BEFORE THE PUBLIC UTILITIES COMMISSION

OF THE STATE OF CALIFORNIA

In the Matter of the Application of California-American Water Company (U 210 W) for a Certificate of Public Convenience and Necessity to Construct and Operate its Monterey Water Supply Project to Resolve the Long-Term Water Supply Deficit in its Monterey District and to Recover All Present and Future Costs in Connection Therewith in Rates	Application No. 12-04-019

SUPPLEMENTAL DIRECT TESTIMONY OF PATRICK PILZ

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Date: January 11, 2013

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I. WITNESS QUALIFICATIONS

Q1. Please state your name, business address and telephone number.

A1. My name is Patrick Pilz. My business address is 1033 B Ave, Suite 200, Coronado, CA 92118. My telephone number is (619) 522-6383.

Q2. By whom are you employed and in what capacity?

A2. I am employed by California-American Water Company ("California American Water") as Manager of Conservation and Efficiencies.

Q3. What are your responsibilities?

A3. In my capacity as Manager of Conservation and Efficiencies, I oversee all conservation programs and activities for California American Water. I am also responsible for Customer Service at California American Water.

Q4. Please state your educational and professional background and experience.

A4. I received an MBA from United States International University in San Diego, CA and graduated with a degree in Economics from University of Munich Germany. I have been employed by California American Water since April 2004. I held the position of Financial Analyst in the Rates Department from 2004 to 2011 and transitioned to the position of Manager of Conservation and Efficiencies in March 2011. Prior to my employment at California American Water, I held several positions in the banking industry in Germany and the United States and worked as a Strategic Management Consultant in Sweden.

Q5. Have you previously testified before a state public utilities regulatory commission?

A5. Yes, I have previously provided testimony on behalf of California American Water and New Mexico-American Water Company.

II. INTRODUCTION AND PURPOSE OF TESTIMONY

Q6. What is the purpose of your Supplemental Direct Testimony?

A6. The purpose of my testimony is to provide responses to certain issues raised in the December 26, 2012 *Administrative Law Judge's Ruling Following Second Prehearing Conference* ("December 26th Ruling") that requires California-American Water Company ("California American Water") to elaborate on several subjects.

Q7. What specific issues will you cover in your Supplemental Direct Testimony?

A7. I will be addressing the following issues:

(i) Introduction and conclusions of various consultants on the effects of price elasticity on the proposed Monterey Peninsula Water Supply Project ("MPWSP").

(ii) Implications of the findings on price elasticity for the proposed MPWSP.

(iii) Impact of external factors on elasticity.

Q8. You mentioned that your Supplemental Direct Testimony provides responses to certain issues raised in the December 26th Ruling. Are others providing testimony to respond to other issues?

A8. Yes. Mr. David P. Stephenson, Mr. Richard C. Svindland and Mr. Jeffrey T. Linam are providing testimony that will address the remaining issues raised in the December 26th Ruling.

III. CONSERVATION AND PRICE ELASTICITY

Q9. Please explain the efforts California American Water has undertaken to explore how price elasticity may affect future water sales in its Monterey County District.

A9. California American Water engaged three separate consultants in an effort to better understand the predicted effects of price elasticity as a result of expected future price increases. The three consultants are:

(i) Dr. David Zetland;

(ii) Dr. Thomas Chesnutt; and

(iii) Mr. Kenneth Parris.

Dr. David Zetland is a senior water economist in the Department of Environmental Economics and Natural Resources at Wageningen University in the Netherlands. He received his PhD in Agricultural and Resource Economics from University of California Davis in 2008 and is the author of *The End of Abundance: Economic Solutions to Water Scarcity (2011).*

Dr. Thomas Chesnutt is President of A&N Technical Services, a national consulting firm specializing in state of the art expertise applied to water resources and water efficiency programs.

Kenneth Parris is the Owner of Business Economic Analysis & Research specializing in policy decision analysis, forecasting system development, and statistical modeling. Mr. Parris has been engaged by several public utilities, including the Los Angeles Department of Water and Power, Southern California Edison, SoCal Gas, San Diego Gas & Electric.

I will sponsor the reports and results for the three consultants listed above. Additionally, I will provide a short summary of my own analysis of price elasticity in the Monterey County District.

Q10. Please provide a brief summary of the work performed by Dr. Zetland and his conclusions.

A10. Dr. Zetland analyzed the effect of an overall demand reduction in the Monterey County District based on a certain level of price increase. Dr. Zetland also studied potential total usage reductions in the Monterey County District through implementation of a number of measures, such as rate design modifications, installation of smart meters, incentive programs, etc.

Dr. Zetland's study estimates that a total demand reduction of approximately 16%, or 1,700 acre feet annually ("afa"), could potentially be achieved through implementation of a series of substantial changes to California American Water's billing system (residential and commercial customers), rate design (residential and commercial), non-revenue water improvements, landscape retrofits, and other measures. Specifically, Dr. Zetland recommends the elimination of Tiers 4 and 5 for residential usage, implementation of higher rates in the remaining three rate tiers in order to convey a "clearer price signal" to customers, and a 100% ban on outdoor watering for both residential and commercial users. Please note that these are not California American Water's recommendations. These are Dr. Zetland's.

Dr. Zetland points out the significant milestones California American Water has already met in its Monterey County District through conservation efforts resulting in significantly below average per capita usage. Dr. Zetland states that compared to other areas in the United States of America, "…per capita use is already – in my opinion – the best in the state. […] Monterey customers can probably claim a leadership role in conservation […] If citizens reduce their consumption levels envisioned by the Cease and Desist Order, then they would be competing for the title of lowest use (smallest footprint) in the developed world."[1] The study cautions, however, that it is particularly difficult to estimate price elasticities because the Monterey County District's situation is unique due to its long ongoing water supply challenges and conservation history. Dr. Zetland adds that demand in the Monterey County District is "under so much pressure that elasticity is likely to be inelastic."[2] For specific study results, please reference Dr. Zetland's study, attached hereto as <u>Attachment 1.</u>

Q11. Please provide a brief summary of the work performed by Dr. Chesnutt and his conclusions.

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[1] *Monterey Demand Price Elasticity Study*, Dr. David Zetland ("Zetland Study"), dated Jan. 10, 2013, p. 13.

[2] *See* Zetland Study, p. 10.

A11. Dr. Chesnutt conducted a demand elasticity study for California American Water's Monterey County District which estimated price elasticity of demand through empirical analysis. Dr. Chesnutt developed a Monterey Rate Model in order to simulate projected impacts of changes in rate structures on customer water demand and expected revenue. Additionally, Dr. Chesnutt conducted a literature review of water demand. The literature review focused specifically on estimating the price elasticity of water demand and evaluated the literature findings' relevance and applicability to the Monterey County District's water supply situation.

Dr. Chesnutt's empirical analysis did not succeed in obtaining a reliable estimate of price elasticity for the Monterey County District but instead relied on literature derived elasticity factors that varied by end use and customer class. These factors were then successfully used in the newly developed Monterey Rate Model to project changes in demand from changes in price. As expected, the elasticity factors used in the simulations showed outdoor residential end uses to be generally less inelastic than indoor residential end uses. Therefore, rate tier elasticity factors were greater in higher tiers and, similarly, demand was less elastic in lower rate tiers. The actual literature derived elasticities by rate tier used in Dr. Chesnutt's Monterey Rate Model varied between -0.05 in Tier 1 and -0.16 in Tier 5. This translates to a 5% to 16% reduction of demand if prices increase by 100%.

The literature review conducted as part of Dr. Chesnutt's study revealed that most literature references to price elasticities in urban water demand analyzed demand situations that were not easily applicable to the Monterey County District. As Dr. Chesnutt points out, circumstances in the Monterey County District differ from studies in the literature due to the District's installed base of conservation technology and conservation education/culture as well as the existence of high rates in the top rate tiers and restrictions already in place in Monterey.

Therefore, Dr. Chesnutt suggests that present work on water demand elasticity is "breaking new ground."

For a Summary of Dr. Chesnutt's specific study results, please reference Mr. Chesnutt's Executive Summary, attached hereto as Attachment 2.

Q12. Please provide a brief summary of the conclusions drawn by Mr. Parris.

A12. Mr. Parris conducted a price elasticity analysis for the Monterey County District using historical billing data ranging from 2004 to 2012 for residential and commercial usage by account. California American Water asked Mr. Parris to determine a Monterey-specific price elasticity factor by customer class[3] based on historical responses to price increases from California American Water customers in its Monterey County District. Weather data in the form of 15-year average monthly temperature and rainfall information from several weather stations in the Monterey County District, was used to account for variations in usage due to weather changes. A time trend was incorporated to account for water use efficiency increases and other conservation efforts during the study time period.

Mr. Parris succeeded in calculating elasticities specific to the Monterey County District. Mr. Parris concluded that price elasticity is generally inelastic – ranging from -0.12 to less than -0.1 for residential usage. This means that a 100% rate increase would result in a 12% or less reduction in demand. For specific study results, please reference Mr. Parris's study, attached hereto as Attachment 3.

[3] The customer classes consisted of residential single family, residential multi-family, and commercial.

Q13. Did Mr. Parris analyze tier specific elasticities in the Monterey County District?

A13. Yes. Mr. Parris analyzed and calculated tier specific elasticities – please reference Attachment 4 to my Supplemental Direct Testimony for Mr. Parris' findings.

Q14. Did California American Water conduct its own internal study on price elasticity in the Monterey County District based on recently seen rate increases and usage patterns?

A14. Yes. I conducted my own price elasticity analysis based on the most recent 14 months of residential usage data in Monterey. This was calculated to provide a timely "reference point" as a comparable to the long-term data analyses produced by the above-referenced consultants. During the period of July 2011 to September 2012, the average bill in the Monterey County District increased by approximately 49%. Because of the very significant bill increases during this time, this period provides a "short-term" look at how demand responds in the Monterey County District. My findings show that an increase in residential demand accompanied the increase in prices. I also calculated a positive price elasticity, contrary to what one would expect if demand was elastic to price on a water demand curve.

These findings essentially confirmed Kenneth Parris' study, which, of course, analyzed a much longer period of time, normalized for weather and analyzed demand on a per customer basis rather than an aggregate demand.
For specific study results, please reference Attachment 5 for Mr. Pilz's findings.

Q15. Can you briefly address the impact of external factors on price elasticity?

A15. Yes. Elasticity is usually measured under the assumption that everything else remains constant and no other changes are being made with price being the only variable that is adjusted. However, in real life other factors may influence overall demand and it is often difficult to measure a pure price effect on demand. The previously mentioned consultant studies accounted for this in various ways such as incorporating a time trend that captures conservation measures and increases in water efficiencies, which reduce demand.[4] So while it is generally difficult to isolate the effects of external factors on price elasticity, the previously discussed studies and models have at least tried to account for some of these external factors.

Q16. Based on the conclusions you provide above with regards to conservation efforts as well as predicted future price elasticity, please provide your opinion as to future consumption that may occur once a new water supply project is online and customers are paying for that supply.

A16. In an effort to answer the question of what would happen to residential and commercial water demand in the Monterey County District once a new water supply project is in place and all costs are rolled into rates, California American Water engaged three independent experts and sought responses to the same question, providing them with similar data sets. California American Water also conducted its own analysis of the most recent 14-month period. The findings of these three consultants and California American Water highlight the difficulty in reliably forecasting an expected demand response to rate increases.

[4] A time trend would also account for other external factors such as, the state of the economy, hospitality usage in Monterey, the public awareness of Monterey's Cease and Desist Order, or generally the awareness of Monterey's water supply situation among Monterey citizens.

California American Water decided not to incorporate a demand elasticity factor in its desalination plant sizing decision because the common denominator of all four analyses is that water demand in the Monterey County District has reached inelasticity and is, therefore, not significantly influenced by the magnitude of price increases that California American Water anticipates with the implementation of the MPWSP.

Q17. Does this conclude your Supplemental Direct Testimony?

A17. Yes it does.

Attachment 1

Monterey Demand Price Elasticity Study

David Zetland[1]

1/11/2013

This study will look at what can be expected in terms of an overall demand reduction given a expectation of a certain level of price increase.

Currently California American Water (CAW) is proposing to build a desalination plant on its own and needs to further verify that the size of the plant requested is appropriate given local conditions and customer demands.

1. Overview of Area

This study addresses supply and demand in CAW's Monterey County District. Since the area is bounded by sea on one side and mountains on the other, both supply and demand growth are somewhat limited, i.e., it is difficult (expensive) to either import water from inland areas or expand urban areas. Current supply comes from aquifers recharged by local precipitation and surface flows; demand (i.e., number of water meters) has grown by less than two percent in recent years. Additionally, the District is now under a moratorium.

Unfortunately, supply and demand are no longer in balance. An increase in demand for instream flows in the Carmel River (to protect steelhead trout) and restrictions on the amount of water that can be withdrawn from the Seaside aquifer has created a "shortage." There are two ways to end this shortage: increase supply or reduce demand.

2. The Problem

The problem is that the State Water Resources Control Board (SWRCB) issued a Cease and Desist Order (CDO) on October 20, 2009 requiring CAW to terminate all unlawful diversions from the Carmel River no later than December 31, 2016. By virtue of that Order CAW has to move forward with a desalination facility. The main questions are the size/capacity of the plant and how to distribute its cost among customers. In this study, I describe the supply side situation and evaluate demand side options. I **assume** that political, legal and regulatory forces are functional and stable, i.e., no blockades, corruption or revolutions. I also **assume** that money is neither an answer nor a constraint, i.e., CAW cannot buy its way out of the problem, and customers cannot turn down a solution as "too expensive." In other words, this study is about water management, not money management (I discuss money as an instrument to sharpen economic incentives, not as an accounting tool to balance the books.).

[1] These opinions are my own and do not represent those of CAW. I am a Senior water economist at the Department of Environment and Natural Resources, Wageningen University, The Netherlands. My email address is dzetland@gmail.com.

3. Supply Side

CAW currently gets 100 percent of its water from two aquifers and a very small desalination plant in Sand City[2]. With limited storage capacity in the current river reservoirs (about 2,000 acre-feet (af)), CAW is highly dependent on annual flows. Local reclaimed water is currently utilized for irrigation; further use would require the construction of extensive facilities. CAW is seeking approval of a desalination plant with a capacity that's subject to some controversy.

3.1. Carmel River Aquifer

The Carmel River Aquifer (CRA) underlies the Carmel River and is recharged annually. CAW withdraws its regulatory limit from shallow (50 feet deep) wells in the CRA. Total extraction from this aquifer is unknown, but CAW is the largest single pumper of many. CAW has rights to 3,376 acre-feet annually (afa) of CRA water but was taking as much as 14,500 af in late 1980s.

The SWRCB's CDO now requires that CAW discontinue any withdrawals of water from the CRA above the authorized rights by December 31, 2016.[3]

3.2. Seaside Basin Aquifer

The Seaside Basin Aquifer (SBA) is recharged by precipitation and holds about 60,000 af. CAW has rights to 1,494 afa of SBA water but has taken more than 4,000 af in the past. CAW is the biggest pumper on the SBA, currently extracting about 2,800 afa.

The SBA is an adjudicated basin, and the court has established a 3,000 af annual limit on total withdrawals. Pumping will fall from the current pace of 5,300 afa in triennial reductions, reaching the target by 2021. This decision (case M66343 in the Superior Court of State of California in and for the County of Monterey) limits CAW's 2021 withdrawals to 1,494 afa.

3.3. Desalination Plants

CAW produces about 300 afa from the Sand City desalination plant CAW reduced its withdrawals from the CRA by one acre-foot for each acre-foot it receives from the Sand City desalination plant.

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[2] The Sand City Desalination plant is limited to an annual production of no more than 300 AF, or less that 3% of total production requirements.

[3] There is also an initial reduction required by the CDO commencing on October 1, 2009, wherein CAW shall reduce diversions from the river by 5%, or 549 afa. Additionally, commencing on October 1, 2010, the base shall be further reduced by 121 afa per year. The 121 af reduction shall be cumulative. For example, 121 af shall be reduced in the first year and 242 af shall be reduced in the second year. Then commencing on October 1, 2015, annual reductions shall increase to 242 afa. The 242 afa reduction shall also be cumulative. Annual reductions shall continue until CAW terminates all unlawful diversions from the Carmel River.

3.4. Storage

CAW's Phase I Aquifer Storage and Recovery (ASR) project at SBA is operational and has a projected annual yield of 1,920 afa. Winter flood flows in the Carmel River are treated to drinking water standards then pumped 8 miles to the ASR facility. The Phase II ASR (almost complete) would add an average of 1,000 afa. Since additions from "new" ASR water are offset by corresponding reductions in Carmel River withdrawals, the ASR project does not increase the supply of water to customers.

CAW can store water behind the Los Padres Dam which has usable storage of approximately 1,800 af.

4. Demand Side

In this section, I provide a brief description of the different classes of demand. In Section 5, I have provided comments to consider what demand reductions hypothetically could occur.

4.1. Descriptive Statistics

In 2007, CAW served about 39,450 water meters in the Monterey County District. Of these, 97 percent of the meters (37,904) and 94 percent of the water deliveries (12,100 afa) were in the "Monterey Main System" — referred to **hereafter** as Monterey. For simplicity, I will concentrate on the Monterey customers and ignore customers in the satellite systems. I make **this assumption** to avoid the complexity of integrating areas that represent a small share of demand but a large share of policy and rate diversity. This assumption is supported by CAW's desire to homogenize historic supply and demand policies, the likelihood that these areas will respond to incentives in the same way as Monterey customers, and their small share of total demand. I discuss non-revenue water (produced but not delivered) in Section 4.3.

Table 1 shows the meter counts and consumption for customer classes in Monterey.[4] In Table 2, I combined customer classes based on their "type" of demand, i.e., residential and Program for Alternate Rates ("PAR")- customers are household water users; multi-residential customers are the same without sub-meters (and often without landscaping); and commercial, industrial, public authority & golf courses all use water for "business."[5] In Table 3, I show the current number of meters and consumption for 2011.[6]

[4]These numbers and per-block amounts all come from the consultant report — prepared by Thomas Chesnutt — used to estimate the distribution of use quantities by customer class and within each tier under prices CAW approved and implemented in February 2011; they come from a different estimate than the 11,645 afa in the draft CDO/SBA restrictions.

[5]I **ignore** fire meters because public health demand cannot be constrained and other meters because they are trivially small.

[6] Table 3 reflects lower production as a result of price increases, the further effects of the CDO, further reductions to SBA operational pumping, and other factors such as the economy.

Table 1: Monterey customer classes, meter counts and consumption (afa & share) as of 2009.

Class	Meters	acre-feet per annum	% share
Residential	31,762	6,207	51.3
PAR Customers	668	123	1.0
Multi-Residential	811	1,453	12.0
Commercial	3,172	2,702	22.3
Industrial	6	91	0.8
Public Authority	553	900	7.4
Golf Courses	8	296	2.4
Fire	888	7	0.1
Other	36	320	2.6
TOTAL	**37,904**	**12,100**	**100.0**

Table 2: Monterey customer classes, meter counts and consumption (afa & share) as of 2009.

Class	Meters	acre-feet per annum	% share
Residential/PAR	32,430	6,330	52.3
Multi-Residential	811	1,453	12.0
C & I, PA and Golf	3,739	3,990	33.0
Fire/Other	924	327	3.7
TOTAL	**37,904**	**12,100**	**100.0**

Table 3: Monterey customer classes, meter counts and consumption (afa & share) as of 2011.

Class	Meters	acre-feet per annum	% share
Residential/PAR	32,549	5,490	53.0
Multi-Residential	1,356	1,481	14.3
C & I, PA and Golf	3,722	3,393	32.7
Fire/Other	852	0	0.0
TOTAL	**38,179**	**10,364**	**100.0**

Since 2009, CAW has been charged with further reducing aggregate demand, and the difficulty in reducing the quantity demanded depends on how big that demand is relative to benchmarks for wasteful consumption. In the urban water business, consumption is judged to be wasteful if it is above per capita norms and efficient if it is below those norms. Thus, we need to translate these aggregate numbers into figures that can be compared to similar numbers elsewhere.

This is where we hit our first data problem. Although CAW has been gathering inhabitant counts for residential customers since 2000, we cannot be sure of the accuracy of these numbers, since customers may inflate resident counts to increase their allocation of equivalent consumption units (ECU).[7] According to CAW's survey figures, the average Monterey residence has 2.8 people; according to the US Census, it has 2.5 people. Given these numbers, current average residential use is 53/59 gallons per capita per day (gcd) for 2.5/2.8 people/meter — for indoor and outdoor use. I will **assume** 65 gcd.

Can we determine the percentage of this water used indoors versus outdoors? If we **assume** minimal irrigation in winter (Dec/Jan/Feb) and compare average consumption in those months to average consumption in peak summer months (Jul/Aug), we see that historic winter demand is about 70 percent of summer demand. This implies an indoor demand of about 45.5 gcd.[8] Although we might want to control for seasonal fluctuations in residential population, it is not clear whether people use their second homes more often in summer or winter.

Note that average *aggregate* demand is 50 af/day in summer and 30 af/day in winter — only 60 percent of summer levels. This number will give a misleading figure for indoor/outdoor use not only because it reflects other use classes but because of tourism. Assuming a local population of about 110,000 residents, the "full-time-equivalent" population of tourists — about 11,000 people — represents a ten percent increase in *average* population. Within this average, there are 30 percent more tourists in Jul/Aug and 30 percent fewer tourists in Dec/Jan/Feb.

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[7] CAW has imperfect data for the number of residents at multi-residential addresses.

[8] This is based on data from Table 1 and we assume for purposes of this study that indoor use remains constant and reductions that have occurred over the past couple of years are reflective of outdoor use reductions, not indoor use.

So — how does 45.5 gcd of indoor use (65 gcd of total use) compare to other places? Table 4 shows that demand is quite low relative to other cities in California and Nevada, but not quite as low as demand in drought-stricken Australia. Compared to their fellow-citizens, Monterey customers can probably claim a leadership role in conservation. Although Monterey may not have the lowest per capita consumption in the developed world, it is surely "competitive." If citizens reduce their consumption to levels envisioned by the CDO, then they would be competing for the title of lowest use (smallest footprint) in the developed world.[9]

Table 4: Residential per capita demands (indoor/outdoor). Most figures are recent; Sydney numbers are from 2001.

City	SFR demand (gcd)	
CalWater mid-peninsula	93 in/out	http://tinyurl.com/ojuzdr
Las Vegas	65 in/100 out	Gleick et al. (2009, p. 105)
Los Angeles	115 in/out	http://tinyurl.com/qpvq8f
Marin MWD	99 in/out	http://tinyurl.com/mesyw2
Monterey (CAW)	45 in/20 out	This document
Palo Alto	114 in/out	http://tinyurl.com/ojuzdr
Santa Cruz	100 in/out	http://tinyurl.com/nlwttt
San Francisco	100 in/out	http://tinyurl.com/nlwttt
Seattle	54 in /100 out	Gleick et al. (2009, p. 105)
Brisbane	32 in/out	http://tinyurl.com/9ojxtv
Sydney	54 in/18 out	http://tinyurl.com/l5m2tk

4.2. Description of Prices

Before 2000, CAW's residential prices were based on usage at the meter. After 2000, they were based on the numbers of ECUs at the meter. ECUs depend on the number of residents, lot size, season, number of large animals and other relatively small allowances. The price per unit of water depends on water consumption, and prices rise as use rises — an increasing block rate structure with very aggressive steps between blocks.[10] After a 2000–2001 transition period to per capita usage charges, per block charges have increased very significantly between January 1, 2002 and the present. The one exception to this progression was a price spike in 2004, when rationing was instituted to respond to a critical drought situation and fourth and fifth block

[9] http://dardel.info/EauConsumption.html reports *indoor* consumption of 30–67 gcd (Belgium–Switzerland).

[10] The increase in block pricing, including surcharges that affect total block rates are: block 1 to 2 is 145%, from 2 to 3 is 96%; from 3 to 4 is 98% and from 4 to 5 is 37%. The change from Block 1 to Block 5 is 1194%

prices increased by 100 percent (to $12.21 and $24.42, respectively) from July to the end of October 2004.[11]

The move from per meter to ECU pricing did not appear to have any effect on demand — perhaps because of offsetting "adjustments" that dampened price effects, broadly-defined ECUs (lot size, etc.), or prices that were still too low to change behavior.

From 2009 to mid year 2011, residential usage dropped by over 13%.

CAW implemented a new pricing schedule that removes any allowance for outdoor watering in Tiers 1 and 2 and reduces the allowance for outdoor watering for higher tiers; it also rolls a ccf "service charge" into tiered prices and reduces the percentage of fixed costs recovered in the service charge.[12] These changes reduced demand by increasing pressure on "lifestyle" water use and sharpening price signals, respectively. The effect of this change in pricing along with the increased prices is noticeable in a comparison of Tables 1 and 3 above.

CAW has set 2012-2014 customer demand targets at the actual consumption level for 2010 and in compliance with the production limitations of the SWRCB CDO and the safe operating yield of Seaside Basin. These targets (10,364 af in consumption and 12,935 af of production rights for Monterey) are approximately 18% below 2007–2008 total consumer demand of 12,703 af. These volumes reflect the impact of the new price schedule on demand. Section 5 discusses how it might or might not reduce it further.

4.3. Non-revenue Water

Non-revenue water (NRW) is produced but not sold to customers. In 2007–2008, CAW had 1,820 af of NRW (production of 14,523 af less metered consumption of 12,703 af) in its service area. In 2011, CAW reduced NRW to 1,252af or approximately 10.7% of total water produced. In 2012, CAW reduced its NRW even further to approximately 10.3%

Generally speaking, NRW losses are considered a type of fixed cost i.e., system losses that occur regardless of system volume. If CAW does nothing about NRW but reduces revenue water deliveries, the share of NRW will likely rise. Can the absolute volume of NRW be lowered? Perhaps by fixing leaks but probably not by reducing flushing for system maintenance, etc. Although an engineer can tell you what can be done, an economist can tell you when the benefits of reducing NRW exceeds the cost[13], and a regulator will decide whether to believe the engineer and economist — allowing the cost to be passed on to customers. CAW has

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[11]Another exception was a surcharge to pay for the Coastal Water Project (CWP). It began at 4% and went to 10% in July 2008; it will remain there until the CWP is repaid.

[12]There is also a tier 1 allowance for medical needs.

[13] These are defined as "economically-efficient NRW" and "socially-efficient NRW, which is lower due to the environmental cost of diverting water that's then "lost" but not returned to its source.

significantly reduced NRW. At this point CAW may not be able to, in a cost effective manner, reduced NRW significantly further. For the rest of this study, I will ignore NRW.

5. Demand Reductions

Economists analyze demand for any good using a "demand curve" that describes the inverse relationship between the price and quantity demanded for that good. While it may seem obvious that people want less of a good as it gets more expensive, the usefulness and limitations of the demand curve is not always obvious. For example, it is important to consider the impact of other, non-price factors on the quantity demanded. These factors are often assumed to be "held equal" but reality does not hold still. These other factors are therefore responsible for "shifts" in the demand curve. For example, an increase in income will increase demand for water at all prices ("shifting demand out") while a change in tastes — the desire to use less — will reduce demand at all prices ("shifting demand in"). In this section, I will take these differences into account and analyze demand from two perspectives: *sliding* up and down the demand curve (price changes) and *shifting* demand in and out (all other changes).

Please remember that this separation is artificial. It is actually quite hard to identify the relative impacts of shifting and sliding on demand. It is even possible that a slide will increase quantity demanded at the same time as a shift decreases demand — creating a net impact that is either positive or negative.[14] In Monterey, the situation is particularly fluid: Customer demand is under the joint influence of changing prices, community debates on desalination, regional drought updates, the politics of climate change, advertising for/against bottled water, local weather conditions, and so on. It is simply not possible to say that "holding all else equal, an *x* percent price increase will reduce demand by *y* percent" and expect to see a *y* percent change. All we can say is that price increases will *tend* to reduce the quantity demanded, even if that means that demand rises by a smaller amount.

In Table 2 and 3, I combined residential customers that face price signals under residential, those who do not under multi-residential, and non-residential customers into a third category of customers that face price signals but do not have a "right" to some cheap water for basic needs. Next, I will discuss demand reduction for each of these three classes (abbreviated as SFR, MFR and NR, respectively), beginning with a baseline total consumption of 10,364 afa

5.1. Residential and Multi-Residential Demand

Single family residences, multi-residential, and PAR customers use 67 percent of the water. They face an aggressive schedule of increasing block rates. Even still, 10% of their demand (668 afa) is

[14]See Loaiciga and Renehan (1997) for a case study of how the move to increasing block rates, higher prices, and public awareness combined to reduce overall demand in Santa Barbara by 46% in the 1986-1992 drought. After prices were reduced ("the March Miracle"), demand only increased to 61% of pre-drought levels. See Kenney et al. (2008) for another example of the interaction of prices and policies on water demand in Aurora, Colorado during the 2000–2005 drought.

in blocks 4 and 5. Demand in blocks 4 and 5 has significantly dropped since 2007 when approximately 1,440 af (19 percent of total demand) of usage was in these blocks. Demand in these blocks probably comes from outdoor irrigation. It is possible that continued increased price signals will eliminate more of this demand. I do not suggest regulations on watering-unless all outdoor watering is banned. It may be useful to give further subsidies or rebates for turf removal, "California friendly" plants, etc., but these positive incentives cost time and money; negative incentives from higher prices might be sufficient. CAW could also eliminate ECU allowances for large animals, lot size and season, which support lifestyle water use. Such an elimination would impact demand in the third block (681 afa or 10% of SFR and MFR demand). CAW could also look into using smart meters. These devices are getting cheaper and better. They allow customers to see their real-time water use — creating a powerful feedback loop.[15] They also make it easier to identify leaks and create "peer competition" among neighbors.

5.2. Non-Residential

The non-residential sector uses about 33% of Monterey water (3,400 afa) for various business and governmental activities. Although this sector has no "right" to a basic block of water, it cannot be cut off completely, since the residents of Monterey are probably not interested in becoming a bedroom community.

That said, prices can still play a role for businesses/government in the area. Higher prices would make irrigated landscaping too expensive and encourage landscaping with native vegetation. Water-intensive businesses would have incentives to conserve water (increasing prices or reducing consumption to earn more dollars per gallon) and perhaps to leave the area. Hotels would encourage their millions of clients — who do not currently pay for marginal water consumption — to reduce water use. And so on.

If water reduction was necessary, my main suggestion for this segment is that the metering and billing system be simplified. The current system gives allocations to businesses as a function as the number of seats in the restaurant, SIC code, etc. This system is both cumbersome to administer and inefficient in its use of price signals.

I suggest replacing it with a price system based on these general principles:

1. All businesses pay an expensive monthly fee that is based on their meter size (one inch, two inch, and so on). Businesses have an incentive to minimize their meter size. Those with meters that are physically larger (for historic or safety reasons) can pay a monthly fee for a smaller, "virtual" meter.
2. For a given meter size, there is a cheap block of water. Use in excess of this block is VERY expensive. The size of the cheap block is larger for larger meters. This price schedule give businesses an incentive to stay within their block, to avoid extra charges.
3. This system is "soft" — CAW does not need to change the physical meter or plumbing. Customers who want to downsize can ask CAW to reduce their "billing meter" and those

[15]Kenney et al. (2008) found that consumers are highly sensitive to smart-meter feedback.

who are paying for a virtual meter that's smaller than their physical meter can make the same request of CAW to increase it (seasonally, for example).

4. Taken together, this two-part tariff encourages each business to self-select into the most economical (and most efficient) rate plan. CAW does not need to know the SIC code, number of seats, or anything else about the business.

For example, a hairdresser may pay $240 per month for a 2 inch meter. With this meter comes 60ccf at $5/ccf. Use above 60ccf costs $15/ccf. Assuming 60ccf are used, the business is paying $9/ccf. If the business can reduce use to 30 ccf, it can get a "virtual" one inch meter for $90/month and 30 ccf for $5/ccf. Because the fixed cost is higher for the 2 inch meter, the business has an incentive to reduce use and get the smaller meter. Just as a ball-park figure, let's **assume** that a simpler yet expensive non-residential price regime would lower demand by 10 percent, or 340 afa.

5.3. Elasticity

I have hardly mentioned elasticity, and that is for two reasons. First, demand in Monterey is under so much pressure that elasticity is likely to be inelastic. Although I am hesitant to make exact predictions ("an *x* percent increase will lower quantity demanded by *y* percent."), I do believe that higher prices may reduce demand.

Second, it seems more important to concentrate in demand destruction (shifts in demand) rather than prices (sliding along the demand curve). Although prices can play a role, lifestyle changes are likely to reduce demand by a greater amount, at a lower cost.[16] I am *not* suggesting more regulations; I am suggesting new norms on outdoor landscaping, MFR charges, etc.

Even so, price pressure should stay intact, as a reminder to the forgetful and complement to conservation programs.[17] I also support prices that rise far above levels for cost recovery — as one would expect with inelastic demand. As usual, excess revenues can be returned via conservation incentives. Even easier, they can be rebated per capita — enhancing the progressive nature of pricing.

Should or can an elasticity factor (either from literature or from a Monterey historical demand analysis) be calculated or used in forecasting demand in Monterey?

A calculated elasticity is better than nothing at all. An estimate based on local data is much more credible than one from the literature. Reliability of this estimate will fall as price changes

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[16]Brisbane got 32 gcd — recall Table 4 — through an "overnight" change in attitudes.

[17] Note that it is possible to raise *effective* prices by narrowing blocks — not just by lowering the number of ccf but also by eliminating non-human ECUs.

rise by more than 10%. Also, if estimating demand based on existing data,[18] do not forget to factor in weather, inhabitants and lot size.

.5.4. General Demand

What are the long and short term effects of doubling or more than doubling customer bills? First, it depends on how bills are doubled. If fixed costs go up then there's "nothing" that customers can do to reduce their bill. If variable charges go up (more likely), then the structure of blocks will determine the response. If additional charges are added to upper blocks but not lower blocks, then conservation efforts will increase. If the charges are put on the lower block, then SOME reduction will occur for customers in that block (but not in a higher block), since they are facing marginal incentives in that block. Customers in higher blocks may reduce their use within their highest block (perhaps to the next lower block), but they will treat lower blocks as fixed costs that cannot be affected. A Household, for example, that's consuming 15 units (putting it in the third block), may reduce use to 13 or 14 units to avoid paying for units in that third block, but they will take costs from the first and second block (covering, say, their first 10 units) as fixed. The demand response, in other words, is going to affected by the customer's *perception* of where they are and where they can go (i.e., if they "write off" lower block consumption). This perception will depend on how they see their use (i.e., smart meters vs quarterly billing), but note that it is a relatively small effect compared to "volumetric use is more expensive." Long term effects (elasticity) will be stronger, since people will have the opportunity to adjust their behavior (changing fixtures, ripping out lawns, etc.). I doubt that residential customers will decide to leave the area when bills rise, unless they pass, say, $200/month (or more than 10 percent of rental/mortgage payments). Note that apartment dwellers may react VERY strongly to higher prices if landlords decide that higher prices are a good excuse to install sub-meters.

What will happen to water demand once new water supply is available and restrictions are removed?

The answer depends on price. If prices do not rise, then people will use the same amount of water. Some may use more, since the signal of "more supply and zero restrictions" leads them to conclude that they need not conserve "for the sake of the community," an effect that we see when it rains during a drought/watering moratorium and people use more water "because there's more around." Taking these factors into account, higher volumetric prices are likely to push down demand. The net effect on demand is not clear.

Can you use a demand response study (estimating a price elasticity factor) as a basis for sizing a new water supply project?

Assume you have an existing demand for 10 afa and you are going to raise prices by 100% (to reduce demand and pay for a desalination plant), then you may be able to estimate an elasticity based on earlier price increases, subject to some caveats: (1) Price increases are only one factor

[18] I.e., by account number for monthly use based on the average – not necessarily marginal -- price per unit paid.

affecting how people demand water. Price changes lead to a "slide" up or down the demand curve, but other factors (e.g., taste for water-using products, income, community perceptions) can shift demand in or out. These slide and shift factors can reinforce or offset each other. (2) That said, the impact of price increases (elasticity) may rise or fall as their magnitude increases. Some people will pay more to initial, small increases while others will pay more attention to later, larger increases. Large price increases (>10%) can lead to unpredictable effects because they can "change the baseline." That is perhaps why $4 a gallon gasoline led some people to trade their large cars for small cars -- or do nothing at all. It depends whether people decide "enough is enough" or if they give up. The premise of price increases influences this decision. People will NOT engage in long term demand destruction if they think prices will drop later in the future.

So, the upshot is that it is HARD to estimate where demand will be from such a large price increase. Given the complications (high costs) of changing a desalination plant capacity, I would recommend going for a larger capacity (or, at a minimum, a pre-clearance to expand) just to make it easier to adjust for unexpected changes in demand. It's MUCH easier to sell less water than expected than try to choke demand that is unexpectedly large. It is also easier – as discussed – to build a larger plant and then sell more water in higher tiers to facilitate subsidies to lower tiers.

6. Conclusion

In my opinion, CAW is facing one of the toughest water management problems in California. Per capita demand is way below average in the residential sector and probably low for the multi-residential and the non-residential sectors. Supply is severely constrained. There is no easy way out of this situation. One option is to increase supply by building a desalination plant. Another is to depopulate the area of residents, visitors and/or businesses.

This reduction will come from clearer price signals (Multi Family Residential ("MFR") submeters, simplified Non-Residential ("NR") billing) and higher prices (eliminating Single Family Residential ("SFR")/MFR Tiers 4 and 5; squeezing marginal use for all classes), i.e.,

Residential and MFR Tier 4 & 5 water eliminated	668 afa
Residential and MFR Tier 3 water reductions	681 afa
Non Residential reductions	340 afa
Total reductions	1,689 afa

I have only identified an estimated 1,689 afa in total reductions, or about a 16% reduction. Is it possible to reduce demand further? Perhaps. Is it fair to do so? No. If these reductions occur, per capita indoor/outdoor residential use will be roughly 45 gcd — 63 percent *below* the State's 20x2020 target. It would be grossly unfair to require additional reductions; it is also possible that additional reductions would conflict with health and safety standards for minimal water supplies. Note that these reductions already **assume** that customers will make radical changes in their lifestyles.

So, I have estimated a reduction of 668 afa from SFR and MFR based on eliminating demand in tiers 4 and 5. These reductions may not happen to the extent that people decide to “save” their lawns from higher prices. Those uses CAN be eliminated by a 100% ban on outdoor watering. Business, likewise, may decide that a fountain, flower garden, waterfall, etc. produces profits worth paying for, so they may also not respond. It is not unwise to consider such bans. The resulting loss in upper tier revenue may recommend higher prices at lower tiers – or an end to tiers altogether.

CAW believes it needs a desalination plant in the area. In my opinion, the desalination plant should be built. I am not usually a proponent of desalination, but I believe that it should be used after demand has been reduced as far as possible. CAW has already done an excellent job at creating the right incentives to reduce demand in Monterey; per capita use is already — in my opinion — the best in the State. If they adopt my suggestions, Monterey would be among the best water conserving regions in the developed world. Under those conditions, I am happy to endorse a desalination plant. (Ironically, a desalination plant is being constructed in Carlsbad, where per capita water consumption is much higher.) I also think that opposition to desalination will weaken if CAW implements every possible means of demand reduction.

In most of California (and the West), people think that “shortages” can be eliminated by increasing supply. We know that such an ideology has done nothing to promote sustainability, since it has ignored increases in demand. CAW has moved aggressively to reduce demand and is willing to make further moves in that direction. Given CAW’s respect for the demand side, it seems both reasonable and efficient to look at the supply side. If CAW is going to reduce Carmel River extraction by another 6,000 afa, it is going to need more supply, and a desalination plant is an obvious source. Such a plant can be part of a “minimized demand, minimized supply, maximized flows” solution.

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Attachment 2

A & N Technical Services, Inc.

Monterey Demand Evaluation and Elasticity Study

Executive Summary

December 2012

Contents

Introduction

The Monterey District faces significant rate increases due to two major capital projects designed to yield environmental benefits, improved water system reliability, and assist CAW in meeting other regulatory constraints on the Monterey Peninsula: the San Clemente Dam Bypass and Removal Project[1] and a Desalination Project (DP). Substantive new rate structures will affect customer water demand—higher prices lead to reduced demand and more reliable water supply avoids shortage costs borne by retail water customers. When confronting large infrastructure and environmental costs, a rigorous understanding of customer demand response is important. This project addresses the need to integrate customer demand response to water rate changes into demand forecasts, and to improve understanding of water demand in financial and resource planning

Literature Review of Water Demand

The economic literature of urban water demand is a well-developed and evolving body of knowledge. Topics that have been addressed include the following among others that are relevant to Monterey:

- Estimating the price elasticity of water demand;
- Identification of non-price factors that influence the level of demand;
- Effects of price and other conservation efforts during water shortages;
- Consumer response to changes in average prices, marginal prices, or rate structure; and
- The value of avoiding shortages.

Although these topics are relevant, there are additional complications to the situation faced by water utilities and water customers in the Monterey Peninsula. For example, what can be expected to occur if an extended period of supply-induced water restrictions is ended, with an associated rapid rise in water prices? The literature can provide insights as to how the Monterey Demand Evaluation should proceed, but we must recognize that the present work is breaking new ground and keep in mind how the circumstances in Monterey differ from studies in the literature:

- Installed base of conservation technology. The saturation of conservation devices on the Monterey Peninsula is high because of the years of active programs implemented, and as a result of water conservation plumbing and energy codes over the past 20 years. The historical implementation of conserving technologies will reduce future response of customers to rate increases.
- Installed base of conservation education and culture. The public education regarding conservation has been very high and has extended many years.
- Existing high rates. The baseline case in Monterey is one with high upper block rates to begin with. And again, this is beyond the experiences described in most of the literature.

[1] The increment to annual revenue requirements of the San Clemente Dam removal was approved of inclusion in 2012 rates at slightly more than $7.6 million dollars or 13.63% of total 2012 revenue requirement for Monterey.

- Restrictions End. Water restrictions have been in effect in Monterey Peninsula for about two decades. The removal of restrictions at the time of a rate increase introduces new uncertainties about future demand.
- Short-term price elasticity. For the purpose of financial planning in the present case, we are looking at a time horizon that is short term in the range of 3 to 10 years.

Estimations of Price Elasticity of Demand

A comprehensive summary of estimates of price elasticity estimates is found in the meta-analysis conducted by Dalhuisen et al. (2003). Of the estimates of price elasticity collected, the mean was -. 41, the median was -.35, and the standard deviation of .86. For income elasticities, the mean was .43, the median .24, and the standard deviation .79.

Studies have generally found that demand for water is inelastic. A summary of this literature presented in Brookshire et al. (2002) reports that elasticity estimates range from -0.11 to -1.588, with an average value of -0.49 (that is, a 10% increase in price results in a 4.9% decrease in consumption), and that this result is consistent with the average found by Espey *et al.*(1997).

In general, long-run elasticities that capture a cumulative effect over a long period are higher than those in the short-run. Indeed, Nauges and Thomas (2003) provide estimates of –0.40 for a long-run elasticity, and -0.26 for a short run elasticity estimate. Hoglund (1999) estimates that the long-run adjustment to price increases takes about four years, with increases in elasticity estimated for ongoing adjustments.

Many of the elasticities discussed above were estimated with low water rates. Several papers in the literature warn that studies have often assumed that elasticities are constant.[2,3]

One study that has included a higher range of prices is reported by Pint (1999), which reports the experience in Alameda County Water District during the drought of 1987-1992. The District introduced a steeply-increasing block rate structure as one of its drought management policies in July 1991. Elasticity was estimated between -.04 and -.29. These are short-run elasticities, and so are lower than any eventual long-run changes. In addition to the rate structure change, many state and local education and conservation technology programs were implemented at the time.

Nataraj and Hanemann (2011) provide one piece of price elasticity evidence that is valuable because it is from nearby City of Santa Cruz and documents the demand response among residential customers facing a near 100 percent increase in water rates. (These were customers in the upper tiers of a newly introduced increasing tier rate structure.) The resulting reduction in

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[2] Gaudin, Griffin and Sickles (2001) state that assumed " . . . restrictions on elasticities are not problematic as long as price variation is small and predictions are made within a similar price range. Because there is evidence that price elasticity is neither constant nor increasing with price level, we need a functional form that allows elasticity to decrease with price.

[3] Brookshire *et al (2002)*state that the "lack of significant variability in water prices over the last 40 years makes it difficult to empirically estimate demand functions. The results can only be as good as the data. Forecasting consumer response outside the range of data from which the function was estimated introduces a tremendous amount of uncertainty. Thus, such estimates generally are unreliable .. ."

observed consumption was close to 12 percent. Though lacking a sophisticated structural model, the results provided suggestive evidence for this study.

Identification of Non-price Factors that Influence the Level of Demand

In addition to weather and climate, a number of studies have investigated variables other than price that could influence the level of residential water demand. Two studies that investigated the effect of income, and are of particular interest because of their location are Renwick and Archibald (1998), which estimates an elasticity of 0.36, based on data from 119 single family households in two Coastal California cities (Santa Barbara and Goleta) over a 6-year period, and Renwick and Green (2000), which reports an income elasticity of 0.25 in 8 urban water agency service areas in California. Other non-price variables in the literature include Family Demographics, Size of the House and/or the Lot, Home Technology and others (Klein et al. 2007).

Do Consumers React to Changes in Average Prices, Marginal Prices, or Rate Structures

Many studies argue that when prices are low and rate schedules are complicated, the information cost of determining the marginal cost is relatively high, so average costs are the more likely perception (for example, Hoglund 1999). Nieswiadomy (1989) tested for differing consumer perceptions of price, and concluded that consumers react to average prices. Nieswiadomy and Molina (1991) found that consumers react to marginal prices in increasing block structures and react to average prices in decreasing block rates. Hewitt and Hanemann (1995) argue that the mere existence of an increasing block structure is associated with reduced demand irrespective of the change in price.

What is it worth to customers to avoid shortages?

Two landmark studies focused on the costs that residential water customers in California were willing to pay to avoid water shortages. In 1987, Carson and Mitchell[4] published a study that estimated the amount that residential customers were willing to pay to avoid particular shortage scenarios. The results, for example, show customers are willing to pay $122 per year to avoid a 10-15% shortage once every 5 years. A 1994 study sponsored by California Urban Water Agencies of nine water utilities in the state measured residential customer willingness-to-pay to avoid water shortages using contingent valuation survey techniques. The results show that the average household willingness-to-pay to avoid a 20 percent shortage with a one-in-ten-year frequency was approximately $180 per year, or $1,800 over a 10-year period. An analysis by the Phoenix Water and Wastewater Department estimated that a mandatory 50 percent curtailment in outdoor water use would cause $325 (1990 dollars) in landscape losses per household, on

[4] QED Research, Inc., "Economic Value of Reliable Water Supplies for Residential Water Users in the State Water Project Service Area." June 9, 1987.

average.[5] A field survey of Santa Barbara County landscapes conducted in 1990 estimated county-wide losses of private landscape totaling $217 million due to prolonged and severe drought and water rationing.[6]

There has also been some work done to estimate commercial and industrial impacts. A 1992 survey of commercial and service firms in Southern California found that half of the responding firms had altered expansion plans or considered relocating because of concerns about water supply reliability.[7] A 1991 survey of 238 manufacturers in 22 industries found frequent or persistent water shortages could result in potentially significant impacts to output and employment in many of California's key industrial sectors.[8] On average, 23 percent of the surveyed firms indicated they would reduce output in response to a 15 percent water shortage. This grew to 36 percent when the shortage scenario increased to 30 percent.[9] A 1991 study of 15 south San Francisco Bay Area industries found significant savings potential in at least some industries, perhaps suggesting that when industry is actually (rather than hypothetically) pushed to save water it can find ways to substantially reduce the use of water as a production input.[10] A study of the effects of the 1987-1991 drought on California's Green Industry found that the loss of 4,500 jobs and $78 million in wages could be clearly attributed to water shortages in 1991.[11]

Demand Evaluation

The Demand Evaluation was comprised of two parts. The first part was the development of the Monterey Rate Model to model the impacts on projected impacts of changes in rate structures on customer water demand and expected revenue. The model was successfully developed and used to simulate changes in rate structure and the achievement of various possible financial goals over a 10 year period.

Second is an empirical analysis to estimate price elasticity of demand for the Monterey Peninsula service area. The empirical arrived at a null result: we were not able to statistically estimate reliable structural models using a time series of historical disaggregate consumption data due to periods of inconsistent data purposes. We did successfully estimate an aggregate model by excluding periods of inconsistent data. Though the aggregate demand model was useful for other purposes (weather normalization) it could not yield the disaggregate estimates of price elasticity

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[5] Dewitt, Jeffrey S., "Estimating the Residential Cost of Drought: A Phoenix, Arizona Case Study," Conserv 90 The National Conference and Exposition Offering Water Supply Solutions for the 1990s. 1990.

[6] Sycamore Associates and Spectrum Economics, Inc., "The Economic Costs of Drought Induced Urban Greenery Losses," State Water Contractors Exhibit 21, Bay-Delta Hearings. June 1992.

[7] Foster Economics, Inc., "Water Use, Conservation, and Planning in the Commercial, Service, and Tourism Sectors of Southern California." January 1993.

[8] Wade, W., J. Hewitt, and M. Nussbaum, "Cost of Industrial Water Shortages," Spectrum Economics, Inc., prepared for California Urban Water Agencies. 1991.

[9] It is important to note that these estimates are derived from survey responses to a hypothetical shortage. They are not empirically observed responses to an actual curtailment. The likelihood that actual response would deviate from hypothetical response is non-trivial.

[10] Manzione, M. B. Jordan, and W. Maddaus, "California Industries Cut Water Use," Journal of the American Water Works Association, October 1991.

[11] Illingworth, Wendy, "The Effects of Water Shortage on California's Green Industry," Proceedings of the American Water Works Association's Annual Conference. 1994.

for accurately depicting the pure-price effects of customer demand repression in the face of increasing water prices.

More detailed estimates of price elasticity of water demand—namely ones that varied by end use and customer class—were derived from the literature and applied in financial simulations using the Monterey Rate Model. This financial simulation allows for testing of alternative price elasticity assumption. The model simulation runs successfully depict the effect on customer demand and revenue generated from required water rate financing in a highly detailed and accurate fashion.

Monterey Rate Model Objectives

The objectives of the Monterey Rate Model include the following:

- Project demand impact from change in rates;
- Calculate rates sufficient to meet a revenue requirement; and
- Examine scenarios for revenue requirements and rate adjustments.

Monterey Rate Model Applications

During the development of the model several methods were developed to use the model to inform analytic and policy questions:

- Find Rates. Use the model to find the rates needed to meet a revenue requirement target. This is the use of the model in the examples provided for this analysis. The revenue requirements for the dam removal and desalination plant were entered and the model was solved to find the rates needed to meet the revenue requirement.
- Find Revenue Shortfall/Surplus. If you plug in a rate projection and use the model to determine revenues expected, you will be able to determine the projected shortfall or surplus that may affect the Water Revenue Adjustment Mechanism (WRAM).
- Test Price Response Assumptions. The model can be used to test the effects of zero price response, small price response, and medium price response to create tables that can be used in the policy process. Historically in CPUC proceedings water demand has been assumed to be nonresponsive to price. Some of the interveners in the CPUC process have raised the question of whether nonzero price elasticity should be used.
- Conservation Goals. The model can be used to estimate the demand response due to changes in price structure, and this demand response can be useful in the pursuit of conservation goals. For example, the demand drop due to rising rates will contribute to meeting 20x2020 goals.

Monterey Rate Model Simulation Runs

Table 1 summarizes an illustration of a set of water rate simulation runs that characterize applications of this analysis. Scenario 1 is a base case with the revenue requirements that were estimated in the respective spreadsheets for the dam removal and regional desalination plant.

Scenarios 1d and 1c include hypothetical cases where the revenue requirements are 50 percent higher and 100 percent higher than expected respectively. Scenario 2b has the same revenue requirement as Scenario 1, the base case, but it includes the assumption that consumers are 50 percent more responsive to price than expected.

Table 1 – Rate Run Scenarios

Scenario	Scenario Name
	Single Family
1	Dam Removal and Desal. Plant(1)
1d	Rev. Req. x 150% by 2020
1c	Rev. Req. x 200% by 2020
2b	Sensitivity Testing: Price Elasticity
	Commercial and Dedicated Irrigation
1	Dam Removal and Desal. Plant(1)
1d	Rev. Req. x 150% by 2020
1c	Rev. Req. x 200% by 2020
2b	Sensitivity Testing: Price Elasticity

(1) Includes revenue requirement increment for the San Clemente Dam Removal and River Restoration Project, and for the Regional Desalination Plant

Monterey Rate Model Structure

The models are Excel "Workbooks" each comprised of a set of "Worksheets" including a "Control Panel" worksheet to construct scenarios and summarize results, a "Model" worksheet with the rate structure logic and several data worksheets.

To accommodate the large number of Single Family customers, the Single Family model was constructed by aggregating customers into like "Bins" that are defined by Lot Size, Large Animals, Total Occupants, and Season. All customers with these like characteristics were lumped together in a bin. In contrast, the Commercial and Dedicated Irrigation customers were modeled at the Account Level because there are not as many and because there is greater heterogeneity in commercial uses.

The Year 2009 is the base year – the model's point of departure (not a simulation year). As such, the model does not need to represent the allocations and rate structure details from the 2009 rate structure. It only needs the rates, revenues, and use for 2009. The first simulation year–or modeled year—is 2010. The rate structure changed in 2010.

Data Sources for Monterey Rate Model

- Billing system data

- Revenue requirement spreadsheets for Dam Removal (SCD Revenue Req Model 07-22-10 v12 SanClementeDam.xls) and Desalination Project (Single Page CAW Only Facilities Coastal Water Project-Regional Desal.xls)
- Tariff sheets: Effective January 1, 2008; May 11, 2009; July 1, 2010; December 23, 2010.

Data validation procedures included comparing status quo revenue and volume summations from the models to other summary tables. Some duplicate Premise IDs remained for commercial and irrigation customers and these are due to one of the following reasons: 1) change of ownership 2) multiple accounts on a single premise (e.g., indoor and landscape meters) 3) change in Business Type (or perhaps two Business Types for a Premise).

Price Elasticity of Demand

The final input data element needed to model customer demand response is a quantitative estimate of customers' price elasticity of demand. As described in the Literature Review above, one of the best introductions to the topic applied to water demand is Griffin's textbook on Water Resource Economics. An excellent summary of estimates of price elasticity estimates is found in the meta-analysis of Dalhuisen (2003). This summary of empirical literature--captures a wide variation of study areas, histories of water demand and water rates, and large differences in available data and applied methods. Unsurprisingly, this summary of publically available studies reveals an unhelpfully wide range of estimates as shown in Figure 1.

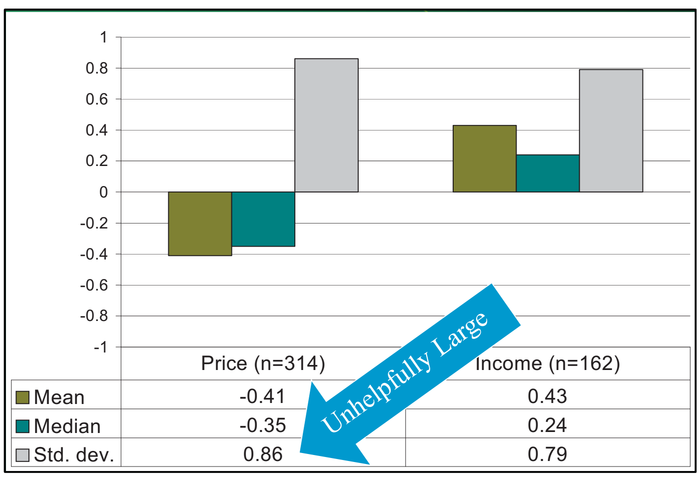

Figure 1 Range of Price and Income Elasticity Estimates in Dalhuisen (2003)

The rigorous studies by Renwick provide solid estimates of price elasticities for aggregate (system wide) urban water demand price elasticities in the State of California. Note that aggregate price elasticities do not provide information on how price elasticity varies by customer class or by customer type within a block of water consumption.

One study that did separately estimate residential price elasticities that varied as a function of outdoor water use (outdoor irrigated area) found an increasing magnitude of price response[12]. For the latter we drew from a detailed study set in California that carefully controlled for household meter-specific variability, weather, conservation programs, and numerous other household characteristics for 23,000 dwelling units in California. Key for this application, the variability of price elasticity across end uses was reliably estimated. Specifically, outdoor residential end uses are less inelastic than indoor residential end uses. On a percentage basis, residential water users have displayed a willingness to reduce outdoor consumption more readily than indoor consumption. The corollary of this finding is that summer demand tends to be more elastic than winter demand, because most outdoor use occurs during the summer.
Figure 2 depicts how single family residential price response varied as a function of irrigated area.

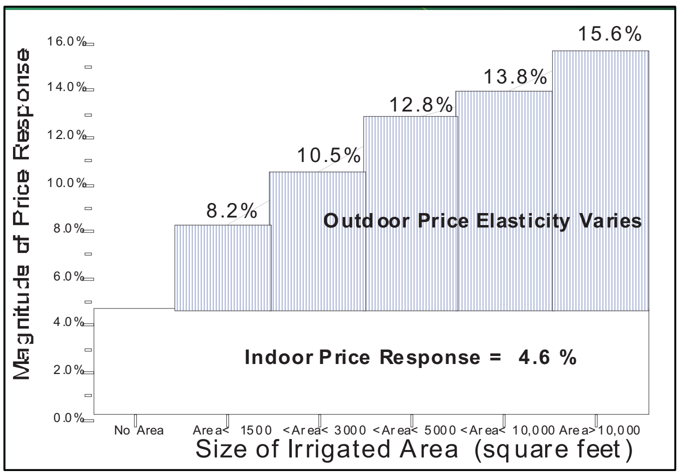

Figure 2 Single Family Price Elasticity as a Function of Irrigated Area (Chesnutt, et al., 1995)

Estimates of short run price elasticity for Commercial customers (excluding dedicated irrigation meters) were taken from the literature and are approximately twice as great as residential customers. Commercial customers have individual allocations determining block width and were modeled individually. Sensitivity analyses were also conducted to capture the effects of alternative assumptions about customer demand response.

Price Elasticity Scenarios for the Monterey Rate Model					
Scenario	Single Family Price Elasticity by Block				
	Block 1	Block 2	Block 3	Block 4	Block 5
Scenario 0	0	0	0	0	0
Scenario 1 (Chesnutt, et al., 1995)	-0.0462	-0.0823	-0.1052	-0.1383	-0.1563
Scenario 2	-0.0693	-0.1235	-0.1578	-0.2075	-0.2345

12 See Appendix A of Chesnutt, T.W., C.N. McSpadden, and A. Bamezai, *Ultra Low Flush Toilet Programs: Evaluation of Program Outcomes and Water Savings*, A report for the Metropolitan Water District of Southern California, July 1995.

(X150%)					
	Commercial Price Elasticity By Block				
	Block 1	Block 2	Block 3		
Scenario 0	0	0	0		
Scenario 1 (Assumption)	-0.10	-0.20	-0.20		
Scenario 2 (X150%)	-0.15	-0.30	-0.30		

We would have preferred a customer level empirical study that includes controlled statistical estimates of price elasticity of demand for the Monterey service area in particular and spent a considerable amount of effort trying to reassemble the three different types of consumption billing dumps. We did not succeed in attaining the data quality necessary for reliable statistical estimates from meter-specific consumption data. To illustrate the data quality issues, Figure 3 plots aggregate historical water consumption in green. We did successfully estimate an aggregate Monterey demand model, but had had to constrain the sample period to exclude the 2004-2006 period. The model was used to weather normalize history to remove weather-induced variability. Aggregate water demand models, though useful for validation, will be very constrained in separating the multiple determinates of customer water demand.

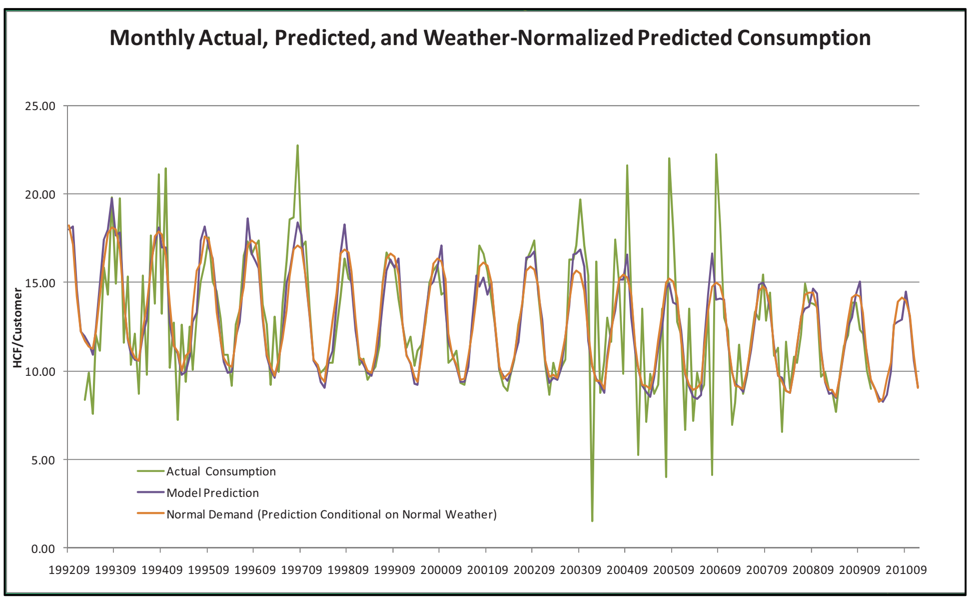

Figure 3 Actual versus Model Predicted Consumption: Variability in Data Quality

In sum, more detailed estimates of price elasticity of demand were used in the Monterey Rate Model that varies by block of consumption and class. The Monterey Rate model was then applied to simulate the effect of water rate increases on expected customer demand over a decade long forecast horizon. Note that this effect of demand repression is necessary to setting revenue neutral rate structures.

Illustrative Results from 2010

Scenario	Scenario Name	Max. Annual Increase in Revenue Requirements 2011-2020	Max.Rate Block 1 ($/10cf) (2)	Max.Rate Top Block ($/10cf)	Percent Change in Consumption 2009-2011	Percent Change in Consumption 2011-2020	Filename
	Single Family						
1	Dam Removal and Desal. Plant(1)	36.9%	$ 0.9286	$ 9.4507	-4.0%	-12.3%	RateModel_SF_Bins_Scenario1_v12.xlsm
1d	Rev. Req. x 150% by 2020	36.9%	$ 1.1017	$ 11.2114	-4.0%	-14.2%	RateModel_SF_Bins_Scenario1d_v12.xlsm
1c	Rev. Req. x 200% by 2020	36.9%	$ 1.2945	$ 13.1738	-4.0%	-15.5%	RateModel_SF_Bins_Scenario1c_v12.xlsm
2b	Sensitivity Testing: Price Elasticity	44.2%	$ 1.5492	$ 15.7660	-5.9%	-27.9%	RateModel_SF_Bins_Scenario12b_v12.xlsm
	Commercial and Dedicated Irrigation						
1	Dam Removal and Desal. Plant(1)	36.4%	$ 1.1030	$ 7.7209	-5.8%	-11.0%	RateModel_Comm_Scenario1_v16.xlsm
1d	Rev. Req. x 150% by 2020	36.4%	$ 1.2934	$ 9.0535	-5.8%	-13.0%	RateModel_Comm_Scenario1d_v16.xlsm
1c	Rev. Req. x 200% by 2020	36.4%	$ 1.4980	$ 10.4854	-5.8%	-14.5%	RateModel_Comm_Scenario1c_v16.xlsm
2b	Sensitivity Testing: Price Elasticity	39.4%	$ 1.4090	$ 9.8627	-8.5%	-20.9%	RateModel_Comm_Scenario12b_v16.xlsm

(1) Includes revenue requirement increment for the San Clemente Dam Removal and River Restoration Project, and for the Regional Desalination Plant

(2) In the commercial model, the Max Rate Block 1 is for Commercial (not Irrigation which has Block 1 equal to Commercial Block 2)

Conclusion

There is a natural relationship between planning for new water facilities, the financing requirements, and the revenue required to pay for these facilities. In general, when any product becomes more expensive, customers choose to buy less of the product. This is empirical fact is known as the “Law of Demand.” This study focused on examining the predictable effects of Monterey water customers reacting to more expensive water. A large scale long term financial model—the Monterey Rate Model—was constructed to capture the customer demand response to higher water rates.

The Monterey Peninsula is a unique community that differs in many respects from other communities—its history of water supply constraint, water curtailments, active conservation program implementation, and history of high water rates. The empirical literature has wide bounds on the parameter used to capture how much customer water demand changes in response to changes in water price—the price elasticity. We used estimates of price elasticity taken from California that fit the unique characteristics of the Monterey Peninsula to depict customer demand response to potential changes in water rates required for water infrastructure investments.

It is critical to accurately depict the financial consequences of alternative ways to pay for reliable and safe water on the Monterey Peninsula. The Monterey Rate Model provides robust empirical estimates of economic consequences that are a prerequisite for informed water resource decision-making.

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Attachment 3

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	Variable	Residential	
		Coefficient	T-Statistic
	Model Adjusted R-Squared	0.8501	
	Intercept	-4.14537	-3.73
	monthly average temperature Monterey Airport	0.22996	12.37
	monthly total rainfall Monterey Airport	-0.34963	-7.3
	Time	-0.01026	-4.64
Elasticity	(price / (cpi/312.92)) * (avg use/ avg price)	-0.12783	-2.9

Year	Month	Actual	Predicted	Residual	Temperature & intercept Predicted	Rainfall Predicted	Time Predicted	Price term Predicted	Temperature Value	Rainfall Value	Time Value	Price term Value
2004	4	8.4652	7.69986	0.76534	8.829	0	-0.01026	-1.11886	56.42	0	1	8.7527
2004	5	9.6066	8.19079	1.41581	9.1578	0	-0.02052	-0.94651	57.85	0	2	7.4044
2004	6	9.0174	8.50657	0.51083	9.4637	-0.00699	-0.03078	-0.91932	59.18	0.02	3	7.1917
2004	7	9.3157	9.13952	0.17618	10.0869	-0.00699	-0.04104	-0.8993	61.89	0.02	4	7.0351
2004	8	9.2523	9.19393	0.05837	10.3191	0	-0.0513	-1.07389	62.9	0	5	8.4009
2004	9	8.7651	8.98734	-0.22224	10.1765	-0.01049	-0.06156	-1.11715	62.28	0.03	6	8.7393
2004	10	7.143	7.02869	0.11431	9.1992	-0.98246	-0.07182	-1.11624	58.03	2.81	7	8.7322
2004	11	6.1425	6.73624	-0.59374	8.2334	-0.29719	-0.08208	-1.11787	53.83	0.85	8	8.745
2004	12	6.1249	5.59923	0.52567	7.8309	-1.29013	-0.09234	-0.84924	52.08	3.69	9	6.6435
2005	1	5.6897	5.72355	-0.03385	7.6447	-0.97896	-0.1026	-0.83957	51.27	2.8	10	6.5679
2005	2	4.9863	6.58833	-1.60203	8.3392	-0.80415	-0.11286	-0.83382	54.29	2.3	11	6.5229
2005	3	5.7346	6.72402	-0.98942	8.7186	-1.04539	-0.12312	-0.82606	55.94	2.99	12	6.4622
2005	4	6.2309	6.94606	-0.71516	8.2955	-0.3741	-0.13338	-0.84192	54.1	1.07	13	6.5863
2005	5	7.8033	8.31651	-0.51321	9.3855	-0.16433	-0.14364	-0.761	58.84	0.47	14	5.9532
2005	6	8.4734	8.50769	-0.03429	9.4867	-0.04545	-0.1539	-0.77962	59.28	0.13	15	6.0989
2005	7	9.7142	8.90379	0.81041	9.9052	-0.0035	-0.16416	-0.83373	61.1	0.01	16	6.5222
2005	8	9.321	8.7027	0.6183	9.7143	0	-0.17442	-0.8372	60.27	0	17	6.5493
2005	9	8.7941	8.41615	0.37795	9.3809	0	-0.18468	-0.78005	58.82	0	18	6.1022
2005	10	8.3231	8.02241	0.30069	8.9692	-0.01399	-0.19494	-0.73791	57.03	0.04	19	5.7726
2005	11	7.1266	7.75506	-0.62846	9.0382	-0.21677	-0.2052	-0.86121	57.33	0.62	20	6.7371
2005	12	5.8732	6.12218	-0.24898	8.1621	-0.96148	-0.21546	-0.86297	53.52	2.75	21	6.7509
2006	1	5.7031	5.93402	-0.23092	7.7505	-0.82513	-0.22572	-0.76559	51.73	2.36	22	5.9891
2006	2	5.3934	6.81437	-1.42097	8.031	-0.23425	-0.23598	-0.74641	52.95	0.67	23	5.8391
2006	3	5.4999	4.6146	0.8853	7.4561	-1.83556	-0.24624	-0.75972	50.45	5.25	24	5.9432
2006	4	5.6062	6.72786	-1.12166	8.33	-0.61535	-0.2565	-0.73025	54.25	1.76	25	5.7126
2006	5	7.937	7.92484	0.01216	9.0175	-0.16433	-0.26676	-0.66161	57.24	0.47	26	5.1757
2006	6	8.991	8.92844	0.06256	9.9282	0	-0.27702	-0.72272	61.2	0	27	5.6538
2006	7	9.7393	9.04801	0.69129	10.119	-0.0035	-0.28728	-0.78026	62.03	0.01	28	6.1039
2006	8	9.4386	8.79556	0.64304	9.8822	0	-0.29754	-0.78909	61	0	29	6.173
2006	9	8.5606	8.60135	-0.04075	9.6706	0	-0.3078	-0.76148	60.08	0	30	5.957
2006	10	8.4142	8.56776	-0.15356	9.6177	-0.01399	-0.31806	-0.71793	59.85	0.04	31	5.6163
2006	11	6.8758	7.02951	-0.15371	8.53	-0.32516	-0.32832	-0.84704	55.12	0.93	32	6.6263
2006	12	5.994	5.68574	0.30826	7.6746	-0.82862	-0.33858	-0.82163	51.4	2.37	33	6.4276
2007	1	6.0675	5.54256	0.52494	6.8973	-0.23076	-0.34884	-0.77516	48.02	0.66	34	6.064
2007	2	5.2461	5.91454	-0.66844	7.8424	-0.79716	-0.3591	-0.77164	52.13	2.28	35	6.0365
2007	3	6.5926	7.07341	-0.48081	8.2978	-0.10839	-0.36936	-0.74661	54.11	0.31	36	5.8407
2007	4	7.0606	6.75994	0.30066	8.1184	-0.22726	-0.37962	-0.75158	53.33	0.65	37	5.8795
2007	5	8.3599	7.62546	0.73444	8.7071	-0.01399	-0.38988	-0.67777	55.89	0.04	38	5.3021
2007	6	8.6052	8.28163	0.32357	9.3809	-0.0035	-0.40014	-0.69561	58.82	0.01	39	5.4417
2007	7	9.4528	8.99733	0.45547	10.142	0	-0.4104	-0.73432	62.13	0	40	5.7445
2007	8	9.3739	9.13751	0.23639	10.3122	0	-0.42066	-0.75404	62.87	0	41	5.8988
2007	9	8.5426	9.11097	-0.56837	10.4065	-0.10139	-0.43092	-0.76322	63.28	0.29	42	5.9706
2007	10	7.654	8.06128	-0.40728	9.5235	-0.2867	-0.44118	-0.73429	59.44	0.82	43	5.7443
2007	11	7.001	7.52644	-0.52544	8.9003	-0.11188	-0.45144	-0.81049	56.73	0.32	44	6.3404
2007	12	5.9419	5.96493	-0.02303	7.5297	-0.24124	-0.4617	-0.86183	50.77	0.69	45	6.742
2008	1	5.6289	4.62836	1.00054	7.6562	-1.76563	-0.47196	-0.79023	51.32	5.05	46	6.1819
2008	2	5.1252	6.08615	-0.96095	8.0264	-0.67129	-0.48222	-0.78675	52.93	1.92	47	6.1547
2008	3	6.4431	6.87351	-0.43041	8.2426	-0.11887	-0.49248	-0.75771	53.87	0.34	48	5.9275
2008	4	7.4323	7.21219	0.22011	8.5507	-0.03496	-0.50274	-0.80083	55.21	0.1	49	6.2648
2008	5	8.5636	7.99767	0.56593	9.2222	0	-0.513	-0.71153	58.13	0	50	5.5663
2008	6	8.7785	8.36054	0.41796	9.5878	0	-0.52326	-0.70404	59.72	0	51	5.5077
2008	7	9.0217	8.54617	0.47553	9.804	0	-0.53352	-0.72431	60.66	0	52	5.6662
2008	8	8.8402	8.66408	0.17612	9.9236	0	-0.54378	-0.71572	61.18	0	53	5.599
2008	9	8.2743	8.75631	-0.48201	10.0156	-0.0035	-0.55404	-0.70172	61.58	0.01	54	5.4895
2008	10	7.9489	8.48761	-0.53871	9.7925	-0.03496	-0.5643	-0.70563	60.61	0.1	55	5.5201
2008	11	6.5255	7.45001	-0.92451	9.2314	-0.35313	-0.57456	-0.8537	58.17	1.01	56	6.6784
2008	12	5.7148	5.32511	0.38969	7.4239	-0.67129	-0.58482	-0.8427	50.31	1.92	57	6.5923
2009	1	5.7698	6.41156	-0.64176	8.2978	-0.52445	-0.59508	-0.76668	54.11	1.5	58	5.9977
2009	2	4.7672	4.98406	-0.21686	8.0471	-1.68522	-0.60534	-0.77249	53.02	4.82	59	6.0431
2009	3	5.7767	5.54509	0.23161	7.8746	-0.97547	-0.6156	-0.73848	52.27	2.79	60	5.777
2009	4	7.0212	7.10285	-0.08165	8.599	-0.12237	-0.62586	-0.74793	55.42	0.35	61	5.851
2009	5	7.9476	7.64814	0.29946	9.0635	-0.08741	-0.63612	-0.69187	57.44	0.25	62	5.4124
2009	6	8.1741	8.36742	-0.19332	9.6982	-0.0035	-0.64638	-0.68093	60.2	0.01	63	5.3268
2009	7	8.9927	8.15769	0.83501	9.5418	-0.03147	-0.65664	-0.69605	59.52	0.09	64	5.4452
2009	8	8.8306	8.70937	0.12123	10.0892	-0.01399	-0.6669	-0.6989	61.9	0.04	65	5.4674
2009	9	8.2088	8.32524	-0.11644	9.7741	-0.07692	-0.67716	-0.69479	60.53	0.22	66	5.4353
2009	10	7.0667	6.8498	0.2169	9.2728	-1.04539	-0.68742	-0.69018	58.35	2.99	67	5.3992
2009	11	6.4131	6.72804	-0.31494	8.2771	-0.0909	-0.69768	-0.76044	54.02	0.26	68	5.9488
2009	12	5.6347	4.99178	0.64292	7.3388	-0.84261	-0.70794	-0.7965	49.94	2.41	69	6.231
2010	1	4.8118	4.37747	0.43433	8.0356	-2.18868	-0.7182	-0.75126	52.97	6.26	70	5.877
2010	2	4.2681	5.43453	-1.16643	8.1253	-1.07336	-0.72846	-0.88894	53.36	3.07	71	6.9541
2010	3	5.243	5.18235	0.06065	8.0356	-1.15378	-0.73872	-0.96076	52.97	3.3	72	7.5159
2010	4	5.4185	5.32764	0.09086	8.1874	-1.12581	-0.74898	-0.98495	53.63	3.22	73	7.7052
2010	5	6.6544	6.57148	0.08292	8.4794	-0.1888	-0.75924	-0.95992	54.9	0.54	74	7.5093
2010	6	7.2387	7.52267	-0.28397	9.3349	0	-0.7695	-1.04272	58.62	0	75	8.1571
2010	7	8.0892	7.5457	0.5435	9.489	-0.01049	-0.77976	-1.15301	59.29	0.03	76	9.0199
2010	8	7.891	7.51826	0.37274	9.5143	-0.05944	-0.79002	-1.14653	59.4	0.17	77	8.9692
2010	9	7.4223	7.82115	-0.39885	9.8201	-0.03147	-0.80028	-1.16721	60.73	0.09	78	9.1309
2010	10	6.766	7.17778	-0.41178	9.4361	-0.29019	-0.81054	-1.15756	59.06	0.83	79	9.0554
2010	11	5.5571	5.50054	0.05656	8.1989	-0.72723	-0.8208	-1.15031	53.68	2.08	80	8.9988
2010	12	4.8521	4.63015	0.22195	7.9344	-1.39852	-0.83106	-1.0747	52.53	4	81	8.4073
2011	1	5.1948	5.55568	-0.36088	8.054	-0.65381	-0.84132	-1.0032	53.05	1.87	82	7.8479
2011	2	4.7782	4.32667	0.45153	7.6769	-1.48243	-0.85158	-1.01619	51.41	4.24	83	7.9495
2011	3	5.0479	4.74293	0.30497	8.3461	-1.72717	-0.86184	-1.01412	54.32	4.94	84	7.9333
2011	4	5.9529	6.09056	-0.13766	8.0241	-0.03846	-0.8721	-1.023	52.92	0.11	85	8.0028
2011	5	6.8548	6.15318	0.70162	8.3576	-0.2867	-0.88236	-1.03532	54.37	0.82	86	8.0992
2011	6	6.6059	6.91477	-0.30887	9.1256	-0.25873	-0.89262	-1.0595	57.71	0.74	87	8.2884
2011	7	7.7782	7.74746	0.03074	9.7557	0	-0.90288	-1.10538	60.45	0	88	8.6472
2011	8	7.4668	7.46293	0.00387	9.5487	0	-0.91314	-1.17267	59.55	0	89	9.1737
2011	9	6.9918	7.86545	-0.87365	9.9926	-0.0035	-0.9234	-1.20023	61.48	0.01	90	9.3892
2011	10	6.3052	6.96504	-0.65984	9.781	-0.74471	-0.93366	-1.1376	60.56	2.13	91	8.8993
2011	11	5.4665	5.53004	-0.06354	8.031	-0.46501	-0.94392	-1.09204	52.95	1.33	92	8.5429
2011	12	5.4841	5.09042	0.39368	7.2537	-0.06993	-0.95418	-1.13922	49.57	0.2	93	8.912
2012	1	5.8224	5.23373	0.58867	7.7198	-0.45837	-0.96444	-1.06329	51.5968	1.31102	94	8.318
2012	2	5.2345	5.53708	-0.30258	7.8363	-0.23538	-0.9747	-1.08917	52.1034	0.67323	95	8.5204
2012	3	5.5209	4.87372	0.64718	8.0128	-1.13836	-0.98496	-1.01581	52.871	3.2559	96	7.9465
2012	4	5.2822	5.81818	-0.53598	8.4573	-0.67035	-0.99522	-0.97352	54.8036	1.91732	97	7.6157
2012	5	6.9684	6.51911	0.44929	8.7509	-0.04818	-1.00548	-1.17815	56.0806	0.1378	98	9.2166
2012	6	7.0085	6.93834	0.07016	9.4683	-0.10599	-1.01574	-1.40819	59.2	0.30315	99	11.0161
2012	7	7.6038	7.14805	0.45575	9.6139	0	-1.026	-1.43984	59.8333	0	100	11.2637
2012	8	7.2909	6.99424	0.29666	9.4	-0.00413	-1.03626	-1.36538	58.9032	0.01181	101	10.6812
2012	9	6.6768	6.8202	-0.1434	9.2191	0	-1.04652	-1.35243	58.1167	0	102	10.5799
2012	10	6.4544	7.2379	-0.7835	9.8562	-0.18996	-1.05678	-1.37159	60.8871	0.54331	103	10.7298

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	Variable	Multi Family Residential Coefficient	T-Statistic
	Model Adjusted R-Squared	0.775	
	Intercept	-13.768	-2.97
	monthly average temperature Monterey Airport	0.61822	8.54
	monthly total rainfall Monterey Airport	-0.71014	-3.81
	Time	0.06535	8.42
Elasticity	(price / (cpi/312.92)) * (avg use/ avg price)	0.36166	6.57

Year	Month	Actual	Predicted	Residual	Temperature & intercept Predicted	Rainfall Predicted	Time Predicted	Price term Predicted	Temperature Value	Rainfall Value	Time Value	Price term Value
2004	4	38.026	36.7543	1.2717	21.112	0	0.06535	15.5769	56.42	0	1	43.0707
2004	5	41.3426	37.4941	3.8485	21.9961	0	0.1307	15.3674	57.85	0	2	42.4913
2004	6	38.479	37.7463	0.7327	22.8183	-0.0142	0.19605	14.7461	59.18	0.02	3	40.7734
2004	7	41.2183	39.4169	1.8014	24.4937	-0.0142	0.2614	14.676	61.89	0.02	4	40.5795
2004	8	40.0936	40.5921	-0.4985	25.1181	0	0.32675	15.1473	62.9	0	5	41.8826
2004	9	38.714	40.1361	-1.4221	24.7348	-0.0213	0.3921	15.0305	62.28	0.03	6	41.5598
2004	10	33.7092	35.8079	-2.0987	22.1073	-1.99549	0.45745	15.2386	58.03	2.81	7	42.1351
2004	11	32.4456	34.1286	-1.683	19.5108	-0.60362	0.5228	14.6986	53.83	0.85	8	40.6421
2004	12	32.4839	30.1039	2.38	18.4289	-2.62042	0.58815	13.7073	52.08	3.69	9	37.901
2005	1	31.9875	30.223	1.7645	17.9282	-1.98839	0.6535	13.6297	51.27	2.8	10	37.6864
2005	2	28.9934	32.9046	-3.9112	19.7952	-1.63332	0.71885	14.0239	54.29	2.3	11	38.7765
2005	3	32.6654	33.5335	-0.8681	20.8153	-2.12332	0.7842	14.0573	55.94	2.99	12	38.8689
2005	4	32.5546	33.8538	-1.2992	19.6777	-0.75985	0.84955	14.0864	54.1	1.07	13	38.9492
2005	5	35.8113	36.7388	-0.9275	22.6081	-0.33377	0.9149	13.5496	58.84	0.47	14	37.4651
2005	6	36.4729	37.3921	-0.9192	22.8801	-0.09232	0.98025	13.624	59.28	0.13	15	37.6708
2005	7	40.9145	39.0323	1.8822	24.0053	-0.0071	1.0456	13.9885	61.1	0.01	16	38.6786
2005	8	39.8528	38.4522	1.4006	23.4921	0	1.11095	13.8491	60.27	0	17	38.2932
2005	9	37.9484	36.8639	1.0845	22.5957	0	1.1763	13.0919	58.82	0	18	36.1994
2005	10	37.144	34.9629	2.1811	21.4891	-0.02841	1.24165	12.2605	57.03	0.04	19	33.9007
2005	11	34.4634	35.0515	-0.5881	21.6746	-0.44029	1.307	12.5102	57.33	0.62	20	34.5911
2005	12	31.1895	31.853	-0.6635	19.3192	-1.95289	1.37235	13.1143	53.52	2.75	21	36.2615
2006	1	32.3689	30.3869	1.982	18.2126	-1.67593	1.4377	12.4126	51.73	2.36	22	34.3211
2006	2	29.3878	32.5192	-3.1314	18.9668	-0.47579	1.50305	12.5252	52.95	0.67	23	34.6325
2006	3	31.2475	27.6878	3.5597	17.4212	-3.72824	1.5684	12.4264	50.45	5.25	24	34.3595
2006	4	30.8033	32.1787	-1.3754	19.7705	-1.24985	1.63375	12.0244	54.25	1.76	25	33.2477
2006	5	36.0757	34.6776	1.3981	21.6189	-0.33377	1.6991	11.6933	57.24	0.47	26	32.3324
2006	6	35.4245	38.0299	-2.6054	24.0671	0	1.76445	12.1984	61.2	0	27	33.7289
2006	7	39.5909	39.0537	0.5372	24.5802	-0.0071	1.8298	12.6508	62.03	0.01	28	34.9799
2006	8	38.862	38.6122	0.2498	23.9435	0	1.89515	12.7736	61	0	29	35.3194
2006	9	36.3767	37.5903	-1.2136	23.3747	0	1.9605	12.2551	60.08	0	30	33.8857
2006	10	36.7074	37.182	-0.4746	23.2325	-0.02841	2.02585	11.9521	59.85	0.04	31	33.0479
2006	11	33.2106	34.3524	-1.1418	20.3083	-0.66043	2.0912	12.6133	55.12	0.93	32	34.8761
2006	12	31.1913	31.6688	-0.4775	18.0085	-1.68303	2.15655	13.1868	51.4	2.37	33	36.4618
2007	1	32.0228	30.5065	1.5163	15.919	-0.46869	2.2219	12.8343	48.02	0.66	34	35.4873
2007	2	28.6148	31.7696	-3.1548	18.4598	-1.61912	2.28725	12.6417	52.13	2.28	35	34.9545
2007	3	33.1568	34.1543	-0.9975	19.6839	-0.22014	2.3526	12.3379	54.11	0.31	36	34.1146
2007	4	33.6845	33.6492	0.0353	19.2017	-0.46159	2.41795	12.4911	53.33	0.65	37	34.5383
2007	5	37.9906	35.0673	2.9233	20.7843	-0.02841	2.4833	11.828	55.89	0.04	38	32.7048
2007	6	37.8419	37.1732	0.6687	22.5957	-0.0071	2.54865	12.0359	58.82	0.01	39	33.2796
2007	7	42.7797	39.2964	3.4833	24.642	0	2.614	12.0404	62.13	0	40	33.2919
2007	8	40.3312	40.5569	-0.2257	25.0995	0	2.67935	12.7781	62.87	0	41	35.3317
2007	9	38.1362	39.9239	-1.7877	25.353	-0.20594	2.7447	12.0321	63.28	0.29	42	33.2691
2007	10	36.5776	37.1151	-0.5375	22.979	-0.58231	2.81005	11.9084	59.44	0.82	43	32.9269
2007	11	34.3407	36.1188	-1.7781	21.3037	-0.22724	2.8754	12.167	56.73	0.32	44	33.642
2007	12	32.2474	32.6828	-0.4354	17.6191	-0.49	2.94075	12.613	50.77	0.69	45	34.8752
2008	1	33.3231	30.1592	3.1639	17.9591	-3.58621	3.0061	12.7803	51.32	5.05	46	35.3377
2008	2	31.3611	33.4306	-2.0695	18.9544	-1.36347	3.07145	12.7682	52.93	1.92	47	35.3046
2008	3	34.7536	34.6655	0.0881	19.5355	-0.24145	3.1368	12.2346	53.87	0.34	48	33.8291
2008	4	35.3708	35.6272	-0.2564	20.364	-0.07101	3.20215	12.1321	55.21	0.1	49	33.5456
2008	5	38.8119	37.1618	1.6501	22.1692	0	3.2675	11.7251	58.13	0	50	32.4203
2008	6	38.1059	38.0897	0.0162	23.1521	0	3.33285	11.6047	59.72	0	51	32.0874
2008	7	39.1375	38.7466	0.3909	23.7333	0	3.3982	11.6152	60.66	0	52	32.1162
2008	8	39.5594	39.2307	0.3287	24.0547	0	3.46355	11.7124	61.18	0	53	32.3852
2008	9	38.138	39.482	-1.344	24.302	-0.0071	3.5289	11.6582	61.58	0.01	54	32.2352
2008	10	37.9309	38.9756	-1.0447	23.7023	-0.07101	3.59425	11.75	60.61	0.1	55	32.4892
2008	11	34.6234	37.8125	-3.1891	22.1939	-0.71724	3.6596	12.6762	58.17	1.01	56	35.0501
2008	12	32.5089	32.637	-0.1281	17.3347	-1.36347	3.72495	12.9409	50.31	1.92	57	35.7819
2009	1	32.7256	35.2123	-2.4867	19.6839	-1.06521	3.7903	12.8033	54.11	1.5	58	35.4016
2009	2	30.1264	32.5146	-2.3882	19.0101	-3.42287	3.85565	13.0718	53.02	4.82	59	36.1438
2009	3	33.6155	33.2541	0.3614	18.5464	-1.98129	3.921	12.768	52.27	2.79	60	35.3039
2009	4	35.012	36.9359	-1.9239	20.4938	-0.24855	3.98635	12.7044	55.42	0.35	61	35.1279
2009	5	36.598	37.9489	-1.3509	21.7426	-0.17754	4.0517	12.3321	57.44	0.25	62	34.0987
2009	6	36.7809	38.9814	-2.2005	23.4489	-0.0071	4.11705	11.4226	60.2	0.01	63	31.5837
2009	7	40.6779	38.6524	2.0255	23.0285	-0.06391	4.1824	11.5054	59.52	0.09	64	31.8127
2009	8	38.9997	40.4708	-1.4711	24.4998	-0.02841	4.24775	11.7516	61.9	0.04	65	32.4936
2009	9	36.8981	39.2695	-2.3714	23.6529	-0.15623	4.3131	11.4598	60.53	0.22	66	31.6866
2009	10	34.4064	35.9379	-1.5315	22.3052	-2.12332	4.37845	11.3776	58.35	2.99	67	31.4595
2009	11	32.8257	35.27	-2.4443	19.6283	-0.18464	4.4438	11.3826	54.02	0.26	68	31.4731
2009	12	32.5016	31.8607	0.6409	17.1059	-1.71144	4.50915	11.9571	49.94	2.41	69	33.0617
2010	1	34.5881	30.8016	3.7865	18.9791	-4.44548	4.5745	11.6935	52.97	6.26	70	32.3328
2010	2	31.8704	34.8808	-3.0104	19.2202	-2.18013	4.63985	13.2009	53.36	3.07	71	36.5008
2010	3	37.3962	35.6233	1.7729	18.9791	-2.34346	4.7052	14.2824	52.97	3.3	72	39.4912
2010	4	36.7325	36.0436	0.6889	19.3872	-2.28665	4.77055	14.1725	53.63	3.22	73	39.1875
2010	5	41.3721	38.9169	2.4552	20.1723	-0.38348	4.8359	14.2922	54.9	0.54	74	39.5182
2010	6	41.7937	41.726	0.0677	22.4721	0	4.90125	14.3527	58.62	0	75	39.6856
2010	7	47.4585	42.7463	4.7122	22.8863	-0.0213	4.9666	14.9147	59.29	0.03	76	41.2396
2010	8	47.622	44.0241	3.5979	22.9543	-0.12072	5.03195	16.1585	59.4	0.17	77	44.6788
2010	9	45.2836	43.3163	1.9673	23.7765	-0.06391	5.0973	14.5064	60.73	0.09	78	40.1106
2010	10	42.5335	42.0008	0.5327	22.7441	-0.58942	5.16265	14.6835	59.06	0.83	79	40.6002
2010	11	36.9406	37.7144	-0.7738	19.4181	-1.47709	5.228	14.5454	53.68	2.08	80	40.2186
2010	12	34.3722	36.0373	-1.6651	18.7071	-2.84056	5.29335	14.8774	52.53	4	81	41.1363
2011	1	35.9682	38.0455	-2.0773	19.0286	-1.32796	5.3587	14.9862	53.05	1.87	82	41.4373
2011	2	33.4379	35.2593	-1.8214	18.0147	-3.01099	5.42405	14.8315	51.41	4.24	83	41.0095
2011	3	36.7478	36.4067	0.3411	19.8137	-3.50809	5.4894	14.6117	54.32	4.94	84	40.4017
2011	4	39.9809	38.9978	0.9831	18.9482	-0.07812	5.55475	14.573	52.92	0.11	85	40.2947
2011	5	45.1744	39.1153	6.0591	19.8447	-0.58231	5.6201	14.2329	54.37	0.82	86	39.3543
2011	6	42.667	41.0583	1.6087	21.9095	-0.5255	5.68545	13.9889	57.71	0.74	87	38.6797
2011	7	48.5125	43.3411	5.1714	23.6034	0	5.7508	13.9869	60.45	0	88	38.674
2011	8	46.9597	43.6493	3.3104	23.047	0	5.81615	14.7862	59.55	0	89	40.8842
2011	9	43.8563	45.3554	-1.4991	24.2402	-0.0071	5.8815	15.2408	61.48	0.01	90	42.1414
2011	10	41.2618	43.1193	-1.8575	23.6714	-1.5126	5.94685	15.0136	60.56	2.13	91	41.5132
2011	11	38.3828	38.9315	-0.5487	18.9668	-0.94449	6.0122	14.897	52.95	1.33	92	41.1907
2011	12	36.8519	38.432	-1.5801	16.8772	-0.14203	6.07755	15.6193	49.57	0.2	93	43.1877
2012	1	39.288	38.788	0.5	18.1302	-0.93101	6.1429	15.4459	51.5968	1.31102	94	42.7082
2012	2	35.5951	38.5472	-2.9521	18.4434	-0.47809	6.20825	14.3736	52.1034	0.67323	95	39.7435
2012	3	40.0792	37.0818	2.9974	18.9179	-2.31214	6.2736	14.2024	52.871	3.2559	96	39.27
2012	4	37.3672	39.369	-2.0018	20.1127	-1.36157	6.33895	14.2789	54.8036	1.91732	97	39.4816
2012	5	46.1079	40.9825	5.1254	20.9022	-0.09786	6.4043	13.7739	56.0806	0.1378	98	38.0852
2012	6	43.7693	44.2518	-0.4825	22.8307	-0.21528	6.46965	15.1668	59.2	0.30315	99	41.9366
2012	7	47.0489	47.1165	-0.0676	23.2222	0	6.535	17.3593	59.8333	0	100	47.999
2012	8	45.576	46.9874	-1.4114	22.6472	-0.00839	6.60035	17.7483	58.9032	0.01181	101	49.0744
2012	9	44.1639	46.6246	-2.4607	22.1609	0	6.6657	17.798	58.1167	0	102	49.2118
2012	10	43.7286	48.1392	-4.4106	23.8737	-0.38583	6.73105	17.9203	60.8871	0.54331	103	49.5502

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	Variable	Non-Residential Coefficient	Non-Residential T-Statistic
	Model Adjusted R-Squared	0.8357	
	Intercept	-15.8078	-2.3
	monthly average temperature Monterey Airport	1.02474	10.16
	monthly total rainfall Monterey Airport	-1.10999	-4.35
	Time	-0.0653	-5.69
Elasticity	(price / (cpi/312.92)) * (avg use/ avg price)	-0.05654	-0.77

Year	Month	Actual	Predicted	Residual	Temperature & intercept Predicted	Rainfall Predicted	Time Predicted	Price term Predicted	Temperature Value	Rainfall Value	Time Value	Price term Value
2004	4	44.9256	55.7607	-10.8351	58.0027	0	-0.06531	-2.17668	56.42	0	1	38.4981
2004	5	66.6723	57.1953	9.477	59.4696	0	-0.13062	-2.14366	57.85	0	2	37.914
2004	6	59.907	58.7248	1.1822	60.8338	-0.0222	-0.19593	-1.89083	59.18	0.02	3	33.4424
2004	7	48.0393	45.5329	2.5064	47.6759	-0.0222	-0.26124	-1.85956	61.89	0.02	4	32.8892
2004	8	47.832	46.203	1.629	48.7119	0	-0.32655	-2.18242	62.9	0	5	38.5996
2004	9	43.6138	45.2976	-1.6838	48.076	-0.0333	-0.39185	-2.35322	62.28	0.03	6	41.6204
2004	10	37.9847	37.7126	0.2721	43.7165	-3.11907	-0.45716	-2.42768	58.03	2.81	7	42.9373
2004	11	32.7601	35.6011	-2.841	39.4084	-0.94349	-0.52247	-2.34127	53.83	0.85	8	41.4092
2004	12	32.0167	30.8261	1.1906	37.6133	-4.09586	-0.58778	-2.10359	52.08	3.69	9	37.2053
2005	1	30.6164	30.8787	-0.2623	36.7825	-3.10797	-0.65309	-2.14266	51.27	2.8	10	37.8963
2005	2	29.3655	34.3885	-5.023	39.8802	-2.55298	-0.7184	-2.22037	54.29	2.3	11	39.2708
2005	3	34.2211	35.256	-1.0349	41.5727	-3.31887	-0.78371	-2.21413	55.94	2.99	12	39.1604
2005	4	35.2237	35.4952	-0.2715	39.6853	-1.18769	-0.84902	-2.15341	54.1	1.07	13	38.0864
2005	5	40.3877	41.0486	-0.6609	44.5474	-0.5217	-0.91433	-2.06274	58.84	0.47	14	36.4828
2005	6	41.5143	41.8989	-0.3846	44.9987	-0.1443	-0.97964	-1.97585	59.28	0.13	15	34.9461
2005	7	48.3532	43.8914	4.4618	46.8656	-0.0111	-1.04494	-1.9181	61.1	0.01	16	33.9247
2005	8	46.4186	43.0236	3.395	46.0142	0	-1.11025	-1.88035	60.27	0	17	33.257
2005	9	41.9621	41.6002	0.3619	44.5269	0	-1.17556	-1.75107	58.82	0	18	30.9705
2005	10	40.8307	39.7535	1.0772	42.6908	-0.0444	-1.24087	-1.65205	57.03	0.04	19	29.2191
2005	11	34.5181	39.2319	-4.7138	42.9985	-0.68819	-1.30618	-1.77227	57.33	0.62	20	31.3454
2005	12	29.6977	32.7299	-3.0322	39.0904	-3.05247	-1.37149	-1.93652	53.52	2.75	21	34.2504
2006	1	30.6984	31.2748	-0.5764	37.2543	-2.61958	-1.4368	-1.92314	51.73	2.36	22	34.0138
2006	2	29.4457	34.2637	-4.818	38.5057	-0.74369	-1.50211	-1.99619	52.95	0.67	23	35.3059
2006	3	31.7758	26.6072	5.1686	35.9413	-5.82745	-1.56742	-1.93923	50.45	5.25	24	34.2984
2006	4	32.7302	34.3528	-1.6226	39.8392	-1.95358	-1.63273	-1.90004	54.25	1.76	25	33.6053
2006	5	39.4456	38.8255	0.6201	42.9062	-0.5217	-1.69803	-1.86096	57.24	0.47	26	32.9141
2006	6	42.3011	43.4012	-1.1001	46.9682	0	-1.76334	-1.80359	61.2	0	27	31.8994
2006	7	47.9314	44.2269	3.7045	47.8195	-0.0111	-1.82865	-1.75287	62.03	0.01	28	31.0023
2006	8	46.6808	43.1274	3.5534	46.763	0	-1.89396	-1.74162	61	0	29	30.8034
2006	9	40.6987	42.1765	-1.4778	45.8193	0	-1.95927	-1.68349	60.08	0	30	29.7753
2006	10	41.025	41.8343	-0.8093	45.5834	-0.0444	-2.02458	-1.68013	59.85	0.04	31	29.7158
2006	11	33.8573	35.8514	-1.9941	40.7316	-1.03229	-2.08989	-1.75804	55.12	0.93	32	31.0938
2006	12	31.0044	30.2577	0.7467	36.9158	-2.63068	-2.1552	-1.87221	51.4	2.37	33	33.1131
2007	1	31.7664	28.5368	3.2296	33.4488	-0.73259	-2.22051	-1.95892	48.02	0.66	34	34.6465
2007	2	29.1764	30.8225	-1.6461	37.6646	-2.53078	-2.28582	-2.02548	52.13	2.28	35	35.8238
2007	3	35.2171	35.0221	0.195	39.6956	-0.3441	-2.35112	-1.97826	54.11	0.31	36	34.9886
2007	4	37.3716	33.6675	3.7041	38.8955	-0.72149	-2.41643	-2.09011	53.33	0.65	37	36.9669
2007	5	40.1761	36.9727	3.2034	41.5214	-0.0444	-2.48174	-2.02261	55.89	0.04	38	35.773
2007	6	40.7233	40.1687	0.5546	44.5269	-0.0111	-2.54705	-1.80006	58.82	0.01	39	31.8369
2007	7	46.7004	43.5591	3.1413	47.9221	0	-2.61236	-1.7506	62.13	0	40	30.9621
2007	8	45.7327	44.2693	1.4634	48.6812	0	-2.67767	-1.73416	62.87	0	41	30.6713
2007	9	41.7802	44.277	-2.4968	49.1017	-0.3219	-2.74298	-1.75979	63.28	0.29	42	31.1248
2007	10	38.8742	39.6467	-0.7725	45.1628	-0.91019	-2.80829	-1.79765	59.44	0.82	43	31.7944
2007	11	33.7727	37.3044	-3.5317	42.383	-0.3552	-2.8736	-1.84981	56.73	0.32	44	32.7169
2007	12	30.0443	30.5878	-0.5435	36.2696	-0.76589	-2.93891	-1.97702	50.77	0.69	45	34.9668
2008	1	30.2516	26.1452	4.1064	36.8337	-5.60545	-3.00421	-2.07884	51.32	5.05	46	36.7677
2008	2	28.1278	31.1181	-2.9903	38.4852	-2.13118	-3.06952	-2.16636	52.93	1.92	47	38.3155
2008	3	34.5939	33.8603	0.7336	39.4494	-0.3774	-3.13483	-2.0769	53.87	0.34	48	36.7332
2008	4	37.3257	35.579	1.7467	40.8239	-0.111	-3.20014	-1.9338	55.21	0.1	49	34.2024
2008	5	40.537	38.6912	1.8458	43.8191	0	-3.26545	-1.86249	58.13	0	50	32.9411
2008	6	41.7839	40.3894	1.3945	45.45	0	-3.33076	-1.72984	59.72	0	51	30.5949
2008	7	45.5531	41.3418	4.2113	46.4142	0	-3.39607	-1.67637	60.66	0	52	29.6492
2008	8	44.4147	41.8604	2.5543	46.9476	0	-3.46138	-1.62587	61.18	0	53	28.756
2008	9	39.8473	42.1744	-2.3271	47.3579	-0.0111	-3.52669	-1.64577	61.58	0.01	54	29.1081
2008	10	38.5155	40.963	-2.4475	46.363	-0.111	-3.592	-1.69698	60.61	0.1	55	30.0138
2008	11	32.0104	37.2078	-5.1974	43.8601	-1.12109	-3.6573	-1.87391	58.17	1.01	56	33.1431
2008	12	28.7021	27.9199	0.7822	35.7977	-2.13118	-3.72261	-2.024	50.31	1.92	57	35.7977
2009	1	28.6965	32.1826	-3.4861	39.6956	-1.66499	-3.78792	-2.06006	54.11	1.5	58	36.4355
2009	2	25.2735	27.3204	-2.0469	38.5775	-5.35015	-3.85323	-2.05373	53.02	4.82	59	36.3234
2009	3	30.7345	28.7469	1.9876	37.8082	-3.09687	-3.91854	-2.04589	52.27	2.79	60	36.1849
2009	4	34.2599	34.7322	-0.4723	41.0393	-0.3885	-3.98385	-1.9348	55.42	0.35	61	34.22
2009	5	36.021	36.9852	-0.9642	43.1113	-0.2775	-4.04916	-1.7995	57.44	0.25	62	31.827
2009	6	37.5435	40.0706	-2.5271	45.9424	-0.0111	-4.11447	-1.74627	60.2	0.01	63	30.8856
2009	7	43.3459	39.2822	4.0637	45.2449	-0.0999	-4.17978	-1.68306	59.52	0.09	64	29.7677
2009	8	42.5062	41.7475	0.7587	47.6862	-0.0444	-4.24509	-1.6492	61.9	0.04	65	29.1687
2009	9	37.917	40.0611	-2.1441	46.2809	-0.2442	-4.31039	-1.66516	60.53	0.22	66	29.451
2009	10	34.9004	34.6784	0.222	44.0448	-3.31887	-4.3757	-1.67175	58.35	2.99	67	29.5676
2009	11	31.0748	33.116	-2.0412	39.6033	-0.2886	-4.44101	-1.7577	54.02	0.26	68	31.0877
2009	12	27.6357	26.2845	1.3512	35.4182	-2.67508	-4.50632	-1.95232	49.94	2.41	69	34.5299
2010	1	25.754	25.0692	0.6848	38.5262	-6.94854	-4.57163	-1.9369	52.97	6.26	70	34.2571
2010	2	23.2149	28.8077	-5.5928	38.9263	-3.40767	-4.63694	-2.074	53.36	3.07	71	36.6819
2010	3	27.8146	27.7554	0.0592	38.5262	-3.66297	-4.70225	-2.40561	52.97	3.3	72	42.5471
2010	4	29.2599	28.6655	0.5944	39.2032	-3.57417	-4.76756	-2.19599	53.63	3.22	73	38.8395
2010	5	32.6917	32.9361	-0.2444	40.5059	-0.59939	-4.83287	-2.13761	54.9	0.54	74	37.807
2010	6	33.714	37.3839	-3.6699	44.3217	0	-4.89818	-2.03962	58.62	0	75	36.0739
2010	7	39.6037	38.1051	1.4986	45.009	-0.0333	-4.96348	-1.90706	59.29	0.03	76	33.7295
2010	8	38.9625	37.9955	0.967	45.1218	-0.1887	-5.02879	-1.90881	59.4	0.17	77	33.7603
2010	9	35.6974	39.274	-3.5766	46.486	-0.0999	-5.0941	-2.01807	60.73	0.09	78	35.6928
2010	10	33.1672	36.6405	-3.4733	44.773	-0.92129	-5.15941	-2.05179	59.06	0.83	79	36.2892
2010	11	27.6444	29.5663	-1.9219	39.2545	-2.30878	-5.22472	-2.15473	53.68	2.08	80	38.1098
2010	12	25.4714	26.0235	-0.5521	38.0749	-4.43996	-5.29003	-2.32144	52.53	4	81	41.0584
2011	1	26.5896	28.7463	-2.1567	38.6083	-2.07568	-5.35534	-2.43093	53.05	1.87	82	42.995
2011	2	24.7712	24.3464	0.4248	36.9261	-4.70636	-5.42065	-2.45267	51.41	4.24	83	43.3794
2011	3	28.0145	26.5561	1.4584	39.911	-5.48335	-5.48596	-2.38554	54.32	4.94	84	42.1921
2011	4	30.2759	30.4531	-0.1772	38.4749	-0.1221	-5.55127	-2.34851	52.92	0.11	85	41.5372
2011	5	32.9379	31.2161	1.7218	39.9623	-0.91019	-5.61657	-2.21942	54.37	0.82	86	39.254
2011	6	32.5897	34.8028	-2.2131	43.3883	-0.82139	-5.68188	-2.0822	57.71	0.74	87	36.827
2011	7	39.0965	38.439	0.6575	46.1988	0	-5.74719	-2.01266	60.45	0	88	35.5971
2011	8	36.9817	37.3628	-0.3811	45.2757	0	-5.8125	-2.10038	59.55	0	89	37.1485
2011	9	33.5395	39.2019	-5.6624	47.2554	-0.0111	-5.87781	-2.16456	61.48	0.01	90	38.2836
2011	10	31.8861	35.7802	-3.8941	46.3117	-2.36428	-5.94312	-2.22405	60.56	2.13	91	39.3358
2011	11	27.6268	28.6523	-1.0255	38.5057	-1.47629	-6.00843	-2.36871	52.95	1.33	92	41.8945
2011	12	27.4039	26.251	1.1529	35.0387	-0.222	-6.07374	-2.49196	49.57	0.2	93	44.0743
2012	1	30.0295	26.9047	3.1248	37.1177	-1.45522	-6.13905	-2.6187	51.5968	1.31102	94	46.3158
2012	2	27.2041	28.2652	-1.0611	37.6373	-0.74728	-6.20436	-2.42052	52.1034	0.67323	95	42.8107
2012	3	31.2995	26.2035	5.096	38.4247	-3.61402	-6.26966	-2.33753	52.871	3.2559	96	41.343
2012	4	30.0265	29.7015	0.325	40.407	-2.12821	-6.33497	-2.2424	54.8036	1.91732	97	39.6605
2012	5	36.1268	33.1183	3.0085	41.7169	-0.15296	-6.40028	-2.04539	56.0806	0.1378	98	36.176
2012	6	35.7541	35.9702	-0.2161	44.9167	-0.33649	-6.46559	-2.14436	59.2	0.30315	99	37.9265
2012	7	40.8194	36.4808	4.3386	45.5663	0	-6.5309	-2.5546	59.8333	0	100	45.1821
2012	8	38.6695	35.3003	3.3692	44.6122	-0.01311	-6.59621	-2.70261	58.9032	0.01181	101	47.7999
2012	9	35.257	34.4408	0.8162	43.8055	0	-6.66152	-2.70314	58.1167	0	102	47.8094
2012	10	35.2302	36.4073	-1.1771	46.6472	-0.60307	-6.72683	-2.90996	60.8871	0.54331	103	51.4673

Attachment 4

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	Variable	Residential Single Family Coefficient	T-Statistic	Residential Single Family Coefficient	T-Statistic	Residential Single Family Coefficient	T-Statistic	Residential Single Family Coefficient	T-Statistic	Residential Single Family Coefficient	T-Statistic
		Tier 1		**Tier 2**		**Tier 3**		**Tier 4**		**Tier 5**	
	Model Adjusted R-Squared	0.6509		0.8401		0.8016		0.8377		0.7708	
	Intercept	-0.03536	-0.06	-1.04532	-3.03	-1.6224	-6.63	-0.8878	-8.01	-1.26877	-5.48
	monthly average temperature Monterey Airport	0.07147	7.5	0.0604	11.06	0.04401	10.79	0.02313	12.29	0.03689	9.4
	monthly total rainfall Monterey Airport	-0.08029	-3.28	-0.10072	-7.15	-0.07283	-6.92	-0.03291	-6.79	-0.05066	-5.01
	Time	-0.0057	-4.64	-0.00432	-7.37	-0.00023	-0.42	-0.00027	-1.09	-0.00041	-0.83
Elasticity	(price / (cpi/312.92)) * (avg use/ avg price)	0.0386	0.77	-0.16852	-2.25	-0.10433	-1.13	-0.22326	-4.13	-0.45052	-5.8
	Weight of Overall Usage	0.535155		0.247293		0.099554		0.042928		0.072498	
	Weighted Price Elasticity	-0.07365									

Attachment 5

Attachment 5 – California American Water Analysis of July 2011 to September 2012 – Usage versus Price

Price Elasticity for Residential and Multi-Residential Usage

measured after significant rate increase events

(a)	Date	July 2011	November 2011	March 2012	June 2012
(b)	Event	WRAM Surcharge	CWP Surcharge I	MPWMD Surcharge	General Rate Case Rates
(c)	Average bill impact/Rate increase	5.78%	12%	12.59%	16%
(d)	Usage increase/ (decrease)	3.26%	9.35%	3.87%	(5.3%)
	(avg of 2 months following rate increase)				
	compared to historical usage baseline				
	(average of the 2 same months of the previous three years)				
	Price Elasticity	0.56	0.78	0.31	(0.33)