in these two districts have the most blocks and the highest block prices. As a result, these two rate structures send the strongest conservation price signals in the sampling.

Durango applies seasonal variation to its increasing block rates. The winter water is set at a lower price because water demands are lower in winter. Also of note, Durango, the City of Grand Junction, Ute Water Conservancy District, and Nucla include an initial volume of essential water use in their respective fixed service charges.

Cedaredge, Collbran, Craig, Crawford, Delta, and Norwood apply uniform rate structures, with Norwood's uniform rate of $3.00 per 1,000 gallons being the highest unit price and Crawford's $1.00 per 1,000 gallons being the lowest. But, Collbran, Crawford, and Delta include the initial volume of water use with the fixed service fee (the first 10,000 gallons in Collbran, the first 20,000 gallons in Crawford, and the first 4,000 gallons in Delta).

Montrose and Olathe use different variations of a decreasing block rate structure. However, Montrose is in the process of modifying its rate structure to something more uniform. As mentioned earlier, decreasing block rate structures do not provide any conservation price signal. In fact, they encourage wasteful use, since the unit price for water decreases as consumption increases.

Table 2
Water Rates for Residential Accounts (3/4”- 1” Services), as of June 22, 2004
Colorado - Western Slope Municipalities

Municipality	Rate Structure Type	Fixed Monthly Service Charge	Consumption Rate: Unit Rate per 1,000 Gallons of Water Consumed
Cedaredge	Uniform	$23.50 (incl. 5,000 gal.)	$1.50
Collbran	Uniform	$24.75 (incl. 10,000 gal.)	$1.40 – over 10,000 gal.
Craig	Uniform	$14.20	$1.56
Crawford	Uniform/Flat Fee	$13.90 (incl. 20,000 gal. in summer)* (a)	$1.00 – over 20,000 gal.
Delta	Uniform	$21.00 (incl. 4,000 gal.)	$2.00 – over 4,000 gal.
Durango	Seasonal & Increasing Block Rate	$9.40 (incl. 2,000 gal.)	$1.60 – from 2,000 to 10,000 gal. $2.00 – over 10,000 gal. (winter) $2.30 – over 10,000 gal. (summer)
Glenwood Springs	Increasing Block Rate	$7.00	$1.20 – up to 5,500 gal. $1.60 – from 5,500 to 17,500 gal. $2.12 – over 17,500 gal.
Grand Junction (City of Grand Junction)	Increasing Block Rate	$7.00 (incl. 3,000 gal.)	$1.80 – from 3,000 to 10,000 gal. $1.95 – from 10,000 to 20,000 gal. $2.10 – over 20,000 gal.
Grand Junction (Ute Water Conservancy District)	Increasing Block Rate	$10.50 (incl. 3,000 gal.)	$2.36 – from 3,000 to 9,000 gal. $2.63 – from 9,000 to 15,000 gal. $2.89 – from 15,000 to 21,000 gal. $3.15 – over 21,000 gal.
Hotchkiss	Increasing Block Rate	$15.00	$2.00 – up to 6,000 gal. $2.50 – from 6,000 to 10,000 gal. $2.75 – from 10,000 to 20,000 gal. $3.00 – over 20,000 gal.
Montrose	Decreasing Block Rate	$13.65 (incl. 2,000 gal.)	$2.60 – from 2,000 to 6,000 gal. $1.71 – over 6,000 gal.
Norwood	Uniform	$17.50	$3.00
Nucla	Increasing Block Rate	$33.00 (incl. 5,000 gal.)	$1.50 – from 5,000 to 25,000 gal. $2.00 – over 25,000 gal.
Olathe	Decreasing Block Rate	$15.75 (incl. 3,000 gal.)	$2.92 – from 3,000 to 10,000 gal. $2.26 – from 10,000 to 20,000 gal. $1.54 – over 20,000 gal.

Note:
(a) During summer months, in-town Crawford customers receive 20,000 gallons of water with their monthly service charge. During the winter, 10,000 gallons are included with the service charge, with additional water usage charged at $1.00 per 1,000 gallons.

How Do the Western Slope Marginal Prices for Water Compare? (Consumption Charges)

The consumption charges billed by a water utility relay the *marginal price* of the water, or the price for the next unit of water consumed. By analyzing the marginal price curves of the various water rate structures, the differences in conservation price incentives become apparent. Although the variation in unit prices is not as significant as on the Front Range, the Western Slope water providers in this analysis implemented a wide variety of rate structure designs as of the summer of 2004. These included uniform rate structures, increasing block rate structures, and even types of decreasing block rate structures. Each of these pricing designs has a unique marginal price curve. Figure 3 illustrates the difference in marginal price curves and the price signals they send.

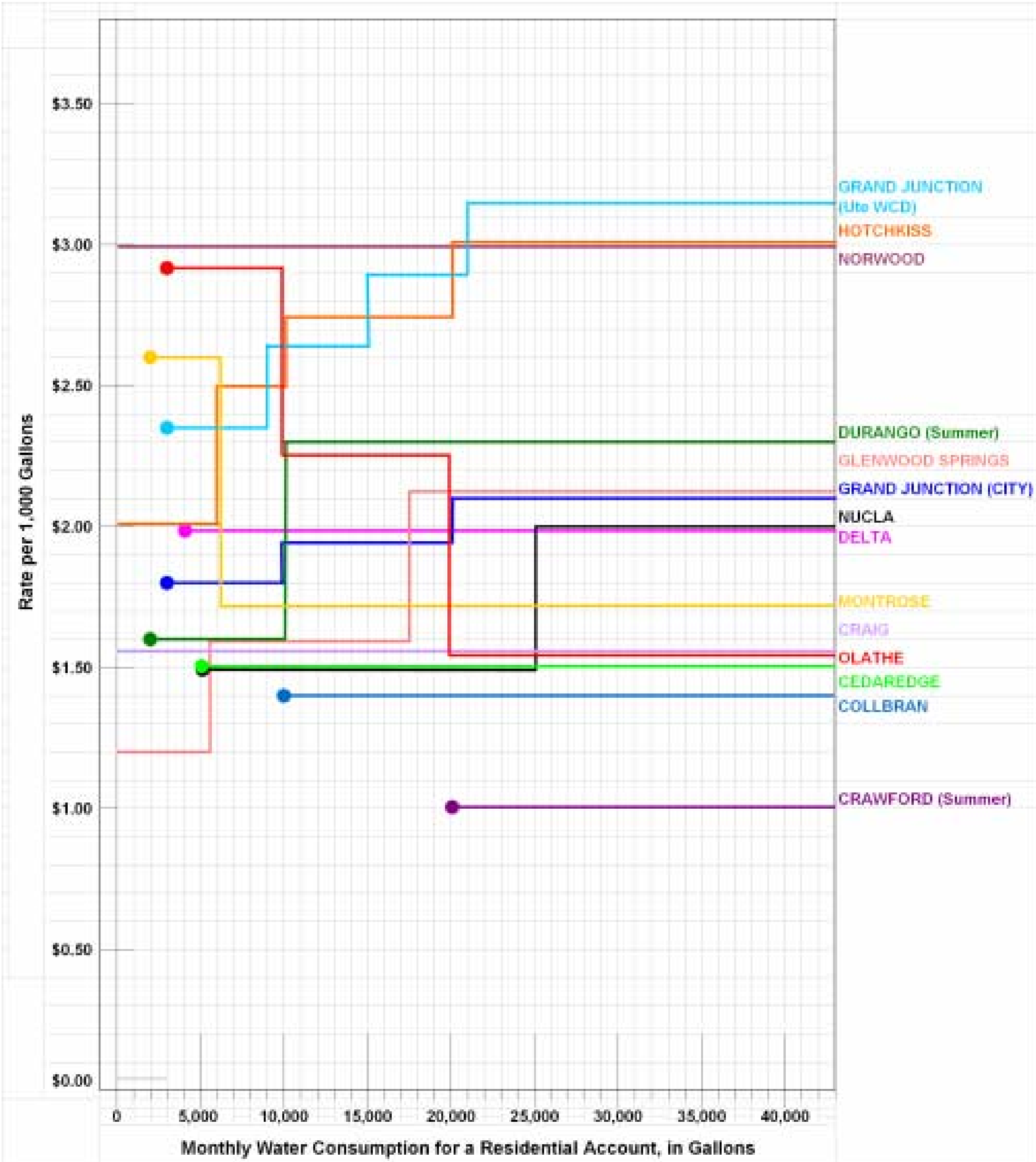
The distinct difference between the marginal price curves of the uniform, increasing block rate, and decreasing block rate is quite noticeable in Figure 3. Another distinct feature of many rate structures on the Western Slope is the automatic inclusion of a set volume of water with the fixed monthly service charge. Ten of the Western Slope municipalities in this sample include some water for essential needs in the fixed service fee (ranging from 2,000 to 20,000 gallons per month per account), with any water used beyond this point being charged per 1,000 gallons. This strategy guarantees a basic volume of water for every paying customer. However, since customers will pay for this initial allotment regardless of their water use each month, this strategy does not encourage conservation for water use up to the allotment volume. Therefore, in towns like Collbran or Crawford, where 10,000 and 20,000 gallons are included in the fixed monthly service fee, respectively, customers can use a substantial volume wastefully before they have any incentive to conserve.

Figure 3 also illustrates that most of the Western Slope municipalities charge somewhere between $1.50 and $3.00 per 1,000 gallons of water use. This is a noticeably small range in consumption charges, particularly when compared to the price range for Front Range municipalities (roughly $1.50 to $9.00 per 1,000 gallons). However, since water rates are directly related to cost of service, one might expect lower, less varying rates where water is more available and its associated development costs are relatively similar from town to town.

The Ute Water Conservancy District (Grand Junction) and Hotchkiss offer the most distinct conservation price incentive in this Western Slope sample. The marginal prices curves for these two water providers illustrate how unit prices increase as water consumption increases. The City of Grand Junction, Glenwood Springs, Durango, and Nucla also have marginal price that increase with use, but the block price increases and the conservation price signal they send are not as significant as in Hotchkiss and the Ute Water Conservancy District.

The marginal price curves of the uniform rates in Cedaredge, Collbran, Craig, and Delta are flat, and thus do not offer any incentive for water conservation. The descending marginal price curves of Montrose (now in the process of modifying its rate structure to something that is more uniform) and Olathe illustrate how the unit price for water decreases as consumption increases. Therefore, the water rate structures in these towns build in an incentive for customers to use more water.

Figure 3
Marginal Price Curves (Consumption Charges) of Water Rate Structures on Colorado's Western Slope (as of June 22, 2004)



Note: Price curves beginning with a "●" indicate that an initial volume of water is included with the fixed monthly service charge. The "●" is located at this volume amount. The line that extends from the "●" is the unit price consumption charge for water used beyond the initial volume inclusion.

<u>How Do the Western Slope Average Prices for Water Compare? (Consumption Charges + Fixed Service Charges)</u>

Average price curves for Western Slope water rate structures are all relatively similar. The consumption charges (marginal prices) do not vary enough from town to town on the Western Slope to yield notable differences in average price curves. Most of the average price curves in this Western Slope sampling tend toward being uniform or flat as consumption increases. The true conservation price signal being sent to customers in most of these districts is relatively minimal or even non-existent in some cases. This result is a function of:

- The block price increases in the Western Slope increasing block rate structures are not large enough to yield notable ascending average price curves that distinguish themselves from the average price curves of uniform rate structures.
- Most of the Western Slope water rate structures include relatively high fixed monthly service charges. A high fixed service fee combined with small changes in block prices yields a relatively flat average price curve.