



Water Rate Structure: A Tool for Water Conservation in Oklahoma¹

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essential ingredient to all living things, so much cheaper than diamonds, which are a luxury and not needed to maintain life? The short-hand answer is that water is relatively much less scarce than diamonds, and the typical person has relatively less use for another diamond, as compared to another glass of water. However, as water becomes more scarce, that trade-off begins to change, and when survival depends on that next glass of water, its value grows by orders of magnitude. While it is not unusual for residents to complain about taxes and utility bills, especially when there are discussions of raising them, the discussion below will suggest that the cost of municipal water is relatively inexpensive for most of us. In fact, most rates are so low, residents are probably paying mostly for the convenience of water and nearly nothing for the water itself.

Introduction

The price of water varies across the state by community and category of user. Whether living in a city or a rural community, water pricing is an important component of monthly utility costs. Not only do prices affect the household's budget, they also influence how to efficiently use water. The cost of water is one factor in conservation management of an increasingly scarce resource. Water rates (the prices the utility charges for water) can be an effective conservation tool (see AGEC-1055 Municipal Water Conservation in Oklahoma: Background, Issues & Options).

Conservation can help communities meet both long-term and short-term challenges. In some parts of the state, water infrastructure and supply are not keeping pace with population growth. From 1950 to 2014, the population of Oklahoma grew by 77 percent (U.S. Census²). Periodic droughts and lifestyle changes have also led to frequent shortages of water supplies in Oklahoma. Water conservation pricing is one of many tools that communities can use to help manage water use. This Fact Sheet provides information on average water rates and rate structures including conservation pricing in Oklahoma and presents some pricing alternatives.

Water Rates: High or Low?

There's a class example of the "paradox of value" in economics referred to as "water and diamonds." Why is water, an

Water Rate Structures: Block Pricing

Consumer response to changing water rates varies by community size, seasons, weather, household income and education about water availability. Block pricing refers to charging flat rates for different segments of consumers. Residential rates may be higher than commercial rates to encourage economic development, for example. In communities facing water shortages, one way to reduce water use is by charging higher prices. A system of higher rates for higher-volume users is called conservation pricing. Conservation pricing provides an incentive for users to reduce non-essential water use like outdoor irrigation, to reduce water waste and to adopt water-conserving technologies and behaviors. Such responsiveness can vary with season, weather and the range of price changes. Evidence from Oklahoma City households (2009 to 2013) shows residential water demand was not responsive to increases in water price, except for high consumption periods such as July and August. In the range of the unit water prices of \$2.26 to \$2.55 per 1,000 gallons (3.79 m³), water demand was relatively unchanged. Household parcel size, income and average monthly temperature were positively related to water demand, while rainfall, household age and water price negatively influenced water demand (Ghimire et al, forthcoming). Lack of rainfall had a positive effect on water demand during the drought, perhaps for bathing/swimming or for maintaining the lawns during the drought period.

Increasing rates for all users, however, may have unacceptable consequences. There is a particular concern for low-income consumers whose utility bills can be a significant

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² 1950 Oklahoma census was 2,193,000, and 2014 census was 3,878,051.

burden. A common solution is to use block pricing, where different volume users are charged a different rate. This approach has been used to provide a low-cost resource to industries needing large volumes of water. When water conservation is the issue, block pricing maintains low cost for small-volume users, but charges more for high-volume users.

There are a number of water rate structures possible with block pricing, but the most common ones are inclining block rates, declining block rates and uniform rates. A “block” is a quantity of water for which the price per thousand gallons is set. In most Oklahoma water systems, a block is 5,000 gallons. Each 5,000-gallon block may have a different per unit rate. With a **Declining Block Rate** the price goes down as usage goes up because the utility charges a lower price per thousand gallons for higher-use blocks as shown in Figure 1.

The declining block rate structure provides cheaper water to high volume users with little incentive to conserve water. With **Uniform Rates** (not shown), the utility charges the same per 1,000 gallons for all levels of water use. With an **Inclining Block Rate** the price goes up with use because the utility charges a higher price per 1,000 gallons for higher-use blocks as shown in Figure 2. Inclining rates are known to reduce both average and peak water demand (Beecher et al. 1994).

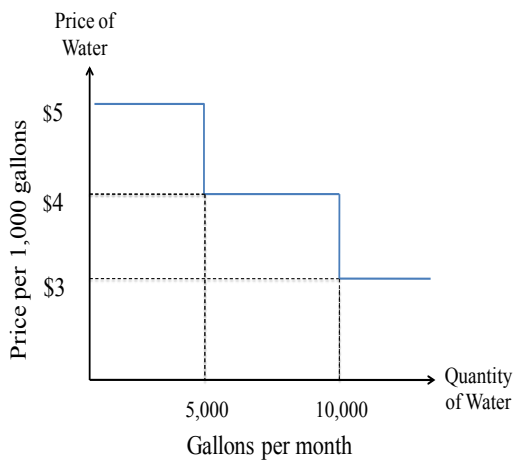


Figure 1. Example of Declining Block Rates.

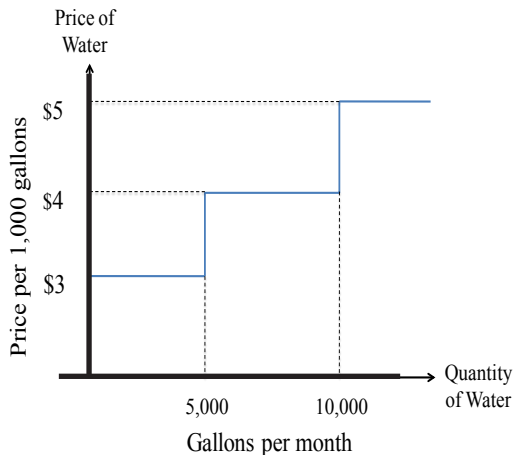


Figure 2. Example of Inclining Block Rates.

Oklahoma Municipal Rate Structures

Most Oklahoma communities used declining block rates (DBR). Residential rates are per household in Table 1. In 2013, Oklahoma had 2.55 people per household; thus, state average consumption is 65 gal./day/person, at about 21 cents/person/day. Small community consumption is about 60 gal./day/person, at about 23 cents/person/day. Small mid-size community consumption is about 73 gal./day/person, at about 17 cents/person/day. Large mid-size community consumption is about 81 gal./day/person, at about 14 cents/person/day. Large community consumption is about 118 gal./day/person, at about 8 cents/person/day.

While all communities are different, there are some generalizations that can be made from the information in Table 1. Average consumption increases as communities increase in population, nearly doubling from small communities with up to 5,000 people consuming about 154 gallons/day/household, to the largest communities with up to 100,000 people consuming about 300 gallons/day/household. Rates generally decline for the higher volume consumers in communities up to 50,000 people. Commercial water rates are lower than residential rates in communities of 50,000 or less. With the average rate less than \$0.25/day/person in all communities, marginal increases in those rates are likely to go unnoticed. Many factors influence water prices in communities, including the age and condition of infrastructure, and water quality and treatment requirements. In many cases, communities may have raised rates to address new infrastructure needs or water quality regulations.³

Why is this important?

Many Oklahoma communities will need to address water shortages at some point in time. Water rates can be effective conservation tools for managing shortages in both the short-term (e.g., from droughts) and long-term (e.g., from weather pattern change or population growth). Inclining block rate pricing is just one of numerous conservation rate structures that could be used to help keep water demand equal with available supply. See Table 2 for examples of alternative water rate structures.

Conclusion

Most municipal water systems in Oklahoma use water rate structures that generally do not encourage conservation, preferring declining block or uniform rates. However, some smaller communities have moved toward an inclining block structure rewarding conservation. Rate structures and average rates may have a strong impact on how efficiently residents use water, and may affect water system revenue, water consumption and other factors important for water systems.

³ Usage and interest in conservation are related to the conditions of the time. Most of Oklahoma was in various stages of drought for 2011 to early 2015.

Table 1. Summary of Residential and Commercial Water Use and Rates, Oklahoma, 2014.

<i>Municipalities (pop.)</i>	<i>up to 5,000</i>	<i>5,001-10,000</i>	<i>10,001-50,000</i>	<i>50,001-100,000</i>	<i>State Average</i>
Avg. Mo. Consumption (Gal.)	4,608	5,553	6,202	9,000	4,875
Avg. Daily Consumption (Gal.)	153.6	185.1	206.7	300	162.5
Res. Min. Charge (\$/month)	17.33	13.44	10.49	5.82	16.2
	(6.6)	(5.3)	(2.6)	(0.57)	(6.6)
5,000 Gal. Charge (\$/month)	30.77	25.89	23.06	22.47	29.53
	(11.3)	(6.6)	(5.0)	(5.6)	(10.7)
10,000 Gal. Charge (\$/month)	51.19	43.1	40.53	46.19	49.36
	(19.8)	(10.9)	(10.4)	(10.1)	(18.7)
50,000 Gal. Charge (\$/month)	208.97	190.8	189.61	250.65	204.97
	(89.1)	(52.8)	(52.4)	(54.8)	(82.3)
200,000 Gal. Charge (\$/month)	800.52	779.56	755.27	1014.89	794.48
	(387.2)	(186.5)	(238.1)	(225.1)	(353.1)

Values in Parenthesis are Standard Deviations.

Analysis of Data from: Oklahoma Municipal League, 2014.

Table 2. Summary of Alternative Conservation Rate Structures.

Rate Structure	Description.
Drought Demand	Rates are higher during drought periods.
Excess-Use	Prices are much higher for above-average water use.
Inclining Block	Price per block increases as water use increases.
Indoor/Outdoor	Prices for indoor use are lower than prices for outdoor use. This requires separate meters.
Penalties	Charges customers for exceeding allowable limits of water use.
Scarcity Pricing	Cost to develop new supplies is added to the bills of all users.
Seasonal Pricing	Water rates are higher during the season of higher demand (usually summer).
Sliding-Scale	The unit price increases, based on average consumption.
Spatial Pricing	Users pay for the actual cost of supplying water to their location. Those farther from the central water source pay more.
Time-of-Use	Water rates are higher during peak hours or peak days of the week.
Water Budget	Block rates are defined uniquely for each customer, based on an efficient level of water use for that customer.

Source: Vickers (2001), Beecher et al. (1994), Mayer et al. (1998).

For more information

Beecher, J.A., P.C. Mann, Y. Hegazy, and J.D. Stanford. (1994). Revenue Effect of Water Conservation and Conservation Pricing: Issues and Practices. National Regulatory Research Institute of Columbus, Ohio.

Boyer, Tracy, Kanza, Patrick, Ghimire, Monika, and Moss, Justin. forthcoming 2015. Household Adoption of Water Conservation and Resilience Under Drought: The Case of Oklahoma City Water Economics and Policy. Water Economics and Policy. Elsevier.

Mayer, P.W., W.B. DeOreo, E.M. Opitz, J.C. Kiefer, W.Y. Davis, et al. (1998). Residential End Uses of Water. Denver, Colorado: American Water Works Association.

Oklahoma Water Resources Board [OWRB]. (2007). Oklahoma Comprehensive Water Plan: 2007 Status Report. Oklahoma City, Oklahoma: Oklahoma Water Resources Board.

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The Cooperative Extension Service is the largest, most successful informal educational organization in the world. It is a nationwide system funded and guided by a partnership of federal, state, and local governments that delivers information to help people help themselves through the land-grant university system.

Extension carries out programs in the broad categories of agriculture, natural resources and environment; family and consumer sciences; 4-H and other youth; and community resource development. Extension staff members live and work among the people they serve to help stimulate and educate Americans to plan ahead and cope with their problems.

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- The federal, state, and local governments cooperatively share in its financial support and program direction.
 - It is administered by the land-grant university as designated by the state legislature through an Extension director.
 - Extension programs are nonpolitical, objective, and research-based information.
 - It provides practical, problem-oriented education
- for people of all ages. It is designated to take the knowledge of the university to those persons who do not or cannot participate in the formal classroom instruction of the university.
 - It utilizes research from university, government, and other sources to help people make their own decisions.
 - More than a million volunteers help multiply the impact of the Extension professional staff.
 - It dispenses no funds to the public.
 - It is not a regulatory agency, but it does inform people of regulations and of their options in meeting them.
 - Local programs are developed and carried out in full recognition of national problems and goals.
 - The Extension staff educates people through personal contacts, meetings, demonstrations, and the mass media.
 - Extension has the built-in flexibility to adjust its programs and subject matter to meet new needs. Activities shift from year to year as citizen groups and Extension workers close to the problems advise changes.

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