Response to WSAC Questions

Concerning Interim Baseline Demand Forecast

Prepared by
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February 11, 2015

Several WSAC members submitted questions concerning the interim baseline demand forecast that I will be presenting at its February meeting. In addition to discussing these questions at Thursday's meeting, I thought it would be helpful to provide written responses as well. I also address the concerns about the forecast raised by SC Desal Alternatives in its February 10 Water Wonk Week email broadcast. I have chosen to answer each question in full even though this entails some repetition since some topics (such as drought rebound) are raised by more than one questioner.

Questions from Sue Holt

1. Rebound

Is there a conflict between expecting a full rebound in demand from our current drought (such as we've seen after past droughts) vs. the weakening relationship between income and water demand that you discuss (page 6, due to the factors mentioned in footnote 10)? When we recover fully from this drought (fingers crossed), will demand return to its previous level or will users' behavior and equipment have changed to some extent? Have complete rebounds been seen in other regions that have recovered from recent droughts? Should we be moderating our assumption about the extent of rebound to expect for Santa Cruz this time?

It is important to keep in mind that droughts don't occur in a vacuum, so that when we look at the data on past droughts and recoveries we have to be cognizant of other factors at play. I have tried to illustrate this in the Feb WSAC baseline demand presentation slide 12 (also reproduced below on page 4). For example, looking at 1977, which was a short but deep drought, rebound in demand was quick at first then the economy went into a sharp recession in 1981 and then 1982 and 1983 were very wet El Nino years. Demand fell in 1982 and 1983 primarily because of wet weather, but by 1985 it was about 9% above where it had been in 1976. Had there not been a recession or the two El Nino years, in my estimation the rebound would have occurred sooner. The pattern of recovery from the 1987-91 drought was also confounded by the 1990-91 economic recession. But from the end of 1992 it took about five years for demand for recover to its pre-drought level. Similarly, the 2009 drought coincided with the worst recession since the Great Depression. When the drought ended, the economy was still mired in recession. Unemployment in Santa Cruz County did not peak until February of 2010 at 15.5%. Unemployment has since fallen to about 6.0%. The recession would have slowed any rebound from the drought. Of equal or greater consequence, 2010-11 was unusually wet, especially in the spring of 2011, which reduced demand by delaying the start of the irrigation season. Demand starts to recover in 2012 and 2013 (Stage 1 restrictions still in place), but then Stage 3 water use restrictions are imposed in 2014.

During each of these drought-recovery episodes, other factors were also at work. Population and income were changing, technology was advancing, plumbing codes and appliance standards were

changing, and water rates were increasing. These factors were also influencing demand for water. In the interim baseline demand forecast we have tried to make allowances for these various factors. As a consequence, the forecast does not predict that demand will "fully recover" to levels seen before the 2009 drought. In fact, the interim baseline demand forecast does not again reach the level seen in 2013.

The interim baseline demand forecast starts with actual demand in 2014, which reflects the effects of Stage 3 drought restrictions. Demand in 2014 was about 30% less than average demand for 2007-08. Absent the reinstatement of mandatory water use restrictions, the interim baseline forecast predicts that irrigation uses, which were sharply curtailed by administrative fiat in 2014, will rebound quickly. It assumes the recovery of residential demands will be much more gradual, lasting five years. At the same time, the forecast is adjusting for the on-going effects of plumbing codes, appliance standards, conservation programs, and rising water rates, such that the net result is demand never "fully recovers" to its 2007-08 level. The drought recovery in the interim baseline demand forecast follows a pattern similar to what was observed following the 1977 drought, except that in the interim baseline forecast demand peaks after three years of growth and then declines thereafter. The interim baseline forecast in 2015 is 19% less than average demand in 2007-08; in 2025 it is 14% less; and in 2035 it is 16% less.

2. Normal droughts

The baseline is meant to characterize normal conditions and normal conditions include a drought every 15 years or so. Perhaps our baseline should include another drought in the next two decades, say 2030-2035. If we don't program in another "regular" drought, we'll need to devote one of our scenarios for this purpose. Since we'll be limited to maybe four scenarios, devoting two of them to the baseline and a regular drought seems wasteful. It would leave us with only two scenarios to play with to characterize our future possibilities.

I would characterize the purpose of the baseline demand forecast somewhat differently. It is meant to characterize the amount of water customers are expected to demand, given projected water rates, income level, population growth, and improvements in water use efficiency. It is a prediction of future demand assuming customers are free to choose how much they consume given the forecasted future cost of water and other factors.

Drought, per se, is not a function of demand. It is an outcome of hydrology. The consequences of drought depend on both the level of demand and the availability of supply. Confluence simulations are used to evaluate these consequences under varying hydrology. Assessing the consequences of more frequent droughts, longer droughts, or deeper droughts requires changing the underlying assumptions about future hydrology, such as is being done for the climate change analysis.

While demand does not depend directly on hydrology, it is influenced by weather. Hotter, drier years push demand up. Cooler, wetter years push it down. The Confluence model makes adjustments to the baseline demand forecast to account for these weather effects when it runs a simulation.

3. Weighting of elasticities

In Table 6, it's unclear how the weighted annual average elasticity values were calculated across the different categories. Single-family and multi-family categories seem to carry different summer vs. winter weights.

To calculate the weighted average elasticity, the 12 calendar months are divided between winter and summer categories. The winter category represents months in which outdoor water use is low and demand is primarily for indoor uses. Indoor demands are less responsive to price changes. The months of Jan-Apr and Nov-Dec are assigned to the winter category. The summer category represents months in which outdoor water use is high. Outdoor demands are more responsive to price changes. The months of May-Oct are assigned to the summer category. The winter and summer weights are calculated separately for the single-family, multi-family, and non-residential customer categories using 10 years (2001-2010) of monthly consumption data. For the single-family customer category, the winter weight is 40% and the summer weight is 60%. For the multi-family customer category, the winter weight is 46% and the summer weight is 54%. For the non-residential category, which includes commercial, municipal, irrigation, and golf, the winter weight is 36% and the summer weight is 64%.

4. References

My online search could not find the citation in footnote 7 - the CUWCC's Water Conservation Rate Structures Handbook. Can a link to the document be provided? Might we also have links to the two Cal Water studies mentioned in footnote 8?

The two Cal Water studies are not yet publicly available. They will become public documents when Cal Water submits its General Rate Case filing with the CPUC in the summer.

The full citation for the CUWCC handbook is:
Chesnutt, Thomas W., et al. "Designing, Evaluating, and Implementing Conservation Rate Structures: A Handbook Sponsored by the California Urban Water Conservation Council." California Urban Water Conservation Council, Sacramento, Calif. (1997).

I do not know if it is electronically available. I believe copies may be obtained by contacting the CUWCC: 916-552-5885.

Questions from Rick Longinotti

1. Need to update the estimate of current water use

You have used as a starting point the 2010 Urban Water Management Plan's estimate of current water use. That Plan used an average of 2007-2008 water consumption as its estimate of current water use. However, water use declined steeply in 2009 due to Stage 2 restrictions. Though restrictions were rescinded, water use dropped below 2009 levels in 2010 and dropped again in 2011. Water demand rose in 2012 and again in 2013, but still remained lower than the 2007-08 levels. Shouldn't our current demand estimate be updated to reflect our recent water use? I recommend averaging the years 2010 through 2013.

The interim baseline demand forecast starts with actual demand in 2014, which reflects the effects of Stage 3 drought restrictions. Demand in 2014 was about 30% less than average demand for 2007-08. Absent the reinstatement of mandatory water use restrictions, the interim baseline forecast predicts that irrigation uses, which were sharply curtailed by administrative fiat in 2014, will rebound quickly. It assumes the recovery of residential demands will be much more gradual, lasting five years. At the same time, the forecast is adjusting for the on-going effects of plumbing codes, appliance standards, conservation programs, and rising water rates, such that the net result is demand never "fully recovers"

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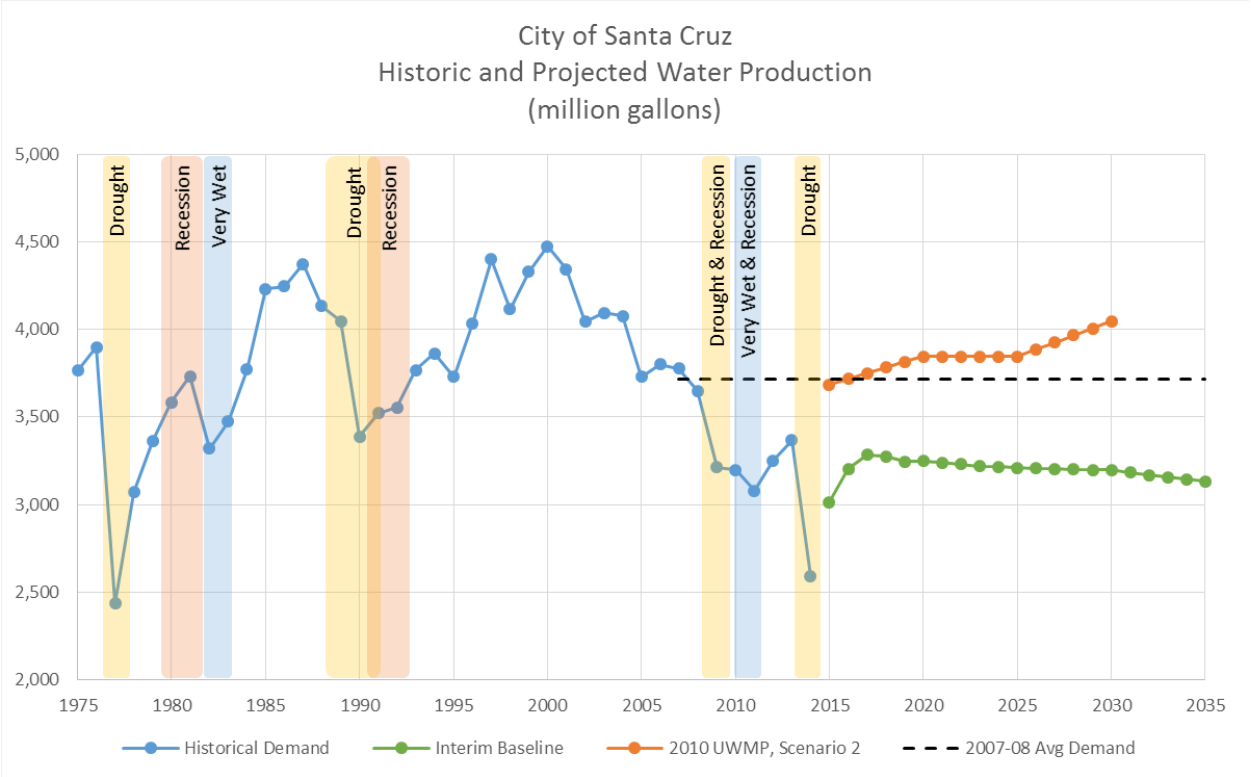
Average demand for 2010-13 was 3,224 mgy. The interim baseline demand forecast is within +/- 3% of this average, except in 2015 where it is 6% less. After 2025, the interim baseline demand forecast always is less than average demand for 2010-13, despite projected growth in population and the economy. The figure below compares historic demand to the interim baseline demand forecast as well as the 2010 UWMP demand forecast. It also shows average demand for 2007-08 to facilitate the comparison with the interim baseline forecast.



2. Residential Growth Adjustment

You have adjusted the 2010 estimate of growth in commercial water demand to better reflect actual growth trends in commercial water use. Would it be warranted to adjust the residential water demand estimate to better reflect actual rates of residential building?

The inside-city component of the interim forecast is predicated on the City's General Plan 2030 and its accompanying EIR. The outside-city component is predicated on AMBAG projections. The General Plan serves as the principal policy and planning document guiding long-range land use decisions in cities and counties and the Water Department tries to align its demand forecasts with it. The Water Department will be updating the residential growth projections for the 2015 UWMP, but these were not ready yet for inclusion in the interim baseline forecast. The interim projection can be adjusted if warranted when the updated growth projections become available. Additionally, the statistically-based demand models

the Water Department will be developing over the next several months will incorporate the updated residential growth projections.

3. UCSC growth

You use an estimate for UCSC growth that is based on the settlement agreement between the City and UCSC that estimates that water demand on campus will roughly double by 2030. Since that settlement agreement, our local LAFCO has adopted the following policy:

"In cases where a basin is overdrafted or existing services are not sustainable, a boundary change proposal may be approved if there will be a net decrease in impacts on water resources."

Because of this requirement, UCSC will need to participate in a program to offset their proposed increased water use. Because of this LAFCO requirement, wouldn't it be more realistic to model water demand at UCSC remaining flat?

See separate discussion of this issue.

4. Growth in Income Adjustment

You note that water use rises with income, due to larger houses, larger landscapes, pools, etc. You've chosen to estimate an increase in water use due to rising income, using an elasticity coefficient that is based on two studies. Can we trust that those studies would produce results consistent with our community, in which large homes often have landscapes that use less water, and the culture of water conservation extends across income levels?

The income elasticity for the interim baseline demand forecast was purposely selected to be at the lower end of the range of published estimates for income elasticity for the reasons you cite. The average income elasticity reported in Hanemann's (1998) review of 39 published studies of municipal water demand was 0.52 and the median was 0.43.[1] The estimate we are using for the interim baseline forecast is 0.25. Thus we are assuming an income effect that is 42% smaller than the median effect and 52% smaller than the average effect reported in the studies summarized in Hanemann (1998). As stated in the demand memorandum, the estimate we are using is consistent with estimates derived from two analyses of 24 different water service districts located throughout California, representing a broad mixture of residential communities – large, small, high income, low income, inland, coastal, northern, southern, and central -- and trends in water use over the last 10 years. In my estimation we are using a defensible and conservative estimate of the income effect on water demand, but I don't disagree that it would be preferable to have an empirical estimate derived from local data. Estimating income response will be part of the statistically-based demand models the Water Department will be developing in the next several months.

5. Drought Recovery

You have assumed following the greatly reduced consumption of 2014 that water demand will completely return to previous levels by 2020. Doesn't history suggest that although there is a rebound of

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water consumption following curtailment, that the rebound won't reach previous levels? The 2010 UWMP notes that water consumption peaked in 1987 at 4.1 billion gallons. Following the drought years of 1988-91, the City's water use never reached the previous peak. The UWMP reports that "After restrictions ended, water use gradually recovered over a period of several years and then stabilized at a level of about 3.75 billion gallons at the beginning of the decade." That's a drop of almost 9% below the 1987 peak.

It is important to keep in mind that droughts don't occur in a vacuum, so that when we look at the data on past droughts and recoveries we have to be cognizant of other factors at play. I have tried to illustrate this in the Feb WSAC baseline demand presentation slide 12. For example, looking at 1977, which was a short but deep drought, rebound in demand was quick at first then the economy went into a sharp recession in 1981 and then 1982 and 1983 were very wet El Nino years. Demand fell in 1982 and 1983 primarily because of wet weather, but by 1985 it was about 9% above where it had been in 1976. Had there not been a recession or the two El Nino years, in my estimation the rebound would have occurred sooner. The pattern of recovery from the 1987-91 drought was also confounded by the 1990-91 economic recession. But from the end of 1992 it took about five years for demand for recover to its pre-drought level. Similarly, the 2009 drought coincided with the worst recession since the Great Depression. When the drought ended the economy was still mired in recession. Unemployment in Santa Cruz County did not peak until February of 2010 at 15.5%. Unemployment has since fallen to about 6.0%. The recession would have slowed any rebound from the drought. Of equal or greater consequence, 2010-11 was unusually wet, especially in the spring of 2011, which reduced demand by delaying the start of the irrigation season. Demand starts to recover in 2012 and 2013, but then water use restrictions are imposed in 2014.

During each of these drought-recovery episodes, other factors were also at work. Population and income were changing, technology was advancing, plumbing codes and appliance standards were changing, and water rates were increasing. These factors were also influencing demand for water. In the interim baseline demand forecast we have tried to make allowances for these various factors. As a consequence, the forecast does not predict that demand will "fully recover" to levels seen before the 2009 drought. In fact, the interim baseline demand forecast does not again reach the level seen in 2013.

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Questions from Doug Engfer

1. Is there anything missing from this baseline, or is this full-system demand?

The interim baseline demand represents full system demand for treated water delivery. This includes metered water consumption from all of the city's customers, miscellaneous unmetered used, and system water loses. It does not include raw water transmission losses and raw water sales to north coast agriculture.

2. Growth

Please characterize the growth rates inherent in the General Plan. What is annual % growth in population, jobs, etc.?

Population forecast for inside- and outside-city service areas are from the AMBAG Monterey Bay Area 2008 Regional Forecast, as reported in Table 2-3 of the 2010 UWMP. Service area 2010-2035 forecasted population growth rate is just under 0.5%.

Projected growth in housing and commercial/industrial space within City of Santa Cruz is reported in Table 4-9 of 2010 UWMP. 3,350 new residential units are forecast for 2010-2030. The forecast is taken from the City's General Plan 2030 buildout analysis (DC&E, 2009). This corresponds to an annual growth rate of about 0.7%. Housing and commercial/industrial growth rate outside of the City of Santa Cruz is projected to be same as the AMBAG population forecast.

Table 2-3. Population Forecast for the Santa Cruz Water Service Area (a)

Year	2010	2015	2020	2025	2030	2035
City of Santa Cruz	58,919	62,480	63,265	64,649	65,884	67,807
Santa Cruz County	32,236	32,831	33,478	34,162	34,746	35,176
City of Capitola	1,010	1,020	1,050	1,070	1,070	1,075
Service Area Total	92,165	96,331	97,793	99,881	101,700	104,058

Notes:

(a) Source: AMBAG Monterey Bay Area 2008 Regional Forecast

General Plan 2030 Water Demand

	Buildout Projections (a)	Water Factor	Water Demand (mgy)
Single Residential (b)	840	194 gal/unit/day	59.6
Multiple Residential (b)	2,510	70 gal/unit/day	64.3
Business/Industry:			
- Commercial Sq Ft	1,087,983	66 gals/ft^2/year	71.8
- Hotel Rooms	311	93 gal/room/day	10.6
- Office Sq Ft	1,273,913	18 gal/ ft^2/year	22.9
- Industrial Sq Ft	776,926	12 gal/ ft^2/year	9.3
Total			**238.5**

3. Drought adjustment

Can you share the data that show essentially "full recovery" in demand within 5 years?

The interim baseline demand projection makes the assumption that irrigation-based demands that were restricted in 2014 would recover within one (municipal) to two years (irrigation/golf). This assumes drought restrictions are not reinstated in 2015. The interim baseline demand projection assumes that residential demands would recover more slowly over a five-year period.

These assumptions reflect professional judgment based on a review of the historical data. At the same time, it is important to bear in mind that the interim baseline demand forecast incorporates other adjustments for price and on-going conservation such that forecasted total demand never "fully recovers" in the sense of reaching its level prior to 2009.

Historically total production has recovered at varying rates following significant droughts. It is important to emphasize that the historical record is noisy with other events that influence water demand (see Feb WSAC baseline demand presentation slide 12), which makes it difficult to say definitively what the recovery rate would have been absent these other events. From the historical record we see:

1977 drought: very deep but short drought. Demand started to rebound quickly until 1980-81, then economy went into recession and 1982-83 were very wet with cool summers, which caused a significant drop in demand. Following the 1982-83 El Nino, demand growth resumed and by 1985 exceeded pre-drought demand in 1976 by about 9%.

1987-91 drought: longer but shallower drought than 1977. End of drought coincides with 1991-92 recession. Demand recovers to pre-drought level by 1997. About a 5-year recovery.

2009 drought: shallow and short drought followed by very wet 2010-11. Precipitation in March, May, and June of 2011 was significantly above average, delaying start of irrigation season and curbing demand. The 2009 drought also coincides with the Great Recession which started in 2008. Unemployment peaked in Santa Cruz County at 15.5% in 2010 (compared to about 6% now). Demand starts to recover in 2012 and 2013, but then water use restrictions imposed in 2014.

4. Demand projections

Please include, for context, data from (say) 2005-2014, too. This applies to the graph and the data tables.

See Feb WSAC baseline demand presentation slide 12 -- Historic and Projected Water Production chart covering 1975-2035. Here is the data for 2005-2014 actual production and 2015-2035 forecasted production.

Year	Production (MGY)
2005	3,729
2006	3,800
2007	3,777
2008	3,650
2009	3,214

2010	3,199		
2011	3,078		
2012	3,250		
2013	3,367		
2014	2,590*		
		2010 UWMP	Interim Baseline
2015		3685	3015
2016		3717	3204
2017		3749	3285
2018		3782	3276
2019		3814	3244
2020		3846	3249
2021		3846	3240
2022		3846	3230
2023		3845	3219
2024		3845	3215
2025		3845	3209
2026		3885	3206
2027		3925	3203
2028		3966	3201
2029		4006	3199
2030		4046	3197
2031			3184
2032			3170
2033			3157
2034			3144
2035			3132

*Provisional estimate

Concerns about Interim Baseline Demand Forecast from SC Desal Alternatives

The February 10 broadcast email of Water Wonk Week from SC Desal Alternatives raised four concerns with the interim baseline demand forecast. The concerns are based on the questions from Rick Longinotti which were discussed earlier. Even though what I write below repeats much of what is said above, I provide full responses to the concerns raised in the SC Desal Alternatives so that my replies to those concerns may be more easily tracked by those following the Water Wonk Week email broadcast.

From SC Desal Alternatives February 10 Water Wonk Week email:

City staff is presenting its new estimate of water demand on Thursday, promising that it will be more accurate this time. However, there are several assumptions in the new estimate that Desal Alternatives questions:

1. that our "current" demand is equivalent to 2007-08 levels, when water demand has declined in more recent years.
2. that in the aftermath of last year's drought, water demand will completely rebound to former levels. What about all those people who were inspired by the drought to replace fixtures and landscapes, etc?
3. that growth in water demand at UCSC will nearly double in the next 15 years, despite the LAFCO policy that growth be water-neutral.
4. that as income rises in our community, that water consumption will rise (based on the experience of other communities in the USA, rather than local experience)

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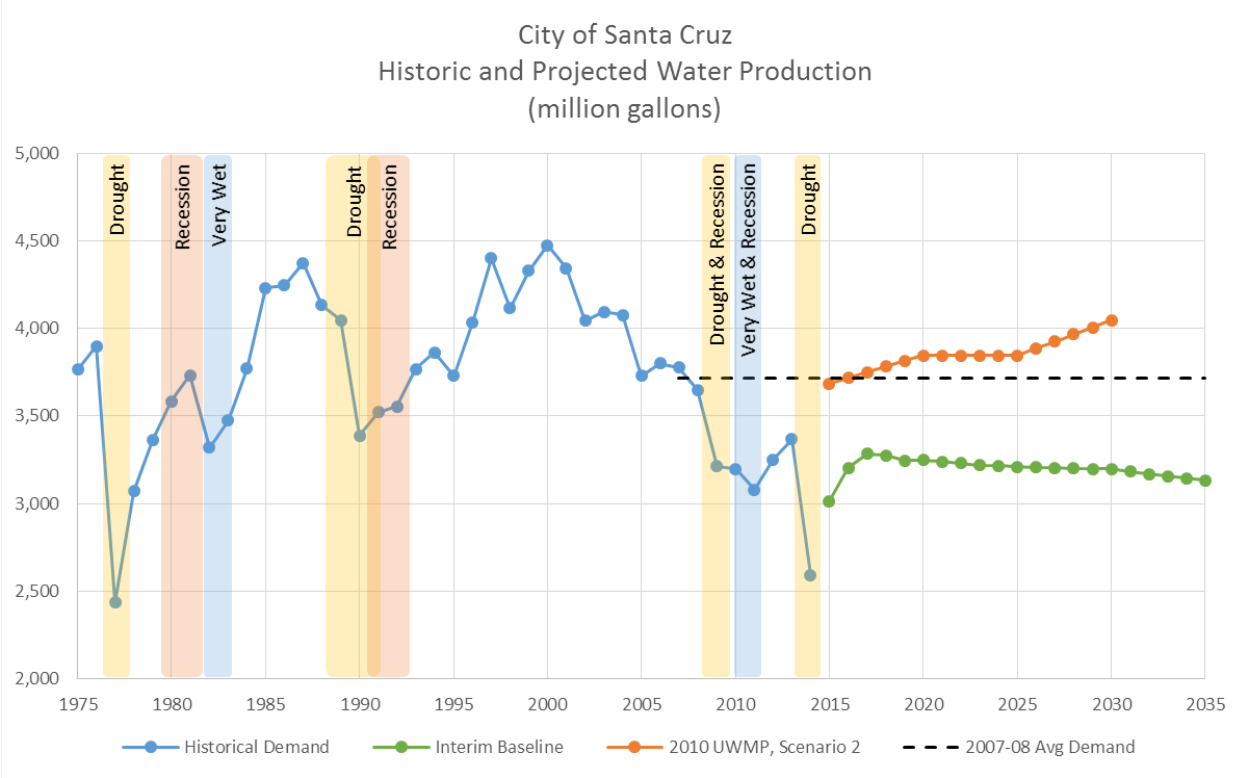
The interim baseline demand forecast nearly matches average demand for the years 2010-13. It is within +/- 3% of average demand for 2010-13, except in 2015 where it is 6% less. After 2025, the interim baseline demand forecast always is less than average demand for 2010-13, despite projected growth in population and the economy. The figure below compares historic demand to the interim baseline demand forecast as well as the 2010 UWMP demand forecast. It also shows average demand for 2007-08 to facilitate the comparison with the interim baseline forecast.



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See separate discussion of this issue.

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Given the housing and water use characteristics of Santa Cruz, the income elasticity for the interim baseline demand forecast was purposely selected to be at the lower end of the range of published estimates for income elasticity. The average income elasticity reported in Hanemann's (1998) review of 39 published studies of municipal water demand was 0.52 and the median was 0.43.[2] The estimate we are using for the interim baseline forecast is 0.25. Thus we are assuming an income effect that is 42% smaller than the median effect and 52% smaller than the average effect reported in the studies summarized in Hanemann (1998). As stated in the interim baseline demand memorandum, the estimate we are using is consistent with estimates derived from two analyses of 24 different water service districts located throughout California, representing a broad mixture of residential communities – large, small, high income, low income, inland, coastal, northern, southern, and central -- and trends in water use over the last 10 years. In my estimation we are using a defensible and conservative estimate of the income effect on water demand, but I don't disagree that it would be preferable to have an empirical estimate derived from local data. Estimating income response will be part of the statistically-based demand models the Water Department will be developing in the next several months.

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Issues related to LAFCO and LAFCO Policies

The information provided here is in response to the question received related to UCSC growth and LAFCO's policy as quoted in the underlined section of the question below.

> UCSC growth
> You use an estimate for UCSC growth that is based on the settlement agreement between the City and UCSC that estimates that water demand on campus will roughly double by 2030. Since that settlement agreement, our local LAFCO has adopted the following policy:
> "In cases where a basin is overdrafted or existing services are not sustainable, a boundary change proposal may be approved if there will be a net decrease in impacts on water resources."
> Because of this requirement, UCSC will need to participate in a program to offset their proposed increased water use. Because of this LAFCO requirement, wouldn't it be more realistic to model water demand at UCSC remaining flat?

To provide clarity, information is provided in a Q/A format.

Q. Does LAFCO have any jurisdiction over decisions related to providing water service **inside** a utility's water service established water service boundary?

A. No. Once LAFCO approves an agency's water service area, it is no longer responsible for any other approvals for, or review of, water service to customers or projects located within that water service area. At that juncture LAFCO only involves itself in the agency's operation should the agency be asked or seek permission to serve properties or customers outside the previously approved water service area boundaries.

Q. Does LAFCO's policy quoted above apply to any additional development that UCSC might pursue that lies **within** the existing water service area boundary areas covered by either its main campus or its other satellite sites or facilities elsewhere in the water service area?

A. No.

Q. Is it feasible that some part of the increased demand included in the interim demand forecast is associated with UCSC growth that is occurring or planned to occur within the existing water service area?

A. Yes. The new Marine Science building being planned for the Marine campus is an example.

Q. What is the status of decision-making by LAFCO over extending water service to the UCSC land area that is outside the current City water service boundary?

A. Since the Draft EIR on extending water service to the north campus was found to be inadequate by the courts several years ago, no further steps have been taken by the University to resolve this matter.

Q. What is the status of the University's compliance with the City-CLUE-University Settlement Agreement?

A. The University is in compliance with all applicable provisions of the City-CLUE-University Settlement Agreement that relate to water, and neither the LAFCO policy statement quoted above nor any provision that would result in a similar outcome is included as a provision of the Settlement Agreement.