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Conservation efforts limit rate increases for Colorado utility

WHEN A CITY'S UTILITY DEPARTMENT WAS ASKED BY A CUSTOMER WHY WATER RATES HAD GONE UP DESPITE RESIDENTS' EFFORTS TO CONSERVE, UTILITY STAFF CONDUCTED RESEARCH AND FOUND THAT CONSERVATION MEASURES HAD ACTUALLY SLOWED THE PACE OF INEVITABLE RATE INCREASES.

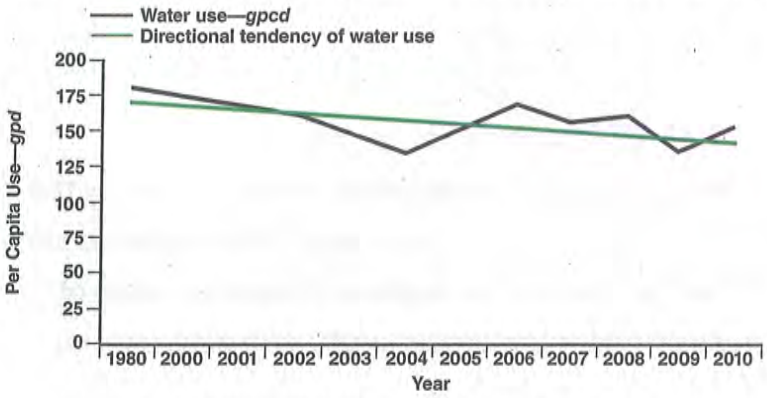
A concerned citizen asked, "Why are my rates going up again? Why do you ask me to conserve and then raise my rates?" This question was raised at a public meeting in Westminster, Colo., in 2011.

The Westminster Department of Public Works and Utilities' (WDPWU's) staff acknowledged that this was a very good question as they struggled, with only limited success, for a compelling answer. They knew water conservation had made a profound impact on the city by reducing demand, reducing the amount of additional water needed to be purchased, and eliminating the need for expansion of facilities, but they didn't have a good way to quantify the effects and respond to the citizen's question.

Similar tough questions have been posed to water utilities across the country as water and wastewater rates have increased faster than the Consumer Price Index (CPI) during the past 15 years (Beecher, 2013; Craley & Noyes, 2013). Managing public response to and understanding of rate increases have taken on growing significance in recent years as utilities grapple with the double-edged sword of rising infrastructure costs and decreasing demands (Goetz, 2013).

Rather than leaving the question of customer conservation and rates hanging without a satisfactory reply, WDPWU staff decided to do some

FIGURE 1 Average per capita water use in Westminter, Colo., 1980–2010



Average gpcd is based on total water use.

research to find answers using data from their own system. The timing of the question was noteworthy because Westminster is working toward completing a series of identified projects designed to meet the city's needs at a projected buildout date of 2050 (using current and projected demands that include conservation). This opportunity enabled WDPWU to look at the difference between 1980 demand projections and current demand projections and place a value on water savings using current costs.

To determine the effect of conservation on water rates, WDPWU looked at marginal costs resulting from the buildout requirements by removing conservation from the equation. The results of the city's research were startling: Reduced water use in Westminster since 1980 has generated substantial savings in both water resource and infrastructure costs, saving residents and businesses 80% in tap fee increases and 91% in rate increases compared with what rates would have been without conservation.

The city's research on water demands and rates since 1980 provided a useful response to the citizen's question and revealed previously unexplored and underappreciated benefits of long-term water conservation in reducing rate increases. Water rates in Westminster are much lower today than they would have been in the absence of demand reductions from conservation. Here's how the WDPWU was able to reach this important conclusion.

CHANGE IN WATER USE

To explore the effects of demand management on water rates and tap fees, utility staff reviewed water demand records, water rates, tap fees, and capital project costs from 1980 through 2010 with the following question in mind: What would water rates and tap fees be today if per-customer water demands had remained unchanged since 1980? The year 1980 was chosen because it predated city-related conservation programs and two levels of plumbing code–related changes.

The first step was to study water use patterns. WDPWU staff established patterns from 1980 through 2010 by taking total demand (all customer classes) and dividing by the best estimate of the service area population for each year. Westminster has a reclaimed-water system that reuses treated wastewater for irrigation, thus lowering the city's impact on water resources. To keep the estimate conservative, reclaimed water was assumed to be a conservation measure. This consumption was added back into potable water use to reflect the full use of water without conservation. As shown in Figure 1, average gallons per capita per day based on total city water use was 21% higher 30 years ago, starting at 180 gpcd in 1980 and ending at 149 gpcd in 2010. Westminster attributes these changes in demand to three primary management factors:

- Utility-sponsored water conservation programs
- The city's inclining block and seasonal-rate billing structure for water use
- National plumbing codes implemented as part of the Energy Policy Act of 1992

NEW SUPPLY REQUIREMENTS AND COST

Once the changes in water demand were quantified, WDPWU staff were able to estimate what water use in 2010 would have been without the

enactment of water conservation programs and policies. Through this analysis it was concluded that if per capita water use had not decreased by 21%, Westminster would have been required to secure an additional 7,295 acre-ft of water in order to meet the customer demand while satisfying the city's reliability requirements.

New water supply in Colorado's Front Range region does not come cheap. Current market costs for a new water supply average $30,000 per acre-foot. Westminster pays close attention to the cost of new supply as it builds these costs into the tap fees of new customers so that the city can fully recover the expense of serving new customers without burdening existing customers with the cost of growth. WDPWU staff concluded that if conservation from 1980 through 2010 had not occurred, the city would have been competing with other water providers in the region to acquire more raw water, further tightening the market and making new water supply even more expensive. At this average price, the estimated cost of obtaining and delivering the required additional 7,295 acre-ft of water would have required an additional capital investment of $218,850,000. With this simple analysis alone, the cost savings associated with reduced water use became obvious, but staff realized this was only part of the story.

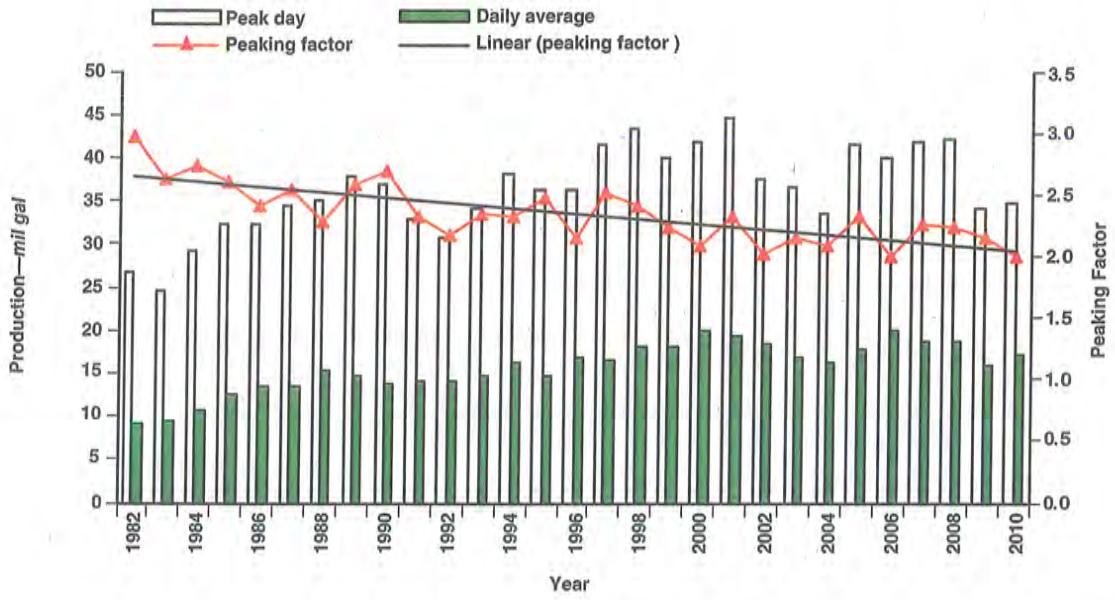
In theory, water and wastewater rates are set by the city so that the revenue generated covers operations and maintenance of the system as well as some of the repair and replacement costs and debt service.

ADDITIONAL PEAK DEMANDS AND INFRASTRUCTURE COSTS

Peak demand in 2010 would also have been considerably higher had conservation not been implemented in Westminster during the past 30 years. The city has found that water conservation programs have altered irrigation patterns, thus reducing the system's peak-day factor. In 1980 the peak-to-average-day (peaking) factor in Westminster was 3.0, but by 2010 changes in irrigation practices and reduced water demand cut the peak factor to 2.1—a 30% reduction (Figure 2).

If 1980 demand levels had been perpetuated along with the 1980 peaking factor of 3.0, then the city's peak requirement at buildout was estimated to be 52 mgd higher than the current planned maximum capacity. This level of peak demand would require the WDPWU to add 52 mgd of treatment capac-

FIGURE 2 Potable water production—peak day, daily average, and peaking factor



ity at an estimated finished and installed cost of $2.5 million per mgd (based on recent projects and engineering estimates). Developing the additional water treatment infrastructure to meet these higher demands would have required a capital investment by the city of approximately $130 million.

ADDITIONAL WASTEWATER TREATMENT INFRASTRUCTURE COSTS

If conservation measures had not been taken and water demands had stayed at 1980 levels, Westminster utility staff determined that the city would have needed to add 4 mgd of wastewater treatment capacity to their system. Adding wastewater treatment capacity costs the city an estimated $5 million per mgd (based on recent projects and engineering estimates). Thus the additional 4 mgd of wastewater would have required an additional capital investment by the city of approximately $20 million.

TOTAL ESTIMATED COSTS OF INCREASED DEMAND

All estimated costs associated with the hypothetical increased demand were assembled in a table; the city then added in the costs of debt-financing, which certainly would have been part of these capital construction projects had they been implemented. As shown in Table 1, if the citizens of Westminster had not reduced their water use, the city's estimated total cost of the increased demand would have been $591,850,000.

WDPWU staff then looked at the increases in operating costs that the city estimated it would have incurred to handle the increased demand and associated additional infrastructure. Although no additional personnel were assumed to be necessary, it was assumed that operating costs (power, chemicals, and other annual costs related to water and wastewater treatment, distribution, and collection) would increase proportionally to the demand increases as shown in Table 2. From this analysis, it was estimated that Westminster would have incurred an additional $1,238,000 per year, on average, in operating costs associated with the additional demand.

TABLE 1 Estimated new infrastructure costs of increased water demand

Component	Volume/Cost
Additional water treatment capacity	52 mgd $2,500,000/mil gal Total: $130,000,000
Additional wastewater treatment capacity	4 mgd $5,000,000/mil gal Total: $20,000,000
Additional water resources	7,295 acre-ft $30,000/acre-ft Total: $218,850,000
Interest (on debt-funding for all projects)	$223,000,000
Total costs	$591,850,000

For the purpose of this analysis it is assumed that debt would have been issued and the resulting debt service would have been paid through rates. Those costs were included in the effects on rates.

EFFECT ON WATER AND WASTEWATER RATES AND TAP FEES

Once the cost estimates were completed, the question of how to recover the additional costs through rates and fees was considered. Westminster has just two sources of revenue available to pay for all costs associated with running the water and wastewater systems: water and wastewater rates, and tap fees. In theory, water and wastewater rates are set by the city so that the revenue generated covers operations and maintenance of the system as well as some of the repair and replacement costs and debt service. Tap fees are set to cover the costs of buying into the existing system based on current value plus any new infrastructure (capital projects) and water resources required by growth.

In practice, existing customers build Westminster's water and wastewater systems before new customers arrive so that growth can

TABLE 2 Estimated additional operating costs of new water demand

Component	Increase
Additional annual operating cost of water treatment facilities	21% Total: $480,400
Additional annual operating cost of wastewater treatment facilities	20% Total: $757,600
Total estimated additional operating costs	$1,238,000/year

No additional staff were added.

TABLE 3 New single-family rates and fees required to pay for additional water demand in 2012

Service Type	Total Average Per-Customer Charges $	Additional Charges Required to Cover New Costs $	New Annual Single-Family Water/Sewer Bill $	Increase in Charges From Additional Demands %
Water	410	553	963	135
Sewer	245	43	288	17
Total	655	596	1,251	91

occur. Infrastructure must be planned for future demands and not constructed as needed. When new customers connect and pay their tap fees, current customers are reimbursed for their investment in the city's existing systems. Those funds pay for capital improvement projects that include repair and replacement, thus reducing the costs to existing customers. Therefore, both rates and tap fees are affected by the same projects.

Working from this basic division of costs between rates and tap fees, the DPWU developed an estimate of what 2012 water and wastewater rates and tap fees for single-family customers would need to be to cover the additional costs incurred as a result of the hypothetical additional supply requirements. In 2012, the average single-family customer in Westminster paid $410 for water and $245 for wastewater service. To cover the single-family sector's share of the additional annual costs associated with the increased demand considered in this analysis, the average single-family customer would have to pay an additional $553 per year for water service and $43 more per year for wastewater service. The weighted average of these additional costs means that the average single-family customer would pay combined water and wastewater rates that would be 91% higher than they are today if 1980-level water demands were perpetuated over the past 30 years. These results are shown in Table 3.

TABLE 4 New tap fees required to pay for additional water demand in 2012

Service Type	Average Per-Customer Tap Fee $	Additional Tap Fee Charges Required to Cover New Costs $	New Average Tap Fee $	Increase in Charges from Additional Demands %
Water	16,325	16,086	32,411	99
Sewer	4,904	866	5,770	18
Total	21,229	16,952	38,181	80

A similar analysis was conducted to evaluate the effect of increased demands on tap fees for new water customers in Westminster. In 2012 the average tap fee for a new customer (residential and nonresidential combined) was $21,229, of which 77% was for water and 23% was for wastewater components. The combined cost of new infrastructure, new water resources, and repair and replacement associated with the increased demand modeled in this analysis would require an 80% increase in the average tap fee—up to $38,181—as shown in Table 4.

INCREASED RATES FROM CONSERVATION LOWER THAN EXPECTED

There is a commonly held belief in the water industry that declining per capita use as a result of water conservation has "forced an increase to rates to account for fewer units of volume billed" (Craley & Noyes, 2013). But the rate increases necessitated by conservation are actually much smaller than the rate increases that would be necessary to account for population growth in the absence of conservation. The 21% reduction in average per capita water demand that Westminster has experienced during the past 30 years has resulted in considerable benefit to its customers and has reduced the rate of increase in water and wastewater rates. Although water and wastewater rates and tap fees have increased during those 30 years, they have increased much less than they would have without water conservation. Customers in

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Westminster have avoided increasing their water rates by 135% and their wastewater rates by 17%—increases that would have been necessary if this level of water conservation had not been achieved. New customers in Westminster have also avoided an 80% increase in water and sewer tap fees by conserving water. Yes, rates have gone up, but because of the costs associated with new water supply and infrastructure, they have gone up much less than they would have.

An answer to the citizen's question about water conservation and rates at that Westminster meeting had been found, and the result was more dramatic than WDPWU staff had anticipated. The next time a question was posed about the relationship between conservation and water rates, utility staff members were prepared with an answer: Water rates are going to increase with or without water conservation because the costs of operating and maintaining the water system continue to rise. However, water rates increase at a slower rate if citizens conserve because the city does not need to purchase expensive new water supply and construct expensive new infrastructure. The net results of water conservation are significant cost savings to the customer in water and wastewater rates and in tap fees.

Each water system is unique, so the results from WDPWU's research may not apply everywhere. Utilities could perform a similar analysis to see the real value of conservation. However, the more than $590 million cost associated with the additional 7,295 acre-ft of demand reveals the hardship associated with expanding water resources supply and treatment infrastructure in today's environment. The high cost also highlights the tremendous value that is inherent in a utility's water treatment, wastewater treatment, and delivery infrastructure. Imagine the cost of obtaining water rights and constructing an entire water supply system today. The least-expensive water by far is the water we already have, and the best way to keep rates and tap fees low is to conserve that existing water. The cost of water to providers may vary by region, but the cost of infrastructure remains more consistent. The least-expensive infrastructure to build, operate, and maintain is the infrastructure that isn't needed in the first place. Customers can conserve water or not—their rates will go up regardless—but if conservation is the lowest-cost source of new supply (and it almost always is), then their rates will increase less than they would have without conservation.

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http://dx.doi.org/10.5942/jawwa.2014.106.0057

REFERENCES

Beecher, J., 2013. Trends in Consumer Prices for Utilities Through 2012. IPU (Institute of Public Utilities) Research Note. Michigan State University, East Lansing.

Craley, R. & Noyes, C., 2013. Water and Wastewater Rates on the Rise. *Journal AWWA,* 105:8:41. http://dx.doi.org/10.5942/jawwa.2013.105.0115.

Goetz, M., 2013. Invisible Peril: Managing Rate Issues Through Public Involvement. *Journal AWWA,* 105:8:34. http://dx.doi.org/10.5942/jawwa.2013.105.0122.

ADDITIONAL RESOURCES

AWWA, 2013. Press Release: Water Scarcity Report Urges Utility Planning on Rates, Conservation. www.awwa.org/home/awwa-news-details/articleid/1167/water-scarcity-report-urges-utility-planning-on-rates-conservation.aspx. Released May 2, 2013.

Effectiveness of Conservation-Oriented Water Rates in Tucson. Cuthbert, R.W., 1989. *Journal AWWA,* 81:3:65.

Water Conservation-Oriented Rates: Strategies to Extend Supply, Promote Equity, and Meet Minimum Flow Levels. Wang, Y.-D.; Smith Jr., J.; & Byrne, J., 2004. Catalog No. 20562.

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