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- Contract with a company offering a mobile/internet application to monitor a customer’s water meter. E.g. <http://dropcountr.com/>
- Explore partnering with Aquajust, a company whose software enables buying and selling customer water allotments. <http://www.smart-markets.com/>

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1. Aquifer recharge with potable water.
2. Aquifer recharge on North Coast.
3. Adding a new water treatment facility---possibly at Bay St. reservoir.
4. Wells to tap Santa Margarita Aquifer in Live Oak area
5. Relocate the main San Lorenzo River diversion upstream
6. Accelerate the replacement of old pipes in the distribution system

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1. The City should conduct a cost/benefit analysis of funding stormwater infiltration projects in groundwater recharge zones.
2. It is recommended that the City convene a joint effort with Scotts Valley Water District and San Lorenzo Valley Water District to contract with the California Conservation Corps to engage in watershed restoration, including restoration of roads; storm water infiltration projects; and partnering with schools and community groups to do restoration.

## **Strategy #1: Price Water to Encourage Conservation**

A basic principle of *conservation pricing* is to charge for water based on how much water is used. The more you use, the more you pay. Although this seems like common sense, there are water utilities in California today that charge a fixed rate for each customer--- no matter how much water the customer uses. The advantage of fixed charges for the utility is a predictable and dependable revenue stream.

The City of Santa Cruz charges for the amount of water used---the *volume charge* portion of the water bill. The other portion of the bill is a fixed rate, called a *readiness to serve charge*. The fixed rate is the same for all customers of that class, (e.g., single family residential customers with a 5/8inch meter).

To further increase the incentive to conserve, the City's charges single-family residential customers a base rate for the lowest volume of water used, and higher rates for higher levels of water used. This is called tiered pricing. Table 1 below shows the tiered price structure for single family customers within the City limits. Customers outside the City pay rates that are 27% higher.

**Table 1: Current Single-Family Residential Monthly Rates  
(includes apts with separate meters)**

<b>Block</b>	<b>Category</b>	<b>Units</b>	<b>Rate</b>
1	Essential needs	1-4	\$1.57
2	Average indoor needs	5-9	\$4.00
3	Average outdoor needs	10-14	\$5.14
4	High use	15-18	\$7.05
5	Inefficient or excessive use	over 18	\$8.79

All customer groups that are not single family residential pay for water at the Block 2 rate. This includes businesses, apartment buildings with a single meter, dedicated landscape accounts, golf courses, etc.

Although the City's tiered rate structure provides a price incentive to conserve water, the fixed charge on a customer's bill does the opposite. When the fixed charge is averaged in with the volume charge, customers who use low or moderate amounts of water pay more per unit of water than customers who use more water. <sup>1</sup>

The City's proposed water rate increases will exacerbate this price penalty. If the new rates are approved by the City Council as planned, the lowest average price per unit will be paid by customers using 15 units per month, a "high use". Customers who use less will pay more per unit.

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<sup>1</sup> The lowest per-unit cost of water when the fixed charge is included is \$4.88 per unit. That's the price that is

There are many ways that Santa Cruz could eliminate the price penalty for conservation. They all involve shifting more of the Water Department's revenue from the fixed charge towards volume pricing. That shift is needed to put the City back into compliance with the California Urban Water Conservation Council's *Best Management Practice* (BMP) which states that revenue from fixed charges make up no more than 30% of a water agency's monthly revenue. Although the City committed to this BMP in its General Plan, it has been out of compliance for the last several years.

The effect of any of one of the following reforms would be to encourage conservation and make the price of water more equitable for customers who use low and moderate amounts. The pricing reforms could be structured to provide the City with reliable revenue.

**Recommendation:**

1. **Water budgets for all landscape accounts. Higher price tiers for exceeding the water budget.** The City has issued water budgets for *large* landscape accounts. Other communities, e.g. Irvine Ranch Water District, have water budgets for *all* landscape accounts. For water budgets to work effectively, there must be a price signal for exceeding the water budget. As part of the drought Stage 3 Curtailment, Santa Cruz has a price penalty for landscapes that exceed the budget. The City needs to implement water budgets with price signals in normal years.
2. **Price landscape water at Block 3 rates.** Currently single-family residential customers pay Block 3 prices for "average outdoor needs", while golf courses and dedicated landscape accounts pay Block 2 rates for landscape water. Charging the Block 3 rate for all landscape accounts would encourage conservation during the dry season---when we need it the most. The reform would also improve the City's compliance with Proposition 218, which prohibits one class of users from subsidizing another class of users.
3. **Tiered pricing for other customer classes** besides single family residential.
4. Increase the price signal by **making the tier steps steeper**. (Increase the price increment for each tier.)
5. **Implement tiers in the fixed charge.** A customer's monthly fixed charge could be based on that customer's highest month of usage during the previous year. This would allow capture of revenue from vacation homes. It would also encourage conservation during the peak season, as customers would have motivation to qualify for a lower tier.
6. **The marginal cost of new water supplies (or new conservation investments) should be charged to the highest tiers**, since low water users are not driving the need for new water supplies. An article published by the American Water Works Association<sup>2</sup> states:  
"When excess water consumption is priced to capture the costs associated with overuse, the rates more closely respect each customers' proportionality requirement by ensuring that those customers who stay within reasonable use of water don't pay for costs generated by those whose use is excessive."

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<sup>2</sup> Hildebrand et al, "Water conservation made legal: Water budgets and California law"

## Criteria Analysis: Conservation Pricing

### Effectiveness

Sue Holt is also submitting a proposal for demand reduction through water pricing. See her analysis of demand reduction rates in response to price increases.

An argument that has questioned the effectiveness of conservation pricing (or other measures meant to influence water use behavior) is the concept of demand hardening. According to the concept, we are close to reaching the limit in elasticity in demand. Customers can't or won't reduce water use much further in normal years. And in drought years they aren't able to either.

In 2001, the City commissioned Gary Fiske to conduct a Water Curtailment Study. In that report Fiske discusses the research on demand hardening. "Evidence of demand hardening is largely anecdotal. If anything, the literature suggests that demand hardening is largely a hypothetical issue....Survey research suggests that those making investments in long-term conservation also have the highest likelihood to reducing their demands during shortages."

Fiske's conclusion that demand hardening is not already occurring has been confirmed by experience in Australia, and also Santa Cruz customers' response to drought curtailment.

### Practicability

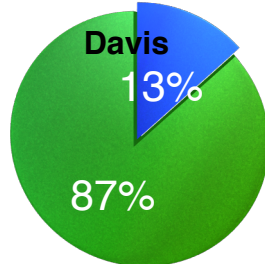
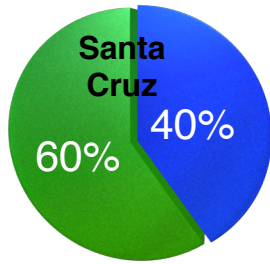
The principle disincentive for water utilities to adopt more robust conservation pricing is the tradeoff in revenue reliability. With fixed rates, water utilities can reliably predict their revenue. Viewed from the utility perspective, conservation pricing can work *too well*, with customers responding to price signals by reducing water use more than expected. In that case water agencies need to cover their expenses by returning to their governing bodies with requests for further rate increases.

Conservation pricing can be accomplished along with revenue reliability by including a price buffer in case demand reduction exceeds utility estimates.

If in spite of the buffer the feared scenario occurs, and revenue from water use is lower than needed---and the agency needs to request a rate increase--- it would be advantageous for customers to understand and support their agency's revenue structure. Water rates that rely more heavily on volume charges rather than fixed charges are more popular with customers. In June 2014, City of Davis voters overturned a new water rate structure due in part to the unpopularity of the high fixed charges. In July, 2016, the Davis City Council adopted a rate structure that reduces revenue from fixed charges to 13% of monthly revenue.

### Revenue from fixed versus volume charges

The California Urban Water Conservation Council *Best Management Practice* calls for a maximum of 30% of revenue from fixed charges. As the chart below displays, San Luis Obispo gets 100% of revenue from volume charges.

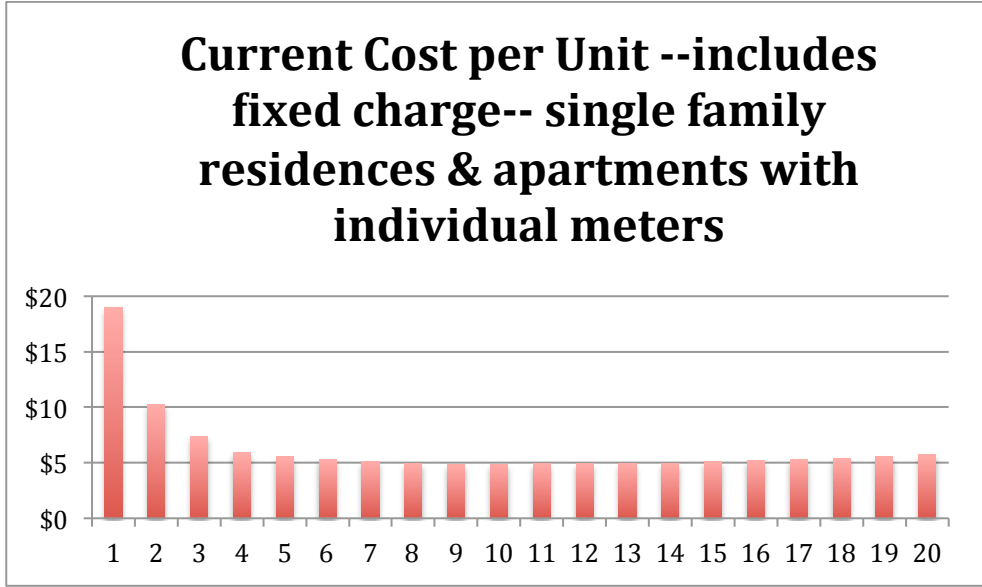


**Environmental and Community Impact**

The benefit of all demand reduction measures is their ability to eliminate or reduce the need for new water supply projects (and their environmental and financial impacts). The Draft Desal EIR estimated that the cost of desalinated water for Santa Cruz is \$10,750 per million gallons. Although some indications are that this figure underestimated lifecycle costs, it is still a very large amount compared to our existing water supplies. The *Integrated Water Plan* (2003) reported that the cost to transmit and treat 1 million gallons of water from Loch Lomond was \$170.

The graph below shows the current average cost per unit when the fixed charge is taken into account. The temporary drought surcharge (not depicted in this chart) will exacerbate the price penalty for low water use.

**Current Cost per Unit --includes fixed charge-- single family residences & apartments with individual meters**



## Strategy #2: Water-Neutral Development to Address Growth

### Growth Increases Our Drought Risk

Santa Cruz needs water policies that will allow reasonable growth to continue without eroding our water security. A City Water Department report put it this way:

“Continuing to provide water to new customers upon request, as is the current practice, may do harm to existing customers by making the potential water shortage situation worse than it would otherwise be.”<sup>3</sup>



The report describes why growth worsens the impact of droughts:

“It is important to note that, even in normal water conditions, three of the four major sources [North Coast streams, San Lorenzo River, Live Oak wells, and Loch Lomond] are presently being utilized at maximum capacity for a significant portion of the year...What this means operationally is that any future increase in seasonal or annual demand for water will be felt through greater and greater withdrawals from Loch Lomond reservoir.”

When a system reaches the limits of its capacity, an additional strain will have an outsized impact—as in the metaphor of the straw that broke the camel’s back.

### We Can Grow Without Using More Water

Water-neutral growth allows new development without increasing the total water demand on the system. Water-neutral growth is achieved by implementing a *water demand offset program*, where developers fund conservation retrofits elsewhere in the system to offset the new demand for water created by the development.

A water-demand offset program for new development encourages developers to build new buildings that are highly efficient. Developers can reduce their offset fees when they demonstrate that a building would use less water than current code requirements would otherwise indicate.

This is already working nearby. Inspired by early efforts by East Bay Municipal Utilities and San Luis Obispo County, Soquel Creek Water District has operated a water demand offset program since 2003.

### Drought Security Comes First

Soquel Creek District is revising its water-neutral growth policy and Santa Cruz can learn from their experience. District Board members pointed out the replacing toilets in the District to offset growth has only hastened the achievement of a level of efficiency that

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<sup>3</sup> *Adequacy of Municipal Water Supplies to Support Future Development* (2004)

would otherwise have been achieved over time with replacement of old plumbing fixtures. Looked at in this way, new development funds short-term savings, but in the long term adds additional demand to the system. The District's serious overdraft indicates that it would have been better to replace toilets---a highly cost-effective measure---to reduce *existing demand*. Developers could fund other measures to offset growth that are truly *additional* to ratepayer-funded conservation measures.

Similarly, Santa Cruz faces a choice between allocating conservation measures to *reduce water demand by existing customers* or devote those conservation measures to neutralizing growth. The former improves the City's water security during drought, while the latter just preserves the status quo.

We argue that **drought security for existing users ought to be the top priority of City conservation programs**. Every measure that reduces water demand of existing users means more water stored in Loch Lomond in case of drought. Developers can fund additional measures to offset growth, such as enhanced rebates for landscape conversion.

### **Recommendation:**

**The City needs to prevent growth from eroding our drought security by adopting a water-neutral growth policy in which developers fund conservation programs that aren't already funded by ratepayers.**

#### Effectiveness

The Soquel Creek Water District has found this to be an effective tool to accommodate growth while reducing the impact of growth on the water security of existing customers.

#### Environmental Impact

Compared to developing new water supplies, conservation has a lower environmental impact.

#### Practicability

For over ten years the Soquel Creek District has administered the program at a low cost.



### Strategy #3: Building Code Revisions & Onsite Water Systems

**Recommendation: the formation of a working group to consider building code revisions that include onsite water systems.**

This strategy calls for the City of Santa Cruz to adopt conservation measures that go beyond the California Building Code, so that new buildings are highly water-efficient---and can capture and re-use water onsite. In addition, the City can pass an ordinance requiring efficient fixtures in existing buildings. A precedent for the ordinance idea was created in 1991, when the City passed an ordinance requiring toilets in existing buildings to have a minimum efficiency.



**Oakes Hall, Vermont Law School, 2300 sq ft.  
Daily municipal water consumption=16 gals.**

Recent revisions in the California Building Code will make a big impact on water conservation. According to Maddaus Associates, the author of the City's draft Master Conservation Plan, savings in the Santa Cruz water service area resulting from California Building Code revisions will amount to 242 million gallons per year in 2030. That's six percent lower than the previous estimated water demand for 2030. Building code revisions will save more water than the sum of all the new conservation measures that Maddaus has identified in the Draft Master Conservation Plan.<sup>4</sup> Building codes are powerful tools to influence water conservation. And unlike financial incentives for conservation measures, the cost to the water utility is minimal.

Maddaus identified some potential building code requirements early in the process of drafting the Conservation Plan that didn't get included in the final draft.<sup>5</sup>

The last measure on the Maddaus list, *requirements for existing buildings*, could be combined with City rebates. For example:

- Require efficient dish wash sprayers in restaurants.
- Require replacement of all toilets using more than 1.6 gallons per flush in existing buildings.
- Require low-flush urinals in existing buildings.

<sup>4</sup> New measures identified by Maddaus amount to a total 192 million gallons/year savings in 2030.

<sup>5</sup> Measures that didn't get included in the final draft:

- a) Require .25 gal/flush urinals in new development
- b) Require hot water on demand in new development
- c) Require efficient dishwashers in new development
- d) Require plumbing for gray water in new development
- e) Ordinance requiring fixture replacement in existing buildings

Interestingly, the Final EIR for the La Bahia Hotel (2014) recommends measures that go beyond existing building code:

*Recommended Condition of Approval: Require incorporation of high efficiency water and energy-saving plumbing fixtures and appliances (toilets, urinals, washing machines, etc.) that go beyond current plumbing codes to minimize indoor water use.*

*Recommended Condition of Approval: As part of the landscaping and irrigation plan, require that only weather-based (ET) controllers be used on automatic irrigation systems to insure that irrigation is at the highest rate of efficiency.*

## Onsite Water Systems

David Sedlak, author of the book, *Water 4.0*, suggests that water agencies need to start looking towards decentralized water systems in order to avoid the increasing financial and environmental costs of centralization. He writes,

“If we can figure out ways to meet our water needs with local resources, to safely treat our wastes close to where they are produced, and to drain the streets without a centralized storm sewer system, we might break free of the cycle of costly investments and environmental damage that currently plague our current water and wastewater systems.”

Sedlak reports that “closed loop water systems in buildings have the potential to help cities break free of the need for centralized water treatment and distribution.”

The San Francisco Public Utilities Commission, with funding the Water Research Foundation, and the Water Environment Research Foundation, has created the *Blueprint for Onsite Water Systems, a Step-by-Step Guide for Developing a Local Program to Manage Onsite Water Systems*. It is available online at <http://sfwater.org/modules/showdocument.aspx?documentid=6057>

The first step in this guide is to create a working group that includes representatives of the water & wastewater utilities, health department, planning & building dept., non-profit and citizen stakeholders.

## **Strategy #4: Encourage Climate-Appropriate Landscaping**



We can increase our water storage in normal rainfall years and increase our resilience in drought years by transforming our landscapes so that they need less water.

In decades past, the City focused on water conservation measures that reduced *indoor* water use. This focus was based on the idea that outdoor irrigation constitutes discretionary water use that could be scaled back in drought years when water curtailment is required. Outdoor water use was considered a buffer that protected more essential water uses from the need for cutbacks during drought. Reducing the amount of the buffer didn't seem like a good idea.

Recently it has become apparent that a focus on conservation in landscape irrigation would actually increase the City's drought year resilience:

- ✓ The less water used in the dry season of normal years, the more water is stored in Loch Lomond and aquifers in case of drought the following year. So reducing landscape irrigation maximizes the buffer of stored water.
- ✓ Drought-tolerant landscapes give the system more resilience. When people have invested in plants that need frequent watering to survive, they feel resistant to dialing back irrigation in drought years.

### **Learning from this year's drought**

The big lesson from the customer response to the City's Stage 3 curtailment is that there is significant ability of customers to cut back on water use (elasticity in water demand). In its April forecast, the Water Department expected customers to reduce water use by 383 million gallons during the months of May through October. Customers have done better than that. The latest estimate from the Water Department is that water production will be 470 million gallons below last year during May-October.<sup>6</sup>

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<sup>6</sup> Slide 54a, Document D, Agenda Packet for Water Supply Advisory Committee August meeting. As a result of customer response, Loch Lomond Reservoir is higher than projected in April's forecast, at 62% capacity as of September 3, 2014, rather than 55%.

It will be valuable to read the Water Department's analysis of where the cutbacks in water use have taken place. In the meantime, it is reasonable to assume that much of the cutback has been in landscape irrigation. If that is so, then there is a large amount of demand elasticity in landscape water use.

A concerted effort should be mounted to analyze how to reduce landscape water use. The draft Master Conservation Plan does not provide measures that significantly impact landscape water use. For example, the estimated water savings from continuing the City's current turf-replacement rebate is just 1 million gallons per year. Doubling the rebate only saves 2 million gallons a year. Converting to water-budget based billing for landscape accounts is estimated to save only 7 million gallons per year---just 6% lower than these accounts would use without water budget billing. Comparing these small savings to the large reduction in landscape water use this year suggests a need to better understand how to achieve the untapped potential in landscape water use.

**Recommendation---investigate the cost/benefit of the following:**

- **Revise the water budget allotments.** The small (7 million gallons per year ) savings from converting to water-budget based billing suggests that the allotments in the water budgets are high. Compare Maddaus' projected savings from the City's landscape ordinance, 8 million gallons per year. That's a savings between now and 2030 on the small number of properties that the ordinance covers: *new* landscape projects and accounts associated with business, municipal and multi-family properties. If that much water can be saved on a relatively small number of *new* projects, this suggests that existing landscapes can save a whole lot more.
  - **Water budgets for *all* landscape accounts** not just the current large landscape accounts. Other communities such as Irvine Ranch Water District and Redwood City have adopted this approach.
  - **Price landscape water at Block 3 rates.** Currently single-family residential customers pay Block 3 prices for "average outdoor needs", while golf courses and dedicated landscape accounts pay Block 2 rates for landscape water.
  - **Co-sponsor community efforts to promote climate-appropriate landscaping** such as the Native Garden Tour; Monterey Bay Friendly Landscape; etc. The City could provide recognition or a prize for customers who achieve a "Water-Friendly Landscape" rating.
  - **Offer a free checkout of drip systems and training on how to use irrigation controllers.** Landscapers report finding many systems have leaks and are overwatering plants and most people struggle with programming their irrigation controllers. Many people have no idea on how much time to water plants. "In some cases, we have reduced water use as much as 70% after a landscape review and repair." –Golden Love, landscaper
  - **Offer free greywater and rainwater evaluations for every property that receives City water.** Implementation of alternatives could save as much as 70% on water bills during the highest demand times, according to Golden Love, landscaper.
  - **Increase rebate incentive to convert lawn and shrub spray irrigation heads, including drip micro-spray heads, to drip tubing.**
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## **Strategy #5: Beyond Curtailment**

“In the end, we will conserve only what we love. We will love only what we understand”.  
- Baba Dioum, Senegalese ecologist

Water Departments everywhere hate imposing mandatory curtailment. The goal of this strategy is to educate and empower the citizenry to use water in way that works for the whole community---including the wildlife, thereby diminishing or eliminating the need for mandatory curtailment.

In order to use water wisely, citizens need to understand:

- the water supply system and its impact on wildlife
- the quantity of our own water use
- how to adopt new water stewardship practices in response to a community need.

### **Department of Watershed Stewardship**

Increasingly, water utilities need a new name in order to reflect their new mission. The City of Atlanta’s water utility is called the Department of Watershed Management. That would be an appropriate title for the Water Dept of Santa Cruz, thanks to state and federal fisheries agencies that have made it clear that protection and restoration of the watershed is now at the core of the Department’s mission.

In order to inform the public about the impact of running a hose on a summer day, the Department needs to educate about the lifecycle of coho and steelhead salmon. We won’t love the salmon unless we get to know them.

**Recommendation: that the Department partner with schools and community organizations to do hands-on watershed restoration work and teach water conservation practices such as rainwater catchment, graywater recycling, climate-appropriate landscaping, and safe use of composting toilets.** (See the trailer for the video, “A Simple Question”, about schools in Sonoma County restoring creeks on private land.  
<http://www.pointblue.org/our-science-and-services/conservation-science/conservation-training/straw-program/>

### **Recommendation: Adopt the following feedback strategies:**

- Change the customer bills so that quantity of water is in gallons instead of ccf.
- Adopt “Water-Smart” type billing feedback, informing customers about meeting targets for fish habitat and reservoir levels.
- Publish in local media information about the goals v. actual water consumption, reservoir levels, and stream flow targets.
- Contract with a company offering a mobile/internet application to monitor a customer’s water meter. E.g. <http://dropcountr.com/>
- Explore partnering with Aquajust, a company whose software enables buying and selling customer water allotments. <http://www.smart-markets.com/>

## Criteria discussion---Beyond Curtailment

We know that cultural shifts about water use happen. One example of a cultural shift was seen in Queensland, Australia, where 20% of the population installed rainwater catchment tanks between 2006 and 2010.<sup>7</sup>

We know less about how cultural shifts happen, or how to encourage them to happen. One theory of diffusion of new ideas in a culture was put forth in a 1962 book, *Diffusion of Innovations*, by Everett Rogers. Rogers coined the expression, “early adopters”. He theorized that an innovative idea needed to be adopted by more than just the early adopters in order to be sustained. One role for a water agency is to discover the early adopters of innovative practices, and catalyze the adoption of those practices among a broader segment of the population.

It is likely that many early adopters in our community are motivated by a worldview that places a value on water stewardship because of the environmental impacts of water use (e.g. on fish populations). It is likely that our community has a good deal of consensus that fish habitat matters. It makes sense, then, that education around fish habitat be given institutional support.

The widespread presence of a value for conservation in a population is not sufficient for that sentiment to be expressed in action. An Australian study found indicated that

“Australians generally have very positive attitudes towards water conservation and water saving appliances, however these positive attitudes are not consistently translated into actual behaviour. The main barriers to adoption of water conservation behaviours identified in the study are: the perception of inconvenience and impracticality, as well as costs associated with purchasing water saving appliances.... It appears that attitudes are translated into action where it is easy to do so; where water conservation does not inconvenience people. For example, people are happy to run the washing machine only when it is full, but reusing water from the washing machine, the shower, sinks, and bath is much less common.”<sup>8</sup>

This finding suggests that a water agency should address the perception of inconvenience and cost.

Doug McKenzie-Mohr is a Canadian social psychologist who applies research from the social sciences to challenges such as the need to reduce water consumption. He has written *Fostering Sustainable Behavior, An Introduction to Community-Based Social Marketing*, in which he writes, “Numerous studies document that education alone often has little or no effect upon sustainable behavior.” McKenzie-Mohr advises that public education needs to be supplemented by removing

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<sup>7</sup> <http://latimesblogs.latimes.com/greenspace/2010/01/australian-water-crisis-provides-clues-for-california-at-gday-usa.html>

<sup>8</sup> Dolnicar, S. & Hurlimann, A. (2010). Australians’ Water Conservation Behaviours and Attitudes. *Australian Journal of Water Resources*, 14 (1), 43-53.

obstacles to participation. He recommends that water policy makers review existing research that identifies those obstacles, and to the extent possible conduct research on local conditions.

One could surmise that when McKenzie-Mohr speaks of “education”, he is not talking about the deeper kind of education that shifts a person’s understanding (and therefore love), for wildlife. Nevertheless, even the deeper education probably won’t be sustained unless it is accompanied by a shift in action. And so water agencies need to facilitate the shift in action by supporting groups of early adopters and subsequent adopters.

**Needed information & recommendations:** We are not able to recommend a dollar figure on the amount of investment in community education.

1. We recommend that the Water Department report on its existing spending on conservation education. A working group would then analyze and evaluate that report with a goal of recommending support for community groups that can catalyze the transition from early adoption to cultural shifts.
2. We recommend that the Water Supply Advisory Committee invite Ron Duncan from Soquel Creek Water District to speak about the District’s *Conservation Plus* program, which is more ambitious than any water agency conservation program that we know of.

#### **Feedback and water use management technology**

1. Mobile/computer application for monitoring the water meter The Draft Master Conservation Plan already proposes installation of AMI meters, a prerequisite for this technology. Presumably, the software to allow customers to read their own meters on their computers would be relatively low cost. The potential savings needs to be determined.
2. Aquajust (establishing a market among water customers to buy and sell allotments of water) has offered a low-cost pilot of their program. We recommend that the City seriously explore this offer, as there is much to gain and little to lose in the exploration. The gain, according to Aquajust, is the ability to reach target consumption levels without curtailment; elimination of customer dissatisfaction with water curtailment restrictions, and by extension, dissatisfaction with the water agency;

**Strategy #6:****Timely & Adequate Demand Management in Dry Years**

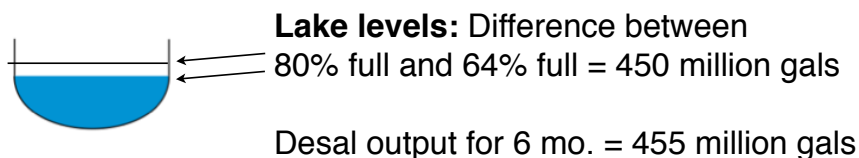
**Recommendation---that the City establish a policy of timely demand management in response to dry conditions that will enable adequate storage for future dry years.**

The timing and adequacy of the City's response to dry conditions significantly affects the severity of future drought curtailments. In general, early and adequate action to reduce water demand in the first dry year optimizes reservoir levels in case the subsequent years are dry.

To understand the importance of early action, it is illuminating to compare the City's response to dry conditions in 2009 versus in 2013. In 2009, in response to a second dry year, the City Council declared a Stage 2 response with a target of 15% reduction in demand. Citizens responded and the goal was met. On October 1st, Loch Lomond was at 90% capacity. At that level, even a subsequent dry winter would likely fill the lake and the City would be well prepared for a third dry year.

In April, 2013, in response to the negligible rain since December, the City Council declared a Stage 1 drought response, aiming for a 5% cutback in water demand. The goal was to have 75% capacity in Loch Lomond on October 1st. At year's end, instead of achieving a 5% reduction in demand, water demand actually rose slightly. The City didn't achieve its goal for Loch Lomond capacity, and lake levels continued to drop to a low of 63% in December. Had the City initially called for a Stage 2 response, reservoir levels would have been significantly higher, providing more water security for 2014 and beyond.<sup>9</sup> Even invoking a Stage 2 response late in the year could have reduced demand on the reservoir, which dropped significantly between September and December.

This strategy of timely and adequate response to dry conditions can be thought of as a *carry-over strategy*, until other longer-term strategies, such as banking water in the aquifers, can be implemented. Once the City has more storage, there will be less need to implement demand reduction measures in the first dry year.



<sup>9</sup> The Water Department classifies each year as wet, normal, dry, or critically dry, based on cumulative runoff in San Lorenzo River. Cumulative runoff is a metric that should probably be revised in order to guide decisions about what stage of water shortage response to invoke. For example, 2013 was the driest calendar year on record. However, because of heavy rain in December, 2012, the runoff year was declared "normal", even though flows in the river and streams were well below normal by April and throughout the dry season.



## **Strategy #7 : Aquifer Restoration via Inter-District Collaboration**



The submission to the WSAC by County Water Resources Director, John Ricker, discusses aquifer recharge by means of sending river water to Scotts Valley and Soquel Creek during winter months, allowing those districts to reduce their well pumping. The submission by Piret Harmon, General Manager of Scotts Valley Water District, discusses aquifer recharge by means of injection wells or surface water infiltration at the Hanson Quarry. These are two of the ten aquifer recharge strategies ranked by Kennedy/Jenks according to cost/benefit and feasibility<sup>10</sup>. Both strategies allow Santa Cruz to “bank” water in the aquifers for use during critically dry years. This discussion is to offer additional information about the long-term potential yield of those strategies.

### **Aquifer recharge should be a principal adaptation to climate change**

The Water Supply Advisory Committee has committed to do water supply planning in the context of an uncertain future climate. Climate modeling points towards a shorter wet season for this region, even in models that envision similar or increased total precipitation. A shorter wet season means reduced aquifer (groundwater) recharge. Lower aquifer levels mean lower stream flows, since the aquifers feed the springs that run off into creeks.

**Recommendation---** that the City commit to aquifer restoration as a principal strategy to prepare for climate change. The Purisima Aquifer, source water for the City’s Live Oak wells, is overdrafted and threatened with salt water intrusion. The Santa Margarita Aquifer, source water for the San Lorenzo River is 200 feet lower than historic levels in the Scotts Valley area.

### **Recharged aquifers yield more water in droughts**

Restoring the Santa Margarita Aquifer would mean that the San Lorenzo River would have a higher base flow in summer months of drought years. Moreover, if the City and Scotts Valley can agree on the *water transfer strategy*, the Santa Margarita Aquifer will be the City’s new savings account. “Santa Cruz Water Department should be able to purchase the banked groundwater in periods of drought”, according to the Kennedy/Jenks study.

If the Purisima Aquifer can be restored to safe levels, Santa Cruz would be able to pump much more water from Live Oak wells during drought years than the City is able to do today. As recently as 2003, the *Integrated Water Plan* assumed that production from Live Oak wells would be 2 million gallons per day. According to the City’s current agreement with Soquel Creek Water District, the City only draws half that much. If the aquifer could be restored enough to allow the City to pump 2 million gallons per day during drought years, the additional 1 million gallons per day represents 40% of the output of the proposed desal plant.

<sup>10</sup> Kennedy/Jenks, *Conjunctive Use and Advanced Aquifer Recharge Project* (2011)

The additional water from Live Oak Wells could be augmented by water from Soquel Creek District wells if the water transfer plan is implemented. According to the submission by John Ricker, "With current infrastructure and the addition of a pump station at 41st Avenue, Soquel could pump 1.44 mgd to the City, or 172.8 million gallons (530 acre-feet) over a 4 month period." Assuming that Santa Cruz would not purchase this water except during critically dry years, that means a water transfer from Soquel Creek District every 6.5 years. The amount of water coming back to Santa Cruz represents about 18% of the water Santa Cruz would supply the District over a 6.5 year period with existing infrastructure (an average 145 million gallons per year).

### **A new reservoir (underground) increases the yield of the old reservoir**

Loch Lomond has always served two functions: provision of water during the dry season, and a reserve for future dry years. Because of Loch Lomond's small size relative to the City's water demand, the need to keep a safe water reserve for future dry years means that the City typically operates the system so that the reservoir remains at high levels through the dry season of normal years. Even in a dry year with Stage 2 restrictions such as 2009, Loch Lomond was over 90% full at the end of September. Given the current lack of underground storage, Desal Alternatives applauds the Water Department's cautious approach in keeping the reservoir at high levels. At the same time we recognize that this approach misses the opportunity to capture more water in the reservoir.

A high lake level at the end of the dry season means that the lake will not capture much storm water in the winter. If the lake is full as of early January, any future storm runoff will spill over the dam.

In one of life's few "if you spend more, you get more" situations, if the City would use more Loch Lomond water in the dry season, it could capture more winter water.

Using the aquifers as storage would allow the City the security to use more Loch Lomond water during the course of normal years.

The average water production from Loch Lomond during 2002-2011 was 484 million gallons per year. In all of those years the reservoir filled during the course of the rainy season. We estimate that the City could double the average reservoir production of recent years and the reservoir would still refill in most winters.

The California Department of Fish and Wildlife has recommended that the City petition to increase its current maximum water right to using 1 billion gallons per year from Loch Lomond. The CDFW recognizes that the reservoir is key to reducing the City's need to divert water in the dry season from river and creeks. The recommendation to use the reservoir in this way would be a lot more viable if the City begins banking water in the aquifers. The benefits of this strategy increase over time.

## **Strategy #8: Water Supply Infrastructure**

In this submission we include water supply infrastructure strategies that could increase the City's water supply, or the system safety and reliability, or both. (The City Council's statement of purpose for the Water Supply Advisory Committee included analyzing "future threats" to the water supply and "potential solutions to deliver a safe, adequate, reliable and environmentally sustainable water supply".)

**Recommendation---that the City conduct an evaluation of the cost, benefit, feasibility and environmental impact of the following:**

**1. Aquifer recharge with potable water.** Fugro and Associates (1999)---included in Carollo Engineers, *Alternative Water Supply Study, 2000*) makes a brief mention of the possibility of injection wells to recharge the aquifer in the vicinity of the Beltz wells. Using potable water for recharge would require water rights revisions, to allow diversion of San Lorenzo River water to storage.

**2. Aquifer recharge on North Coast.** Fugro also recommended exploring the potential of aquifer recharge using a quarry at Wilder Ranch for infiltration and wells in the vicinity to recover groundwater during the dry season.

**3. Adding a new water treatment facility---possibly at Bay St. reservoir.**

In the WSAC August agenda packet is Document Q, a Vulnerability Report from City staff. The report concludes:

One area that continues to receive attention is treatment redundancy. The City operates 2 treatment plants with over 90% of its water being treated at the Graham Hill Treatment Plant...A redundant facility would improve reliability and redundancy and meet emergency flows, at a minimum, should the Graham Hill Plant be out of service for an extended period of time.

The CDM study of system reliability<sup>11</sup> concluded,

...Major damage to or catastrophic failure of the finished water tank, backwash tank, or reclaimed water tank could render the Graham Hill Plant inoperable for significantly longer than the 7 days and 30 days<sup>12</sup> specified in the proposed reliability goals for emergency outages.

CDM makes the recommendation to "Evaluate the benefits/cost of a second surface water plant to provide redundancy."

Water from the North Coast streams arrives at Bay St. reservoir by gravity. Historically the Bay St. reservoir supplied the City via gravity. The advantage of a gravity-powered water supply will once again be appreciated in a future of high electricity prices and potential electricity brown-outs and black-outs. Adding an array of solar panels at the Bay St. reservoir, and DC-powered pumps, would add the ability to treat water and/or pump water to higher elevations in the system during extended electricity black-outs.

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<sup>11</sup> CDM, "Technical Memo No. 2, System Service Reliability Goals", (2002)

<sup>12</sup> 6 million gallons per day within 7 days; 12 million gallons per day within 30 days

There is a potential need for additional water treatment capacity if the City and neighboring water agencies adopt a plan for water transfers. According to a report from County Water Resource Director, John Ricker<sup>13</sup>, one option calls for the Graham Hill Plant capacity to be upgraded from 10mg/day to 16 mg/day capacity. If a redundant water treatment facility were built at the Bay St site, this would have the potential to free up sufficient capacity at Graham Hill Treatment Plant so that no expansion there would be necessary to maximize the yield from water transfers.

#### **4. Wells to tap Santa Margarita Aquifer in Live Oak area**

Carollo Engineers (2000) recommended this strategy and reported that there are no existing wells that are deep enough to tap this aquifer. The City built a test well to provide information about this option.

#### **5. Relocate the main San Lorenzo River diversion upstream**

The San Lorenzo River at the site of the Tait St. diversion used to have a higher velocity flow in the dry season of past years than it currently does. The diversion site is just about ten feet upstream from stagnant ponding. This will be exacerbated by sea level rise, with the lagoon at the river mouth extending farther upstream.

The CDM report on system reliability notes that the City's principal diversion on the San Lorenzo River and adjacent pump station are vulnerable to floods. The 1982 flood nearly inundated the pump station. The California *Climate Adaptation Strategy* (2009) reports, "With a sea level rise of approximately one foot, the anticipated 100-year flood event in Santa Cruz is expected to occur every 10 years, increasing the likelihood of storm-related inundation."

Moving the City's main diversion upstream of Paradise Park will also improve source water quality, as septic systems in Paradise Park have insufficient distance from the river.

#### **6. Accelerate the replacement of old pipes in the distribution system**

Bill Kocher once reported to the Water Commission that the City would have to invest eight times the amount of money it currently spends on replacing water mains in order to meet the standard recommended by the AWWA.

Investing in pipe replacement is a water conservation strategy, since old pipes leak. The Draft Master Conservation Plan calls for expanded main replacement and active leak detection.<sup>14</sup> The Draft lists the estimated cost per million gallons of water saved is \$2,344, which ranks this measure in the top tier of potential conservation measures. The cost of main replacement should be understood in the context that the mains would need replacement at some point anyway. Hence the expenditure is not really discretionary. With that in mind, it makes good economic sense to expand the main replacement well beyond the amount envisioned by Maddaus in the Draft Conservation Plan.

Even more important than the conservation value of this measure is the benefit to system reliability. As CDM notes in their study, in the 1989 earthquake it took six weeks to restore the 82 breaks in distribution mains. "Aging cast-iron, galvanized steel, and asbestos-cement distribution lines suffered approximately 75% of the failures." The earthquake damage to distribution pipes meant that fire protection was compromised.

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<sup>13</sup> John Ricker, progress report to Soquel Creek Water District, Nov 5, 2013

<sup>14</sup> Maddaus, "Draft Master Conservation Plan", Measure #1, Water Loss Control Program

## **Strategy #9 : Watershed Restoration**

This submission recommends watershed restoration as a strategy for aquifer recharge as well as habitat restoration for federally listed fish species.

### **Low Impact Development**

It is not only over-pumping that depletes aquifers. Aquifer depletion occurs when impervious surfaces prevent rainwater from penetrating the ground. Several aquifer recharge strategies were evaluated in a recent study by Kennedy/Jenks.<sup>15</sup> The study ranked the top ten strategies according to cost/benefit and feasibility. The study's #1 alternative is *Enhanced Stormwater Recharge through Low Impact Development in Scotts Valley*. This involves retrofitting streets and parking lots to allow rainwater to penetrate the sandy soils of Scotts Valley.

The fact that *low impact development* was named the most cost effective aquifer recharge strategy should give us a wake-up call. Our water agencies invest in *low impact development* if there is state grant money available. But if retrofitting impervious surfaces is a cost-effective strategy protecting and enhancing our water supply, it should be considered for direct ratepayer funding.

**Recommendation:**  
**The City should conduct a cost/benefit analysis of funding stormwater infiltration projects in groundwater recharge zones.**

### **Sediment Reduction Strategies**

In the past the Water Department has had the luxury of avoiding water from streams and river during and after storms when the water is too muddy. Instead of diverting turbid river water, the City has used reservoir water during these events. The City is now considering water treatment upgrades to enable it to treat turbid water. Lowering turbidity in our source water would ease the burden on water treatment technology. So it makes sense to consider investments in strategies to reduce human-caused sediment runoff into our streams. This would also benefit fish habitat, since sedimentation is *the major factor* besides excessive water diversions in preventing steelhead and coho salmon from successful reproduction.

Sediment runoff in the San Lorenzo River watershed is a formidable problem. A Metro Santa Cruz article, *Roads to Ruin*, reported, "Santa Cruz County environmental planner Dave Hope ... echoes an opinion widely held among geologists, biologists and even foresters that disastrous erosion problems stem from an estimated hundreds of miles of both new and abandoned logging roads and illegally constructed roads that snake throughout Santa Cruz County."<sup>16</sup>



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<sup>15</sup> Kennedy/Jenks study, *Conjunctive Use and Enhanced Aquifer Recharge Project, Phase One* (2011)  
[http://scceh.com/Portals/6/Env\\_Health/water\\_resources/FINAL\\_SCCUP\\_Phase1\\_Report\\_082211\\_small.pdf](http://scceh.com/Portals/6/Env_Health/water_resources/FINAL_SCCUP_Phase1_Report_082211_small.pdf)

<sup>16</sup> "Roads to Ruin", Kelly Luker, Metro Santa Cruz, April 16, 1998

The County developed a San Lorenzo Watershed Management Plan in 1979 that called for watershed restoration. An update to the plan in 2000 reports:

Stronger regulations were implemented to reduce erosion from new development, but many of the recommendations for funding and technical assistance to address existing chronic erosion sources were not fully implemented due to significant funding cutbacks in local and federal programs. Stream sedimentation has not improved substantially since adoption of the 1979 Plan. Chronic sediment contribution from public and private roads remains as a significant source of stream degradation.<sup>17</sup>

Recent monitoring indicates that there has been some improvement in stream sedimentation during storm events.<sup>18</sup>

The City is prepared to commit to a Habitat Conservation Plan that will require the City to invest in watershed restoration projects. The City's Draft HCP (2011) discusses watershed restoration projects:

The City will provide funding for the Santa Cruz County Resource Conservation District to set up a Technical Advisory Committee to guide and implement region-wide restoration priorities. The City will provide annual funding for projects and the TAC will decide on projects and allocate the funds.<sup>19</sup>

We note that there exists a huge backlog of needed watershed restoration work alongside a need for local youth employment. The California Conservation Corps contracts with local government agencies to conduct restoration projects. A half-million dollars per year would employ 12 CCC youth.

**Recommendation:**

**It is recommended that the City convene a joint effort with Scotts Valley Water District and San Lorenzo Valley Water District to contract with the California Conservation Corps to engage in watershed restoration, including restoration of roads; storm water infiltration projects; and partnering with schools and community groups to do restoration.**

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<sup>17</sup> San Lorenzo Watershed Management Plan Update, p 4

<sup>18</sup> Balance Hydrologics, *Suspended Sediment Monitoring for Zayante, Bean and Valencia Creeks* (2010)

<sup>19</sup> "Examples of the types of projects that may be funded under this program include:

- Projects that decrease watershed sedimentation rates (cost share for roads program, etc.)
- County LWD management program support
- Infiltration/recharge projects
- Graywater/recycled water projects
- Lagoon/off channel habitat creation
- Passage improvements (Newell, SLR gorge, Upper San Lorenzo River, etc.)
- Restoration Project maintenance/monitoring (San Vicente pond, etc.)
- Other projects as identified by TAC in key Central Coast ESU watersheds/ other cohowatersheds as identified by recovery plan.