Agenda Item 8c

# RATE INCREASES STRENGTHEN WATER SAVINGS

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## DROUGHT AND RATIONING

Our three-year drought and water rationing imposed May 1st have encouraged most of us to find ways to save on water use. Our motives are many – to "do the right thing" to help our community live with less supply, to live within our household ration limits and avoid penalty fees, and to curtail spending while we recover from the recession.

Total water use by Santa Cruz customers is now down to around 7 million gallons a day (mgd), from a normal summer level of about 10 million gallons a day in a healthy economy. That amounts to 30% water savings across all users – residential, commercial, and others. An astonishing 93% of households have lived within their ration limits this summer. This is the "new normal" for us – if the drought continues and no new supplies occur, and population doesn't grow.

## WILL WE CONTINUE OUR LOWER WATER USE? REBOUND OR NOT?

Some city officials and consultants expect that water use will rebound when the drought and rationing end and the economy is healthy again.

But the drought and recession have lasted an unusually long time by recent standards, long enough that our community has changed its water use habits. Social norms have changed too. Our 93% compliance with ration limits is strong evidence of changed habits and norms.

What will the new normals for water use and rainfall be? Will our conservation norms persist if the rains return to normal and when the local economy recovers? Will we keep some or all of these new water habits or will a wet winter erase them? What conditions can help us maintain lower water use levels?

The City Council recently approved drought surcharges (temporary) and rate increases (permanent). Rates rose 15% on October 1. Over the next five years they will rise 61%. (That's 10% a year compounded over 5 years, necessary to finance capital improvements and stabilize revenue.)

So the question is will these higher prices for water sustain, maybe even increase the water savings we have achieved in the last few years? If there is a rebound in water demand – from 7 mgd to some higher level, will it be small or large?

Surprises are in store for those who expect a sizeable rebound in water use if it doesn't occur. Or surprises for those who expect that new habits and higher rates will curtain more use than subsequently might occur.

Will demand return to 10 mgd or stay below that level? We don't know, but we have tools to make educated guesses. And the City may eventually fund a study to learn the answer. In the meanwhile, what does previous research show?

## WHY WATER DEMAND WILL STAY BELOW 10 MGD

When rates rise, customers tend to cut back on water use to some degree, and a smaller supply of water is required to meet their demand. Table 1 gives estimates of the extent of water that will no longer be needed from the city system as customers curtail their use in response to the rate increases. (The calculations are explained in footnotes and Table 2.)

**Table 1. Estimated Water Savings Due to Santa Cruz's Recent Rate Increases**

| | | 2015 | 2020 + |
|---|---|---|---|
| | Rate change | 15% more | 61% more |
| | Demand change | 4.5% less[1] | 42.7% less[2] |
| Projected Water Savings[3] | Single Family Residences only | 65 MGY[4] at $0 additional cost<br>178,000 gd[5] | 630 MGY at $0 additional cost<br>1,726,000 gd |
| | All Users | 160 MGY at $0 additional cost<br>438,000 gd | 1500 MGY at $0 additional cost<br>4.1 mgd[6] |
| | Very conservative – cut all savings to 40% | 175,000 gd | 1.6 mgd |

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[1] Estimates that demand initially falls by 3% for any 10% increase in rates, based on research in Table 2.
[2] Estimates that demand eventually falls by 7% for any 10% increase in rates, based on research in Table 2.
[3] Assumes no drought, a healthy economy, and normal demand of 3500 million gallons a year.
[4] MGY = millions of gallons a year.
[5] gd = gallons a day.
[6] mgd = millions of gallons a day.

Economists use the term "elasticity" for the size of customer response to higher water prices. They have estimated its impact on water use across many communities and several decades. The careful estimation process must separate the effects of rate changes from simultaneous changes in weather and conservation programs, and variation in household size, income, landscaping and irrigation.

This large body of peer-reviewed research, described in Table 2, shows that the typical single family household will reduce water use 3-4% when rates rise 10%. People can be flexible about their water "wants" as long as they can satisfy their water "needs."

Realistically, as we experience rate increases, some households that are already strongly conserving may not be able to reduce their use much further. But wherever there is greater discretion in how water is used, the responsiveness is larger. Research shows there is greater discretion among larger users in higher-rate tiers, for higher-income households than lower-income, during dry seasons than wet ones, for larger lots than smaller ones and for outdoor uses vs. indoor.

## INITIAL BEHAVIOR

People are motivated by rate increases to become water-wiser and more efficient – just as they are motivated by drought, water rationing, and a weak economy. They change some habits and some fixtures. These behaviors include learning more about their own water use, replacing or repairing equipment (e.g., dripping faucets), and practicing more cautious use patterns. Each household makes its own choices about what to learn, what to fix or change, and what to be more cautious about (e.g., shorter showers vs. irrigation timing). Different households make different choices, depending on the characteristics of their household, their habits, knowledge, and the savings and livability they expect from any method of reduced water use.

## EVENTUAL BEHAVIOR

Given more time, studies show that customers become more conserving – because they get more opportunity to learn, to change habits, to replace less efficient equipment, and to choose new technologies that were previously unavailable or expensive (e.g., a meter monitor on a kitchen counter). Over time, social norms also shift more toward conservation and away from outward signs of heavy water use (e.g., lush lawns, water running down the sidewalk). Therefore, the total effect of any rate increase becomes larger over time, across the five years our rates will increase and beyond. Studies show that this long-run effect in households is around 7% for a 10% increase in rates.

## THE WELL-INFORMED CUSTOMER

People don't tend to closely monitor their purchases of low-cost items. And when rates are low, being uninformed about water-savings opportunities makes sense. The effort to become better informed may not generate much savings on the water bill. So they'll tend to ignore water conservation programs and rebate offers.

But new information about water use, information that is household-specific, has been shown to cause reductions in water use by itself. For example, when multi-family units are sub-metered, water use in California cities tends to fall 15% (item 6, Table 2). And when irrigation accounts in Santa Cruz were billed more frequently (monthly vs. bi-monthly), water use fell 11% (item 16, Table 2). When East Bay Municipal Utility District and Soquel Creek Water District used WaterSmart software to show its customers how their use compared to their neighborhood, water use fell 5%.

Higher rates plus feedback about household-specific water use, more feedback and more frequent feedback, energizes all customers to pursue their cheapest options for water savings. Officials cannot know which conservation methods or water use restrictions work best for which customers. But customers know and when rates rise, they achieve much more conservation and at a lower cost, than any conservation master plan can achieve. As a result, the entire community cooperates to conserve water in the cheapest and most reliable ways.

## SANTA CRUZ CAN PLAN FOR DEMAND CHANGES – AVOID WASTEFUL PROGRAMS

Our new rates will do a lot to encourage water efficiency, beyond what the drought and City conservation programs have accomplished. For example, the research in Table 2 shows that household water use is twice as sensitive to rate changes as weather conditions (items 1 and 4). Officials may complain that there are few takers for conservation rebates when rates are low, but they find many more takers when rates rise. The primary reason is that higher prices strengthen the motive for water conservation and encourage customers to become better informed in order to capitalize on water-saving opportunities.

In its conservation master plan, the Water Department has focused on education and replacement and rebate programs. The plan does not address rate responsiveness. Yet it is reasonable and useful to do so. There is reason to be concerned that the conservation master plan will prove unnecessarily expensive – not because people won't conserve but rather because rate increases are motive enough and the master plan might generate little additional savings.

Over the next several years officials may be surprised by the extent of conservation that water customers will choose. And if conservation is not properly anticipated, new supply projects may prove too large and too costly.

## EFFECTIVENESS

1. **Water savings estimated at 438,000 gallons a day in the first year and 4.1 million gallons a day after several years. See Table 1.**

   Using peer-reviewed, careful elasticity estimates, we estimate that single-family residences will respond to rate increases by reducing their demand about 65 MGY initially (2015) and by 630 MGY eventually (2020 and later). If other users can be characterized by the same elasticity values as single-family residences, then total water demand will drop by 160 MGY initially and 1500 MGY eventually. To the extent that these estimates are valid, the rate increase alone will eventually **reduce demand, and therefore desired supplies, by 43% (1500 MGY, or 4.1 mgd).**

2. Most customers won't experience substantially higher rates until they move into higher tiers during dry months, when most outdoor use occurs. That means the estimated

water **savings will occur primarily during the peak dry months, when we most need it.**

3. Now let's be **especially conservative**. Suppose Santa Cruz isn't typical of the communities where these elasticity values were calculated. Suppose that those elasticities are too high for Santa Cruz, say 2.5 times too high. Even then we can expect total demand to drop by 65 MGY initially and 600 MGY eventually, mostly during the peak season. This amounts to a 17% reduction in demand without any drought or recession effects. This effectively spreads existing supplies 17% further **by saving 600 MGY or 1.6 million gallons a day; it closes 17% of the gap between demand and supply.**

4. The elasticity effect will interact with any other programs the City uses – conservation outreach and rebates, and any feedback such as WaterSmart billing information. **Synergies among these programs will make all of them more effective.**

## PRACTICABILITY

1. **Estimated Costs = $ ZERO**. This is not a major new capital project. It involves no new facilities, programs, land acquisition, or staff. This is an existing program, simply one whose consequences have not be fully anticipated and incorporated in the conservation plan.

2. **$0 per million gallons saved**. This proposal is the least-cost, most cost-effective method among all those proposed. It will not create huge new supplies but it is the cheapest route to any additional water savings.

3. **Proven implementability.** It is a normal, common and widespread practice for water agencies to raise their rates as their costs increase. The effects on water users have been documented extensively in the water resources literature (see Table 2). Rate increases reliably dampen demand, regardless of whether that is the intent.

4. **Proven acceptability.** These rate increases have gone through public hearings and been adopted by the City Council. They went into effect October 1.

5. **Avoid some costly new supply project**s that end up being idled once the full rate increases are in effect and customers have exploited the widest variety of conservation opportunitiess.

## ENVIRONMENTAL AND COMMUNITY IMPACT

1. Promotes **sustainability**, and living within the limits of our natural water supplies. Demonstrates that Santa Cruz can "**walk the talk**."

2. Promotes our community **adaptation** to a warmer, potentially drier climate. Increases our ability to make less water go further.

3. Contributes to **fairness and equity** – The heaviest water users will face the highest costs. Tiered rates will still offer the lowest rates to those who consume the least water.

4. Rewards customers who become **better informed** about their water use and their options to conserve.

5. Encourages **innovation** in water waste reduction methods and in water-conserving equipment and services.

6. Increases demand for **water-saving programs and technologies**. More customers and sales for businesses and workers who offer water-conserving equipment and services.

7. Reduces **greenhouse gas emissions** as less water is collected, pumped, stored, treated, and delivered.

8. Protects **fish** flows by reducing water use, especially in peak-demand dry months.

9. Protects **native habitats** by promoting native landscapes. Supports native birds, bees, and butterflies.

10. Reduces demand for **water-intensive landscapes** and the businesses and employment that support them.

11. Reduces demand for **spas and hot tubs** and the businesses and employment that support them.

12. Encourages **collaboration among** neighbors interested in sharing water-conserving ideas.

13. Builds stronger **social norms** for water conservation.

## UNKNOWNS

1. **How "typical" are City water customers compared to those in the research literature?** Will the City experience the same reduction in water use as is characterized in the research or more or less?

2. What **margin of error** should the City use in estimating the demand reduction?

3. Can **customers who are not single-family residents** be characterized by the typical values in the literature? Will they reduce their water use by the same percentage, or more or less?

4. In the past, when droughts ended and the local economy had recovered from recession, water demand rebounded. But now, **have rates and norms and conservation technologies changed enough to permanently dampen water demand compared to past recoveries?** If so, will the rate responsiveness make water demand even lower than it currently is?

5. The City has a number of education, rebate, and replacement programs in its draft Water Conservation Master Plan. Some of the use of these programs will be due to rate responsiveness

and some to other reasons. What portion of these opportunities will customers use because of the rate increases?

6. **What risk does the City take** if and when it assumes a certain level of rate responsiveness among its customers? If future demand turns out to be larger than expected, will curtailment programs be necessary? If future demand is smaller than expected, will new supply facilities need to be idled?

7. If rates don't keep pace with income growth and inflation, will water demand rebound? How much? How soon?

8. How responsive will water demand be to population increases?

9. How much higher can rates go before customers exhaust all reasonable water-saving methods? At what level of rates will demand harden?

I'd like to hear from you. Please contact me with questions and ideas. You can reach me at suholt@cabrillo.edu

Table 2. Elasticity Estimates for Water Demand, peer-reviewed publications

| | **Elasticity Value** | **Context** | **Citation** |
|---|---|---|---|
| 1 | average is -0.51; short-run median is -0.38; long-run median is -0.64; tiered rates have strong effects compared to weather & household size | meta-analysis of 124 estimates, 1963-93 | M. Espey, J. Espey, W.D. Shaw, Price elasticity of residential demand for water: a meta-analysis, Water Resources Res. 33 (1997), 1369–1374. http://ron-griffin.tamu.edu/x677/readings/espey.pdf |
| 2 | -1.6 at top tier rates in summer, so 10% increase in summer price leads to 16% drop in water use | summer residential use, average lawn 9000 sqft, 1981-85, Texas | Julie A. Hewitt and W. Michael Hanemann, A Discrete/Continuous Choice Approach to Residential Water Demand under Block Rate Pricing, Land Economics, Vol. 71, No. 2 (May, 1995), pp. 173-192 http://www.jstor.org/discover/10.2307/3146499?uid=3739560&uid=2&uid=4&uid=3739256&sid=21102471684651 |
| 3 | -0.46 year-round average; -0.36 in winter; -0.70 in summer | review of 18 studies | Hanemann, W. M., 1997, Determinants of urban water use, in Urban Water Demand Management and Planning, Baumann, D. et al, eds., McGraw Hill, New York , pp. 1-75. http://are.berkeley.edu/courses/EEP162/spring2007/documents/hanemannDeterminantsUrbanWater.pdf |
| 4 | twice as strong in summer or in drought (-0.23 to -0.30) as in winter or in plenty (-0.14); but price may get credit for drought effects | aggregated across 3 Bay Area districts before (1982-86) and during (1987-92) drought; restrictions | Corral. L., A.C., Fisher, N.W. Hatch. (1999). "Price and Non-Price Influences on Water Conservation: An Econometric Model Aggregate Demand under Nonlinear Budget Constraint." Dept. of Agriculture and Resource Economics, UCB, UC Berkeley. http://escholarship.org/uc/item/3gx868tg |
| 5 | mean of -0.41, median of -0.35 | meta-analysis of 314 estimates | Price and Income Elasticities of Residential Water Demand: A Meta-Analysis, *Jasper M. Dalhuisen, Raymond J. G. M. Florax, Henri L. F. de Groot, and Peter Nijkamp, Land Economics,* May 2003, 79(2): 292-308. http://ron-griffin.tamu.edu/x677/readings/dalhuisen.pdf |
| 6 | -0.27 in short run for indoor multi-family use; indoor water use dropped 15% with submetering | 460,000 units in 13 mostly western US cities, 1999-2002 | Peter W. Mayer, et al, National Multiple Family Submetering And Allocation Billing Program Study, 2004, Aquacraft, Inc. and the East Bay Municipal Utility District. http://li215-232.members.linode.com/sites/default/files/pub/Mayer-(2004)-National-Submetering-and-Allocation-Billing-Study.pdf |
| 7 | long-run ranged from -0.39 to -0.84 | 16 south Florida water districts, single family use, 2002 | Whitcomb, J.B., Florida Water Rates Evaluation of Single-Family Homes, Southwest Florida Water Management District, 2005. http://www.swfwmd.state.fl.us/documents/reports/water_rate_report.pdf |
| 8 | -0.38 average; -0.26 for high income; 40% larger when price posted next to quantity used | 1995, 383 utilities | Gaudin, S., Effect of price information on residential water demand, Applied Economics, 2006, 38:383-393. http://ron-griffin.tamu.edu/x677/readings/gaudin2006.pdf |
| 9 | short-run values of -0.3 to -0.4; larger values at higher rates | hundreds of studies reviewed | Olmstead, SM, and RN Stavins, "Managing Water Demand: Price vs. Non-Price Conservation Programs," Pioneer Institute White Paper No. 39, 2006.http://www.hks.harvard.edu/fs/rstavins/Monographs_&_Reports/Pioneer_Olmstead_Stavins_Water.pdf |

| | Elasticity Value | Context | Citation |
|---|---|---|---|
| 10 | -0.33 on average; -0.61 with tiered rates | 1028 households, 16 urban agencies, 1990s | S.M. Olmstead et al., Water demand under alternative price structures, Journal of Environmental Economics and Management 54 (2007) 181–198 http://www.hks.harvard.edu/fs/rstavins/Papers/Water_Demand_JEEM.pdf |
| 11 | short-run values of -0.263 to -0.522 for those consuming twice the average (40 CCF/bill) | City of Santa Cruz households, 1994-98 | Nataraj, Shanthi. "Do Residential Water Consumers React to Price Increases? Evidence from a Natural Experiment in Santa Cruz." *Agricultural and Resource Economics Update* 10(3) (2007):9-11. http://giannini.ucop.edu/media/are-update/files/articles/v10n3_3.pdf |
| 12 | indoor water use not responsive; -0.48 for large-lot outdoor use by above-avg income; -0.87 for small-lot outdoor use OR below-avg income | 1028 households, 16 urban agencies, 1990s | The Value Of Scarce Water: Measuring The Inefficiency Of Municipal Regulations, Erin T. Mansur and Sheila M. Olmstead, NBER Working Paper 13513, 2007.http://www.nber.org/papers/w13513 |
| 13 | from -0.34 for low users to -0.75 for high users; restrictions only gave 6-14% reductions | 10,000 households, 1997-2005, big rate increases, major drought, restrictions | Kenney, D.S. et al, Residential Water Demand Management: Lessons From Aurora, Colorado, JAWRA, 44:1, 2008. http://www.kysq.org/docs/Kenney.pdf |
| 14 | if shortage is 20% & elasticity is -0.40, then shortage will be avoided by temporary 50% price increase | overview – no data | Comparing price and nonprice approaches to urban water conservation, Sheila M. Olmstead and Robert N. Stavins, Water Resources Research, Vol. 45, W04301, doi:10.1029/2008WR007227, 2009. http://www.hks.harvard.edu/fs/rstavins/Papers/Olmstead_Stavins_Water_Resources_Research.pdf |
| 15 | elasticities at least twice as big in winter as summer, and larger for lower water users: -1.93(-0.99) for smallest users, -1.53 (-0.45) for largest users, in winter (summer); drought cuts summer elasticity by close to 2/3 | metro Phoenix data aggregated across 11 census blocks, 5 percentile ranks, 2000-03, new rates each season | H. Allen Klaiber, V. Kerry Smith, Michael Kaminsky, and Aaron Strong, Measuring Price Elasticities for Residential Water Demand with Limited Information, 2012 paper. http://aede.osu.edu/sites/aede/files/publication_files/Klaiber%20-%20Price%20Elasticities.pdf |
| 16 | 11% less use due to switch from bimonthly to monthly billing | 55 residential irrigation accounts served by City of Santa Cruz, 2006-2011 | Pourzand, Roxanna Neda, The Response Of Large Irrigation Accounts In Santa Cruz County To A Change In Billing Cycle: Implications For Conservation, UCSC senior thesis, 2012. http://ciwr.ucsc.edu/document_links/pourzand_senior_thesis_2012.pdf |