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Use of Incentive-Based Pricing: Cataloguing Current Water Rate Structures and Analyzing Community Adopter Characteristics for Select Municipalities in New Mexico

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Abstract

Facing water scarcity, population growth, and issues of climate change, New Mexico municipalities should consider incentive-based pricing (IBP), empirically shown to encourage conservation. Given that adoption of IBP will likely be affected by community and political will, it is important to know what socio-economic and demographic factors may influence a municipality's decision to adopt. As such, this research descriptively summarizes and catalogues the use of IBP structures for a select sample of 30 NM communities; further, t-tests are used to statistically investigate significant differences in a select set of 12 community characteristics between those that adopt IBP and those that do not. In summary, results indicate that the majority of the sample municipalities (67%, or 20 out of 30) incorporated some type of IBP structure. However, in many of those cases, the increasing block rate steps in an IBP structure are set relatively or even extremely high, compared to typical or expected distributions of residential household use. In addition, the evidence indicates that means of the percent of individuals who voted for the Green party in the 2012 election, of individuals with Bachelor degrees, of individuals who speak Spanish at home (and speak English "less than very well"), and of the population, per capita income, and elevation for communities with and without IBP were significantly different (at least 0.10 level). Knowing what differences likely exist may aid planners in helping municipalities to develop IBP for conservation in the future by tailoring conservation or rate structure education to the specific needs of municipalities without IBP. As such, it is recommended that this research be expanded upon to include a larger sample and a broader array of characteristics.

Keywords: incentive-based pricing, climate change, New Mexico, municipal water supply, demand-side water management

Introduction

Water resources in New Mexico are limited and the population is expected to increase. Faced with climate change, drought, and potentially increasing future water demands, policymakers in New Mexico have been actively debating water management strategies over the last several decades. Not uncommonly in these debates and discussions over water resources, water managers, municipalities, and stakeholders focus primarily on supply-side water management, approaching water management from an engineering perspective rather than an economic one (Olmstead & Stavins, 2007). However, with climate change threatening future supplies, it may be even more prudent for municipalities to fully consider the implementation of demand-side alternatives such as incentive-based pricing (IBP). IBP can be defined as an economic instrument that promotes the use of water charging to both act as an incentive to the consumer to sustainably use water resources and recover the costs of supplying, delivering, and maintaining water resources and water services (Elnaboulsi, 2008). While the adoption and implementation of IBP in municipal water rate structures is often bound by a variety of financial (e.g., cost recovery) and local legal or regulatory constraints, implementing IBP ultimately takes community and political will (McGuckin et al., 2012). Community politics can influence the choice of municipal water rate structures as much or more than the financial/economic, or legal considerations (McGuckin et al., 2012). IBP is an important demand-side management tool for municipalities because it encourages conservation; this principle holds whatever the specific motivation or legal requirements behind adoption of such measures.

New Mexico municipalities may greatly benefit from the use of incentivized water use conservation through pricing. Traditionally, many water managers have relied heavily on or recommended the adoption of water efficiency technologies (i.e., low-flow fixtures), water use

restrictions (i.e., summer water use regulations), or other non-price demand strategies (i.e., rebates or education campaigns). However, price-based (or rate-based) demand-side conservation strategies have demonstrated to be effective in limiting water use by households and individuals (Olmstead & Stavins, 2007). Empirical research also suggests that price-based water management approaches are more cost-effective for municipalities than non-price approaches (Olmstead & Stavins, 2007). Furthermore, price-based approaches rely on the response of the consumer to price signals rather than requiring or relying on consumers to purchase and install water efficiency technologies in their homes. Additionally, municipalities are spared paying for information campaigns or enforcing water use regulations (Olmstead & Stavins, 2007).

Price elasticity of demand, a measure used in economics to show the proportionate responsiveness or 'elasticity' of the amount demanded of a good or service to a change in price, is often used by economists to evaluate residential water use and utility pricing. Price elasticity of demand gives the percentage change in quantity demanded as a response to a one percent change in price. Price elasticity of demand is either 'elastic' (quantity demand for a good or service changes more than proportionately as price increases or decreases) or 'inelastic' (quantity demand for a good or service changes less than proportionately, or relatively unaffected by a change in price). For example, if water use is in the inelastic portion of the consumer's demand curve, as is common for municipal water demand (Zetland, 2011), then price increases can be revenue-enhancing for a municipality (Zetland, 2011). When prices are increased for a good that is inelastic, as is most indoor residential water use, revenue is increased (Zetland, 2011). While water utilities and municipalities typically do not aim to maximize profits, price elasticity is still very important to them (Zetland, 2011). Based on elasticity of water demand, higher prices

typically cause consumers to minimally conserve water indoors (e.g., with a price increase of 10 percent, consumers will use two to four percent less water) and highly conserve outdoor use (e.g., with a 10 percent increase in price, consumers will use 7 to 12 percent less water) (Zetland, 2011). Finally, IBP and alternative conservation approaches need not be seen as substitute choices in a municipal water conservation program.

Facing climate change and population growth, inventorying the use or lack of use of demand-side water conservation measures, particularly price-based incentive strategies, is important for water managers and policy-makers in New Mexico. To help protect scarce future water supplies and manage increases in consumption expected due to projected increases in population, it is important to encourage municipalities to consider adoption of IBP.

As such, the objectives of this research are: (i) descriptively summarize and catalogue the municipal water rate structures for a select sample of 30 New Mexican communities (accounting for approximately 57% percent of the 2013 NM population), expanding upon prior analyses (Western Resource Advocates (2006) and McGuckin et al., (2012)); and (ii), statistically analyze, for a sample of 30 communities, the absence or presence of any significant differences in a select set of 12 characteristics between those that adopt IBP and those that do not. This research does not investigate residential or municipal water demand or use, but rather focuses on pricing strategies and differing characteristics among communities. Given the projected effects of climate change, limited or costly supply augmentation alternatives for many communities, and projections of future population growth, it is important to improve our understanding of demand-side management opportunities in NM. Furthermore, considering the potential importance of political and community will in adopting IBP (McGuckin et al., 2012),

this analysis will help catalogue current community efforts and analyze their significant characteristics to date.

Climate Change in the Southwestern United States

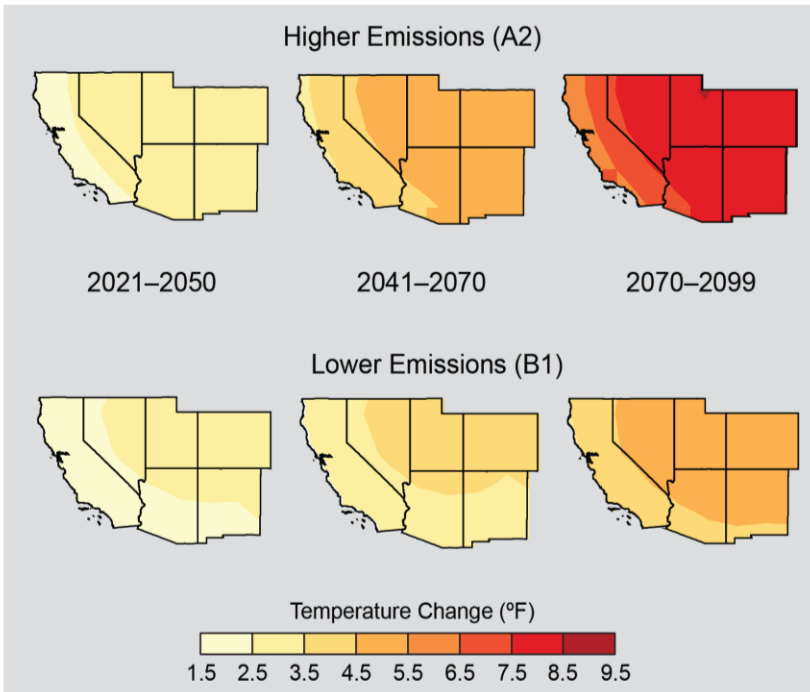
The Southwest region of the United States is the hottest and driest region; climate change will only pose more challenges for the region as the area gets hotter, and in the Southern half, significantly drier (U.S. Global Change Research Program, 2014). Higher temperatures and changes in snowpack and precipitation are projected to significantly impact the Southwest region of the United States (California, Nevada, Arizona, Colorado, Utah, and New Mexico). Climate change will affect the 56 million people who live and work in the Southwest; and to exacerbate the issues, this population will continue to expand and is expected to increase by 68% by 2050 to 94 million (U.S. Global Change Research Program, 2014). Drought will likely cause a competition for water resources amongst farmers, producers of energy, urban residents, rural residents, and plant and animal species (U.S. Global Change Research Program, 2014).

Climate change will cause ecological and environmental changes; however, the economy is likely to face challenges as well. The Southwest produces more than half of the nation's specialty crops (including fruit, vegetables, and nuts); agriculturalists will likely face hardships, the severity of which will depend on seasonal changes, pests, and water availability (U.S. Global Change Research Program, 2014). The Southwest may suffer economic losses due to the widespread loss of plant and animal diversity along with tree death and forest fires (U.S. Global Change Research Program, 2014). The communities who rely on tourism and recreation will face economic hardships as landscapes, stream flows, and snow packs change (U.S. Global Change Research Program, 2014).

While impacts are likely to progress in the future, the Southwest is already facing the negative aspects of global climate change. Temperatures have been on the rise in recent decades. The last 60 years has been hotter than any comparably long period in the last 600 years (U.S. Global Change Research Program, 2014). Precipitation has increased in some areas and decreased in others, and evidence suggests that anthropogenic climate change along with drought has likened the probability of tree-mortality, increased forest fires, forest insect outbreaks, earlier spring snowmelt, and earlier spring runoff (U.S. Global Change Research Program, 2014).

As seen in Figure 1 below, annual temperatures in the Southwest are projected to rise by 2.5 to 5.5 degrees Fahrenheit by the year 2041 to 2070 and by 5.5 to 9.5 degrees Fahrenheit by 2070 to 2099 with continued growth in global emissions (A2 scenario) (U.S. Global Change Research Program, 2014). If emissions decrease dramatically, the projected temperature increases are slightly less severe with temperature expected to rise by 2.5 to 4.5 degrees Fahrenheit by 2041 to 2070 and 3.5 degrees to 5.5 degrees by 2070 to 2099 (B1 scenario) (U.S. Global Change Research Program, 2014). Urban public health will be affected as summer heat waves become more intense (hotter and longer); additionally, heat stress increases, and urban infrastructure is impacted through risks to electric power generation (U.S. Global Change Research Program, 2014). Furthermore, these environmental stressors will also directly impact the productivity and yields of certain regional agricultural crops (U.S. Global Change Research Program, 2014).

Figure 1. Projected Temperature Increases in the Southwest. This figure illustrates the projected temperature changes in the Southwest under two different emissions scenarios (U.S. Global Change Research Program, 2014).



Climate Change in New Mexico. Like the Southwest in general, temperatures in New Mexico have increased substantially over the past several decades (Gutzler, 2012). These changes in temperature are consistent with the relative changes in climate due to the higher concentration of greenhouse gasses in the atmosphere. Surface water supplies in New Mexico are projected to be affected profoundly (Gutzler and Robbins, 2010). Furthermore, temperature increases in New Mexico will be particularly profound during the summer months where average annual temperatures increase far beyond the historical range of variability by the mid-twentieth century (Gutzler, 2012). These changes in temperature will likely result in a shorter snow season and earlier snow melt in the spring (Gutzler, 2012). Temperature changes and stream flow reductions

in New Mexico will also likely result in increased surface water demand by both riparian vegetation and municipal uses (Gutzler, 2012).

New Mexico relies heavily on both surface and ground water, and ground water supplies are being depleted faster than they can be restored (Thomson, 2012). In 2010, withdrawals for water use by all categories in New Mexico totaled 3,815,945 acre feet[1] (AF) (Longworth et al., 2013). Of this, surface water withdrawals accounted for 53.5 percent of total withdrawals (2,041,844 AF). Groundwater accounted for 46.5 percent of total withdrawals (1,774,101 AF) (Longworth et al., 2013). Water withdrawals for public use, which includes municipal and industrial uses, amounted to 317,410 AF (8.3% of total withdrawals) (Longworth, et al., 2013). New Mexico will face many challenges (and currently faces challenges) regarding its water resources as demand increases and available supply decreases.

Population Projections for the Southwestern United States

In addition to already impending sustainability issues in the arid Southwest, population growth is another consideration. Over the 20th century, the population in the Southwest increased from 2,100,000 to over 50,000,000 people (MacDonald, 2010). This population will continue to expand and is expected to increase by 68% by 2050 to 94 million (U.S. Global Change Research Program, 2014).

Population Growth in New Mexico. As seen in Table 1, the population in New Mexico is projected to steadily increase. Population in New Mexico is projected to reach a full 2,827,692

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[1] For a more detailed discussion of New Mexico water use, please refer to the “New Mexico Water Use by Categories 2010” technical report provided by the New Mexico Office of the State Engineer Water Use and Conservation (Longworth et al., 2013).

people by 2040; this is an increase by 761,866 people, which is very significant, particularly in a state that is expected to have decreased surface water availability in the future. Table 2 shows that New Mexico as a whole is projected to have positive growth rates into the year 2040, despite the projection of population decline in many of New Mexico's counties. While the growth rates are positive, they do start to decrease as the years progress, starting at a rate of 1.34 for years 2010 through 2015 and ending at 0.72 for years 2035 through 2040.

Table 1

New Mexico County Population Projections July 1, 2010 to July, 1 20140.

County	2010	2015	2020	2025	2030	2035	2040
New Mexico	2,065,826	2,208,450	2,351,724	2,487,227	2,613,332	2,727,118	2,827,692
Bernalillo	664,636	721,153	780,244	835,325	886,564	932,091	970,371
Catron	3,725	3,825	3,909	3,976	4,000	4,005	4,012
Chaves	65,783	68,538	71,632	74,867	77,949	80,724	83,263
Cibola	27,213	28,236	29,133	29,909	30,630	31,361	32,090
Colfax	13,752	13,710	13,631	13,506	13,296	12,998	12,642
Curry	48,941	51,001	52,900	54,778	56,707	58,611	60,395
De Baca	2,022	1,987	1,950	1,909	1,879	1,840	1,803
Dona Ana	210,536	226,855	243,164	258,887	273,513	286,818	299,088
Eddy	53,829	55,832	57,908	59,945	61,836	63,595	65,258
Grant	29,371	29,417	29,457	29,433	29,310	29,166	29,102
Guadalupe	4,687	4,742	4,765	4,779	4,776	4,773	4,760
Harding	695	693	684	670	647	625	607
Hidalgo	4,894	4,857	4,818	4,764	4,671	4,546	4,403
Lea	64,727	71,465	78,407	85,773	93,712	102,090	110,661
Lincoln	20,497	21,104	21,577	21,875	21,979	21,959	21,888
Los Alamos	18,026	18,058	18,063	18,016	17,880	17,603	17,210
Luna	25,095	26,478	28,024	29,694	31,465	33,399	35,595
McKinley	71,802	72,691	73,483	73,946	73,805	72,988	71,580
Mora	4,881	4,865	4,826	4,753	4,665	4,548	4,423
Otero	64,275	65,542	66,367	66,825	67,047	67,064	66,841
Quay	9,041	8,954	8,891	8,840	8,804	8,788	8,805
Rio Arriba	40,371	40,780	41,026	41,058	40,872	40,509	40,008
Roosevelt	20,040	21,657	23,178	24,522	25,721	26,836	27,912
Sandoval	132,434	154,048	176,276	198,950	221,644	243,897	265,607
San Juan	130,170	138,487	146,388	154,065	161,593	168,850	175,678
San Miguel	29,393	29,315	29,157	28,785	28,176	27,413	26,594
Santa Fe	144,532	154,756	164,006	171,905	178,124	182,410	184,832
Sierra	11,988	12,020	12,048	12,100	12,218	12,421	12,737
Socorro	17,866	17,998	18,008	17,879	17,621	17,274	16,857
Taos	32,937	35,012	36,769	38,183	39,221	39,850	40,062
Torrance	16,383	16,927	17,589	18,266	18,865	19,344	19,801
Union	4,549	4,803	5,066	5,318	5,553	5,773	5,977
Valencia	76,735	82,644	88,380	93,726	98,589	102,949	106,830

Source: ***New Mexico County Population Projections July 1, 2010 to July 1, 2040***, Geospatial and Population Studies Group, University of New Mexico. Released November 2012.

Table 2

Projected Annual Population Growth Rates for NM Counties, 2010-20140.

County	2010-2015	2015-2020	2020-2025	2025-2030	2030-2035	2035-2040
New Mexico	1.34	1.26	1.12	0.99	0.85	0.72
Bernalillo	1.63	1.58	1.36	1.19	1	0.8
Catron	0.53	0.43	0.34	0.12	0.02	0.03
Chaves	0.82	0.88	0.88	0.81	0.7	0.62
Cibola	0.74	0.63	0.53	0.48	0.47	0.46
Colfax	-0.06	-0.12	-0.18	-0.31	-0.45	-0.56
Curry	0.82	0.73	0.7	0.69	0.66	0.6
De Baca	-0.35	-0.38	-0.42	-0.32	-0.42	-0.41
Dona Ana	1.49	1.39	1.25	1.1	0.95	0.84
Eddy	0.73	0.73	0.69	0.62	0.56	0.52
Grant	0.03	0.03	-0.02	-0.08	-0.1	-0.04
Guadalupe	0.23	0.1	0.06	-0.01	-0.01	-0.05
Harding	-0.06	-0.26	-0.41	-0.7	-0.69	-0.58
Hidalgo	-0.15	-0.16	-0.23	-0.39	-0.54	-0.64
Lea	1.98	1.85	1.8	1.77	1.71	1.61
Lincoln	0.58	0.44	0.27	0.09	-0.02	-0.06
Los Alamos	0.04	0.01	-0.05	-0.15	-0.31	-0.45
Luna	1.07	1.13	1.16	1.16	1.19	1.27
McKinley	0.25	0.22	0.13	-0.04	-0.22	-0.39
Mora	-0.07	-0.16	-0.3	-0.37	-0.51	-0.56
Otero	0.39	0.25	0.14	0.07	0.01	-0.07
Quay	-0.19	-0.14	-0.12	-0.08	-0.04	0.04
Rio Arriba	0.2	0.12	0.02	-0.09	-0.18	-0.25
Roosevelt	1.55	1.36	1.13	0.95	0.85	0.79
Sandoval	3.02	2.7	2.42	2.16	1.91	1.71
San Juan	1.24	1.11	1.02	0.95	0.88	0.79
San Miguel	-0.05	-0.11	-0.26	-0.43	-0.55	-0.61
Santa Fe	1.37	1.16	0.94	0.71	0.48	0.26
Sierra	0.05	0.05	0.09	0.19	0.33	0.5
Socorro	0.15	0.01	-0.14	-0.29	-0.4	-0.49
Taos	1.22	0.98	0.75	0.54	0.32	0.11
Torrance	0.65	0.77	0.76	0.65	0.5	0.47
Union	1.09	1.07	0.97	0.86	0.78	0.69
Valencia	1.48	1.34	1.17	1.01	0.87	0.74

*Source: Geospatial and Population Studies Group, University of New Mexico. Released November 2012.

Population for Selected Municipalities in New Mexico

As seen in Table 3, several municipalities are projected to have substantial increases in population.[2] Alamogordo, Clovis, Las Cruces and Portales are projected to have fairly substantial changes in population with annual population growth rates of 3.6 percent, 3.8 percent, 3.5 percent, and 3.6 percent respectively. Other municipalities are projected to see a decline in population; most significantly, Raton and Tucumcari are projected to shrink with a percent change in population of negative 4 and negative 3 percent respectively.

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[2] For each selected municipality, population projections for years 2025 and 2050 were calculated through the exponential growth function: $N = N_0 e^{rt}$ where N_0 is the starting population; N is the projected population; e is the base of natural logarithms expressed as the constant 2.71828...; *r* is the growth rate; and *t* is the elapsed time was used in order to solve the exponential growth formula algebraically (Tsishchanka, 2010). The estimated populations for 2010 and 2012 were sourced from the Census Bureau ACS 2008 to 2012 Five Year estimated survey. The growth rates used in the calculations were calculated based on the changes in population from year 2010 to year 2012 and were calculated by the United States Census Bureau (United States Census Bureau, 2013).

This function does not account for mortality, immigration, economic changes, and other social factors that determine the growth or decline of a given population. While the population projections calculated through these means are by no means accurate predictions, they do allow for a sense of general trends in population growth and decline.

Table 3

Population Projections for Selected New Mexico Municipalities.

Municipality	Population 2010	Population 2012	Percent Change	Population 2025	Population 2050
Alamogordo	30,403	31,500	3.6	50,299	123,715
Albuquerque	545,852	555,417	1.6	556,573	558,804
Aztec	6,763	6,683	-1.2	5,717	4,235
Belen	7,269	7,255	-0.2	7,253	7,249
Bloomfield	8,112	7,968	-1.8	6,305	4,020
Carlsbad	26,138	26,687	2.1	35,064	59,274
Clayton	2,980	2,910			
Clovis	37,775	39,197	3.8	64,238	166,101
Deming	14,855	14,793	-0.4	14,043	12,707
Edgewood	3,735	3,779			
Espanola*	10,224	10,240			
Farmington	45,877	45,854	-0.1	45,261	44,144
Gallup	21,678	22,008	1.8	27,810	43,615
Las Cruces	97,618	101,047	3.5	159,267	382,063
Las Vegas	13,753	13,529	-1.7	10,846	7,091
Los Alamos	12,019				
Los Lunas	14,835	15,168	2.2	20,190	34,994
Lovington	11,009	11,275	2.4	15,403	28,066
Moriarty	1,910	1,868			
Portales	12,280	12,723	3.6	20,316	49,969
Raton	6,885	6,607	-4.0	3,927	1,445
Rio Rancho	87,521	90,818	3.9	150,785	399,757
Roswell	48,366	48,477	0.2	49,753	52,304
Ruidoso	8,029	8,005	-0.3	7,698	7,142
Santa Fe	67,947	69,204	1.8	87,449	137,147
Silver City	10,315	10,273	-0.4	9,752	8,824
Socorro	9,051	8,906	-1.6	7,233	4,848
T or C	6,475	6,411	-1.0	5,629	4,384
Taos	5,716	5,676	-0.7	5,182	4,350
Tucumcari	5,363	5,204	-3.0	3523	1664

*Source: Census Bureau American Community Survey 5 Year Estimates for 2008 to 2012
Data were not available for Espanola, Los Alamos, Clayton, Moriarty, or Edgewood

Sustainability in the Southwest becomes even more difficult when water resources challenges are compounded by an increasing population (U.S. Global Change Research Program,

2014). While municipal uses are not the primary uses of water in New Mexico, they are expected to continue to grow in demand for the State; municipalities may also have an increased surface water demand as temperatures increase (Gutzler, 2012).

Brief Review of Water Pricing Strategies

Municipalities with rate structures that better reflect the true value of water (including the costs of obtaining new supplies) have been found to have lower per capita use (Western Resource Advocates, 2006). As such, these municipalities are able to stretch existing supplies farther and avoid large development projects, which can be costly, controversial, and time consuming (Western Resource Advocates, 2006). Avoiding the need to develop freshwater supplies helps to protect water resources and the communities who rely on them.

Water Utility Water Pricing Systems

Water is a unique commodity; water resources are mobile and constantly changing state. Water resources flow, seep, and evaporate; they are difficult to establish as "property" in a typical exchange economy (Olmstead & Stavins, 2007). Water is a bulky commodity difficult to transport and store; water resources are highly variable in time, space, and quality and are thus often stored in reservoirs for easier management. Furthermore, water is a unique commodity in that often one water supply is often shared by numerous communities and stakeholders, for a variety of purposes (Olmstead & Stavins, 2007). Yet perhaps its most unique quality, water is literally necessary for life and it holds few alternatives (Field, 2008; Krause, et al., 2003). Residential water is typically supplied by public municipal water utilities (Field, 2008; Zetland, 2011). Providing water as a public good and as a special and unique commodity served by public utilities, helps to ensure that the economic value of water is captured and that certain public uses

are not undersupplied. Publically-supplied water speaks to the notion that water is often considered to be a good or commodity that all people have right to use and obtain at a low and equitable price (Olmstead & Stavins, 2007).

When selling water to consumers, public water suppliers come up with a municipal water rate structure for residential households. A rate structure can be defined as a set price or the monetary charges for the retail of water to the consumer; these charges for treated water are typically set at a rate per unit (volume of water used) and are meant to cover the costs of the water, which include the operation and maintenance of the water delivery system (Western Resource Advocates, 2006; Field, 2008.) Rate structures include a service charge (the fixed fee per monthly billing cycle regardless of the amount of water used) and the consumption charge (the charge or price amount for each unit of water that is consumed) (Western Resource Advocates, 2006, Field, 2008; Carter & Milon, 1999).

Public utility companies have traditionally set prices in two ways: cost-based pricing and average-based pricing. In cost-based pricing, prices will be set so that revenues will cover costs incurred through supplying, maintaining, and delivering water. Ideally, costs should cover operation and maintenance so that the municipality doesn’t collect fees to cover costs in another way, such as tax revenues (Field, 2008). In addition, revenues should not exceed that of operation and maintenance costs (it might be deemed inappropriate for public utilities to make money through supplying a necessary good) (Field, 2008; Olstead & Stavins, 2007). The second type of reasoning, average-cost pricing, works on the premise that the total costs of delivering water should be divided by the total quantity of water delivered; the unit price is then set according to this calculated average value (Field, 2008). Average-cost pricing, borne out of municipalities attempting to eliminate profits, does not account for opportunity costs (the

benefits lost from using water for an alternative purpose, e.g., water habitat restoration) or the true value of water and will lead to consumers wasting water resources (Carter & Milon, 1999; Food and Agriculture Organization of the United Nations, 2004) IBP is a cost-based rate-structure; however, ideally it also includes the opportunity costs and the eventual economic costs of system expansion and the procurement of additional resources, which are typically much more costly to develop than current supplies (Olmstead & Stavins, 2007; Olmstead et. al., 2005). If designed well, a rate structure has the potential to decrease indoor and outdoor use through incentivizing water conservation through price (Western Resource Advocates, 2006). In addition, an appropriate rate structure conveys the true value of water to the customer (Western Resource Advocates, 2006), which would include the opportunity cost of using water now rather than conserving scarce resources.

Using Rate Structures to Encourage Conservation

The provision and protection of both sources and availability of water require the use of capital, labor, and other scarce resources (Olmstead & Stavins, 2007). The resources used to supply and develop other water resources also have opportunity costs in that they are no longer able to be used for alternative purposes (Olmstead & Stavins, 2007). As such, the true "value" or the true cost of water is based in society's willingness to choose between competing uses of resources (Olmstead & Stavins, 2007). Water rate structures can promote water efficiency by better relating the true costs of water to the consumer (Western Resource Advocates, 2006; Borisova et al., 2008). If water prices are more reflective of the true economic costs of water, customers will have a better understanding of its worth. True costs of water include: operation and maintenance costs; costs to obtain and develop additional water supplies; and social and ecological opportunity costs of losing other potential benefits of water in order to develop and

consume it (Western Resource Advocates, 2006; Olmstead & Stavins, 2007). For example, if New Mexico proceeds with select current proposals for the diversion and storage development of surface flows from the Gila River, under the Arizona Water Settlement Act, there may be opportunity costs to the health of the watershed, to the vitality of the river's biodiversity, and to the economy of those who rely on the river for purposes of tourism (Oglesby, 2011) By not accounting for these social and ecological costs in the price for water, municipal water utilities are selling water to consumers at a subsidized rate; furthermore, without accurate price signals, consumers pay too little for water and have little incentive to conserve (Carter & Milon, 1999; Western Resource Advocates, 2006). If the full marginal social and ecological costs of providing municipal water to residential households are increasing with an increasing volume of water provided, then cost-based pricing would need to reflect this, which then provides the incentive to consume less.

Water rate structures can be a very important tool in promoting conservation and efficient use in households; the rate structure ensures that water consumption charges are directly related to the price signals sent to the consumer (Western Resource Advocates, 2006; Borisova et al., 2008). Understandably, many assume that when conservation charges are included in the rate structure, which makes the price signal higher, water bills will dramatically increase; however, this does not have to be the case (Olmstead & Stavins, 2007; Western Resource Advocates, 2006). If a rate structure is designed appropriately, households that conserve water can actually have lower water bills; a rate structure that is well-designed by keeping non-discretionary water use (i.e., water use for cooking, drinking, and sanitation) prices relatively low and affordable can both encourage conservation through pricing and maintain equitable pricing to customers (Borisova et. al, 2008; Western Resource Advocates, 2006). Additionally, a well-designed rate

structure can also provide municipality utilities with a steady and reliable revenue stream that can consistently cover operation and maintenance costs (Olmstead & Stavins, 2007; Western Resource Advocates, 2006). Water rate structures can play a pivotal role in signaling the value of water to consumers and ultimately promoting long-term conservation (Borisova et al., 2008; Olmstead & Stavins, 2007; Western Resource Advocates, 2006).

Price elasticity of demand, or the proportional responsiveness of water usage to water rates, is an important element of rate structure design (Olmstead. et al., 2005; Zetland, 2011; Borisova et al., 2008). Typically, water price elasticity is negative (consistent with a downward-sloping demand curve); this indicates that an increase in price results in a decrease in quantity demanded (Borisova et al., 2008). In other words, as the price of water to the consumer increases, the amount of water that the consumer uses decreases. Price elasticity of demand is measured such that values from 0 to -1 represent an inelastic demand where a change in price tends to cause a smaller percentage of the quantity demanded; an increase in price will result in an overall increase in revenue (Borisova et al., 2008; Zetland, 2011). On the other hand, an elastic demand (categorized by a value less than -1) means that an increase in price will result in a much larger decrease in quantity demanded, and thus a much larger decrease in revenues (Borisova et al., 2008).

For residential and typically non-discretionary indoor water use (water used for cooking, showers, toilets, etc.), price elasticity is often estimated to roughly be in the range of -0.2 to -0.4. This implies that an increase in the price of water will likely lead to a minimal reduction in water use and in increase in revenues (Zetland, 2010; Borisova et al., 2008). For outdoor discretionary uses (water used for lawns, car washing, swimming pools, etc.), price elasticity is often estimated to be roughly in the range of -0.7 to -1.2 (Zetland, 2011). This means that as prices for water

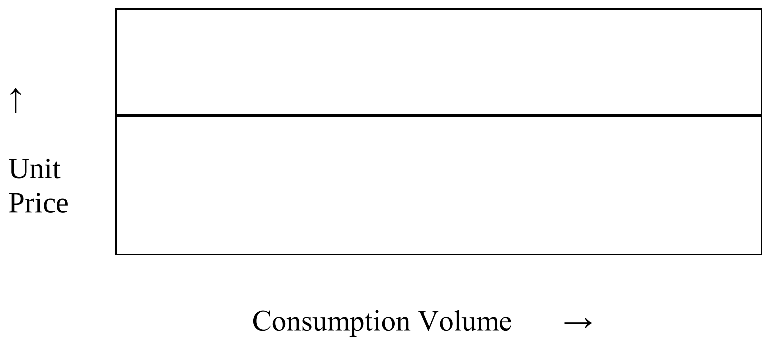
increase, consumers use less discretionary water and a little less non-discretionary water. This implies that people facing lower water prices will find more uses for water and waste, while those facing higher prices will eliminate non-essential water uses (Zetland, 2011; Borisova et al., 2008). The price elasticity for water uses will vary from region to region and may be different for different water uses, different customers, and different seasons (Borisova et al., 2008). For example, price elasticity is usually less elastic for low-income users as they typically do not have as many non-essential or discretionary uses (Borisova et al., 2008).

As previously mentioned, the majority of water rate structures include two charges: the service charge and the consumption charge. By using these two charges as a basis for developing a rate structure, water utilities have devolved several water rate variations. These charges include the unit price, or the consumption charges for water sold (unit price does not include the monthly service charge) (Borisova et al., 2008; Olmstead & Stavins, 2007; Western Resource Advocates, 2006). Consumption charges (or marginal prices) are reflective of the price for using the next volume amount of water. These charges are typically set at a dollar amount per 1,000 gallons or dollars per 100 cubic feet (Western Resource Advocates, 2006). There are several variations of rate structures; however, for the purposes of this analysis, only three rate structures will be explored in depth. These include uniform rate structures, increasing block rate structures, and seasonal rate structures. In addition, this section will briefly describe common non-price demand-side conservation strategies.

Uniform Rate Structure. In a uniform rate structure, a consumer is charged the same price-per-unit fee (beyond the fixed service charge) regardless of how much water is consumed. (See Figure 2.) This rate structure does send a price signal to consumers because the bill will increase as water used increases. However, this signal is less effective in encouraging conservation than

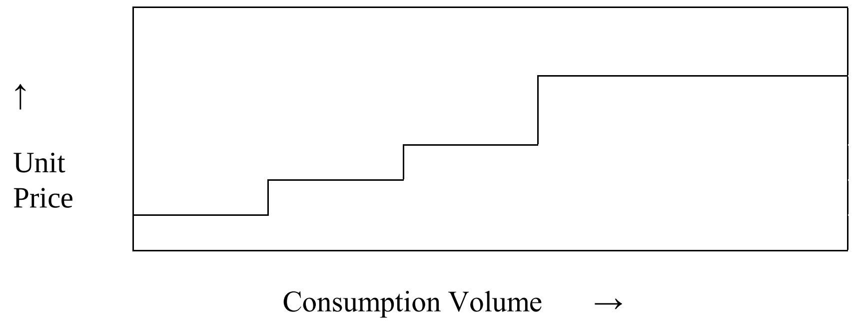
other structure types (EPA, 2012). This is because the per unit price for water is flat and does not change regardless of how much water the customer uses (Western Resource Advocates, 2006).

Figure 2. Uniform Rate Structure. This figure illustrates the relationship between the price and consumption of water at a uniform rate.



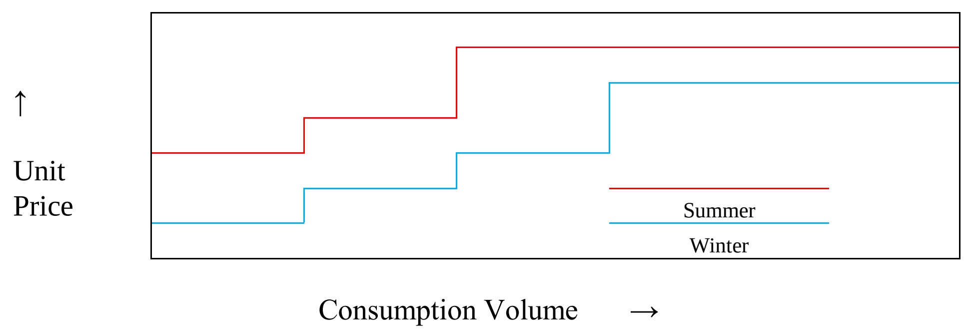
Increasing Block Rate. An increasing block rate pricing structure is a tiered pricing structure where the per-unit charges increase for water as the amount used increases. For example, the first unit or block of units is charged at one unit rate, the second unit or block of units is charged at a higher unit rate, and so forth. (See Figure 3.) Increasing block rates can be a useful tool in encouraging conservation (EPA, 2012). Depending on the block rates, consumers that use a modest amount of water will likely be charged a reasonable rate, while consumers using excessive volume amounts will likely be charged at much higher unit prices (Western Resources Advocates, 2006; Borisova et al., 2008). The increasing block rate structures also allow for flexibility by the municipalities, as there are numerous ways to structure each volume block (Borsiova et al., 2008; Olmstead & Stavins, 2007; Western Resource Advocates, 2006). While not focused on here, and not commonly used in NM, the inverse of an increasing block rate structure is a decreasing block rate structure, which creates incentives for using more water (Borisova et al., 2008; Olmstead & Stavins, 2007).

Figure 3. Increasing Block Rate Structure. This figure illustrates the relationship between water price and water consumption at an increasing block rate.



Seasonal Rate Pricing Structures. Seasonal rate structures include unit prices that rise and fall depending on total water demands in a municipality, weather conditions, or time of year (EPA, 2012). Typically, higher prices are set during the summer months rather than the winter months. In the summer, temperatures are higher, costs to provide water may be higher, water is more valuable, and water availability is more limited (Olmstead & Stavins, 2007; Western Resource Advocates, 2006). Please refer to Figure 4 below, which shows a seasonal rate structure, combined with an increasing block rate.

Figure 4. Seasonal Rate Structure. This figure illustrates the relationship between water price and water consumption at a seasonal rate structure combined with an increasing block rate.



While not evaluated further here, a number of non-priced based demand side management approaches or a combination are listed below. Price-based measures involve movements along a residential water demand curve, as quantity demanded responds to changes in the per unit price. Non-priced based measures involve shifts in demand curves (Zetland, 2011).

Rebates. Another demand-side conservation strategy is offering rebates for the purchasing of water efficiency technologies, such as low-flow toilets and showerheads, water efficient faucets, washing machines, dishwashers, etc. A potential problem with this approach is that behavioral responses can be counterproductive to conservation. For example, consumers with low-flow shower heads may take longer showers or low-flow toilet owners may flush more frequently (Olmstead & Stavins, 2007). This is an example of what economists refer to as a moral hazard problem (Wild et al., 2012). However, Price et al. (2014) have recently shown that water conservation rebate programs in Albuquerque, particularly for low-flow toilets, were successful in reducing household water demand.

Water Audits. Some municipalities offer free water audits in order to help consumers determine where they can save water or where they are currently using water in excess. While this may be helpful for some consumers who find water to be more valuable, it may be unlikely that consumers will seek out water audits unless their bill is considered to be high.

Education and Public Information Campaigns. Finally, some municipalities use education campaigns and public awareness in order to attempt to shift consumption preferences and decrease use. The successes of these campaigns vary, and their implementation can be costly.

Describing and Cataloging Residential Water Rate Structures for Selected Municipalities in New Mexico

In 2006, the Western Resource Advocates (2006) produced a report, now commonly cited (e.g., Darby et al., 2007; Christian-Smith & Kaphiem, 2010; Brookshire et al., 2012), analyzing the water rate structures of seven prominent municipalities in New Mexico. This report collected rate-structure type and pricing data for these municipalities and analyzed their strength as demand-side conservation strategies. The report also graphically illustrated the consumption charges for the seven communities. Overall, they argued that New Mexico's use of demand-side conservation approaches, such as increasing block rate pricing structures, was lacking. The seven municipalities evaluated were: Alamogordo, Farmington, Las Cruces, Albuquerque, Santa Fe, and Roswell. They represented some of the larger municipalities in the state, accounting for 39 percent of the population in 2000 (US Census Bureau, 2013). In 2012, McGuckin et al. (2012) provided a comparative analysis of the rate structures and consumption charges for Santa Fe, Albuquerque, and Las Cruces. While informative, this analysis only included three of the many municipalities across the state. Based on these selective reviews, considerable opportunities appear to remain available for New Mexico municipalities to adopt demand-side conservation approaches like IBP.

There have been other efforts to inventory the price of water to consumers and/or the effectiveness of other non-price demand-side conservation strategies in New Mexico. The New Mexico Environment Department's Construction Program Bureau's water and sewer survey collected the costs of water and sewer utility services to residential and commercial customers in 97 municipalities in 2011. The survey provided the residential water rate per month at 6,000 gallons, the commercial water rate per month, the total number of water connections, the

residential sewer rate per month, the commercial sewer rate per month, the average monthly water use/connections, the monthly water production for July 2011, the total annual water production for 2011, the average July 2011 water use/connection, and the monthly average use per connection. However, the survey did not evaluate the type of rate structures that municipalities implemented (NMED, 2013).

Price et al. (2014) evaluated demand-side strategies other than IBP by examining the effects of low-flow fixture rebates on household water use in Albuquerque. The study used panel regression techniques to statistically evaluate the effects of rebates from the Albuquerque Bernalillo County Water Utility Authority (ABCWA) on the household water use of rebate recipients (Price et al., 2014). Controlling for weather conditions and price, Price et al. (2014) found a negative correlation between household water use and the use of low-flow devices. Low-flow toilets appeared to have the greatest impact on reducing household water use; xeriscaping and installing low-flow appliances such as dishwashers, washing machines, and showerheads also decreased use, although not as significantly (Price et al., 2014). Rebates for air-conditioning systems, rain barrels, and hot water re-circulators were found to have no significant impact on reducing household water use (Price et al., 2014).

Aside from the limited analyses of McGuckin et al. (2012), which examined three communities, and the Western Resource Advocates (2006), which examined seven communities, the use of price-based, demand-side conservation strategies across New Mexico has not been rigorously evaluated. As such, the objectives of this research are to incrementally expand upon these prior efforts and to add additional analyses of community characteristics.

There were several factors considered when selecting the sample population of 30 New Mexico municipalities. Because the intent of this analysis was partly to update and expand upon the analysis by the Western Resource Advocates (2006), for purposes of comparison the previous seven municipalities (Alamogordo, Albuquerque, Farmington, Las Cruces, Rio Rancho, Roswell, and Santa Fe) were selected. The remaining 23 municipalities were not fully randomly selected, but were added based on: (i) public access and availability of rate information; (ii) a rough breakdown by geography (Northern Southern, and Central) and (iii) a mix of different populations served. This was done in order to add variability and to arrive at a reasonably representative sample of New Mexico municipalities. In sum, the sample population included 30 municipalities, which is not the universe of possible NM communities (numbering approximately 343). However, the selected sample of municipal systems provides residential water to 57% of New Mexico's population.[3]

For purposes of descriptive analysis, the municipalities were divided by population, region, and rate structure. The Census Bureau defines urbanized areas (UAs) as having populations of 50,000 or more people (US Census Bureau, 2013); however, in order to include more municipalities in the 'urban' category, this analysis considered all municipalities with 45,000 or

[3] This was determined by comparing the 2012 population estimates for each selected municipality to the 2012 population estimate for New Mexico as a whole. Population estimates were sourced from the United States Census Bureau 2008-2012 American Community Survey (ACS) 5-Year estimates.

more people as urban.[4] Conversely, all municipalities with a population less than 45,000 were considered to be rural.

In order to compare municipalities by region, the state of New Mexico was separated into three specific regions: northern, central, and southern. Municipalities north of Santa Fe were considered to be in Northern New Mexico. Municipalities that are located south of Santa Fe and north of Belen were considered to be in Central New Mexico. (Central New Mexico municipalities included Santa Fe and Belen.) All municipalities south of Belen were considered to be in Southern New Mexico. As seen in Table 4 below, 11 of these municipalities were considered to be in Central New Mexico. Eight of the 30 municipalities were considered to be in Northern New Mexico, and 11 were considered to be in Southern New Mexico. Despite making allowances in the determination of urban areas to include municipalities with populations of 45,000 people or more, the majority of these municipalities, 23 out of 30, were still considered to be rural. The remaining seven were urban. In order to determine population, data from the United States Census Bureau 2008-2012 American Community Survey (ACS) 5-Year estimates were used.

[4] The United States Census Bureau also defines urban clusters (UCs) of having at least 2,500 people and less than 50,000 people. However, because the majority of municipalities in New Mexico would qualify as UCs, in order to differentiate between municipalities, this report used a modified definition of UAs to classify municipalities.

Table 4

New Mexico Municipalities Included in the Sample Population

Municipality	Population (2012)	Urban or Rural	Geography
Alamogordo	31,500	Rural	Southern
Albuquerque	555,417	Urban	Central
Aztec	6,683	Rural	Northern
Belen	7,255	Rural	Central
Bloomfield	7,968	Rural	Northern
Carlsbad	26,687	Rural	Southern
Clayton	2910	Rural	Northern
Clovis	39,197	Rural	Southern
Deming	14,793	Rural	Southern
Edgewood	3779	Rural	Central
Espanola	10,240	Rural	Northern
Farmington	45,854	Urban	Northern
Gallup	22,008	Rural	Central
Las Cruces	101,047	Urban	Southern
Las Vegas	13,529	Rural	Central
Los Alamos	12,019**	Rural	Northern
Los Lunas	15,168	Rural	Central
Lovington	11,275	Rural	Southern
Moriarty	1868	Rural	Central
Portales	12,723	Rural	Southern
Raton	6,607	Rural	Northern
Rio Rancho	90,818	Urban	Central
Roswell	48,477	Urban	Southern
Ruidoso	8,005	Rural	Southern
Santa Fe	69,204	Urban	Central
Silver City	10,273	Rural	Southern
Socorro	8,906	Rural	Central
T or C	6411	Rural	Southern
Taos	5,676	Rural	Northern
Tucumcari	5,204	Rural	Central

*Source: Population data were provided by the Census Bureau ACS 2008-2012 5 Year Estimates.

**Los Alamos is represented by 2010 population Census estimates.

After rate structure data were collected (methods discussed below) municipalities were categorized as 'with incentive-based pricing' (WIBP) and 'without incentive-based pricing'

(WOIBP). WIBP municipalities included municipalities with seasonal increasing block rate structures and increasing block rate structures. WOIBP municipalities use uniform rate structures for their water pricing. Note that Albuquerque is an outlier in this analysis as the city has a very unique water rate structure. One could argue to categorize Albuquerque as a municipality WIBP or WOIBP. Albuquerque has a uniform rate structure for the months December through March. It is during this time that a 'conservation average' is established; this is the monthly average of water use for these four months. During the months of April through October, a customer can use up to 2 times the amount of their conservation average and still pay the uniform rate. However, if the customer uses 2 to 3 times their conservation average, the rate increases by 50%. If they use 3 to 4 times their conservation average, the rate increases by 100%. Finally, if they use over 4 times the conservation average, the rate increases by 150%. Albuquerque is considered to be a municipality WIBP for this analysis because the unit rate does change based on volume of use. However, the city is something of an outlier because the change is based on the use of each household rather than a standard use or block structure.[5] Although no customer is allowed a conservation average of more than 15 units (each unit is 748 gallons), arguably, this rate structure could actually encourage consumers to waste water during the winter months so that their conservation average is higher (McGuckin et al., 2012).

Data regarding rate structure type and water rate prices were collected through a variety of methods including internet searches, email exchanges with utility employees or city/town

[5] As of July 1st, 2014, rates for Albuquerque residents will increase; this increase will be reflected in the monthly base rate and will add less than 3 dollars to the average monthly residential water utility bill (ABCWUA, 2014). The unit price will not be affected. This rate change was approved by the Water Authority Board for the ABCWUA (ABCWUA, 2014).

employees, and/or phone calls with municipality officials or water utility employees. Regardless of how the initial rate structure type and water price data points were collected, information for each municipality was confirmed through a phone call. During these confirmation phone calls, the information requested was strictly restricted to relating to publically available information about the current water rate structure and the current water prices. Questions never pertained to the personal opinions of the employees or any personal information.

The rate structures and consumption prices collected are reflective of residential rates. These are typically defined as: single-family detached homes, duplexes served by individual meters, townhouses served by individual meters, condominiums served by individual meters, and/or mobile homes served by individual meters. It should also be noted that rates used for analysis were only representative of residents within city limits. Meter sizes varied and included 5/8”, 3/4”, and 1”. Comparing industrial, commercial, institutional, and multi-family rates was outside of the scope of this analysis. Additionally, comparing prices and rate structures for residents outside of city limits, for residents with water rights for irrigation, and for residents qualifying for senior discounts was also outside of the scope of this analysis. It should also be noted that municipalities with seasonal rate structures for industrial or commercial uses, but not for residential uses, were not included as municipalities with seasonal rate structures. Only the consumption charges and rate structures for residential uses within city limits were compared. (See Tables 5 through 8.)

Table 5

Rate Structure and Consumption Rates for Selected Municipalities, Year 2014

Municipality	Rate Structure Type	Fixed Monthly Charge	Consumption Rate
Albuquerque	Uniform Rate/Seasonal Rate Structure (WIBP)	$8.63	$1.025 per Unit (1 Unit is equal to 748 gallons)
			$1.53 per Unit, 2X to 3X the conservation rate (April through October)
			$2.05 per Unit, 3X to 4X the conservation rate (April through October)
			$2.56 per Unit, over 4X conservation rate (April through October)
Belen	Increasing Block Rate (WIBP)	$21.37	$21.37 (0 to 3,000 gallons)
			$3.01 per 1000 gallon (3,001 to 6,000 gallons)
			$3.37 per 1,000 gallons (6,001 to 10,000 gallons)
			$3.79 per 1000 gallons (10,001 to 25,000 gallons)
			$4.24 per 1000 gallon (Over 25,000 gallons)
Los Lunas	Uniform Rate (WOIBP)	$16.65	$16.65 (0 to 1,000 gallons)
			$3.25 per additional 1,000 gallons
Las Vegas	Increasing Block Rate (WIBP)	$16.10	$1.94 per 1,000 gallons (0 to 2,000 gallons)
			$4.37 per 1,000 gallons (2,001 to 6,000 gallons)
			$9.34 per 1,000 gallons (6,001 to 10,000 gallons)
			$24.60 per 1,000 gallons (10,001 gallons and Over)
Rio Rancho	Increasing Block Rate (WIBP)	$9.20	$4.25 per 1,000 gallons (0 to 6,000 gallons)
			$4.60 per 1,000 gallons (7,000 to 10,000 gallons)
			$4.96 per 1,000 gallons (Over 10,000 gallons)
Santa Fe	Seasonal Increasing Block Rate (WIBP)	$18.42	$6.01 per 1,000 gallons (0 to 7,000 gallons) September through April
			$21.72 per 1,000 gallons (More than 7,000 gallons) September through April
			$6.06 per 1,000 gallons (0 to 10,000 gallons) May through August
			$21.72 per 1,000 gallons (More than 10,000 gallons) May through August

Table 6

Rate Structure and Consumption Rates for Selected Municipalities, Year 2014

Municipality	Rate Structure Type	Fixed Monthly Charge	Consumption Rate
Tucumcari	Uniform Rate (WOIBP)	$17.07	$17.07 (0 to 3,000 gallons)
			$3.30 per 1,000 gallons (More than 3,000 gallons)
Aztec	Increasing Block Rate (WIBP)	$17.2	$3.00 per 1,000 gallon (0 to 5,000 gallons)
			$3.50 per 1,000 gallons (5,001 to 10,000)
			$4.10 per 1,000 gallons (10,001 to 15,000 gallons)
			$4.50 per 1,000 gallons (15,001 to 25,000 gallons)
			$5.00 per 1,000 gallons (25,001 to 50,000 gallons)
			$5.50 per 1,000 gallons (50,001 gallons and Over)
Bloomfield	Uniform Rate (WOIBP)	$15.84	$4.35 per 1,000 gallon
Espanola	Uniform Rate (WOIBP)	$17.96	$4.38 per 1,000 gallon
Farmington	Increasing Block Rate (WIBP)	$13.90	$2.09 per 1,000 gallons (0 to 7,000 gallons)
			$2.61 per 1,000 gallons (7,001 to 20,000 gallons)
			$3.26 per 1,000 gallons (20,001 to 40,000 gallons)
			$4.90 per 1,000 gallons (40,000 gallons and Over)
Raton	Increasing Block Rate (WIBP)	$9.50	$1.75 per 1,000 gallons (0 to 25,000 gallons)
			$2.035 per 1,000 gallons (25,001 gallons and Over)
Taos	Increasing Block Rate (WIBP)	$10.47	$3.64 per 1,000 gallons (2,000 to 6,000 gallons)
			$5.26 per 1,000 gallons (6,001 to 12,000 gallons)
			$7.28 per 1,000 gallons (12,001 gallons and Over)
Alamogordo	Increasing Block Rate (WIBP)	$13.30	$1.35 per 1,000 gallons (Up to 11,220 gallons)
			$2.15 per 1,000 gallons (11,221 to 22,441 gallons)
			$3.35 per 1,000 gallons (22,442 to 29,922 gallons)
			$5.50 per 1,000 gallons (29,923 to 37,402 gallons)
			$7.95 per 1,000 gallons (37,403 gallons and Over)
Socorro	Uniform Rate (WOIBP)	$7.73	$2.35 per 1,000 gallon

Table 7

Rate Structure and Consumption Rates for Selected Municipalities, Year 2014

Municipality	Rate Structure Type	Fixed Monthly Charge	Consumption Rate
Carlsbad	Increasing Block Rate (WIBP)	$9.15	$9.15 (Up to 3,000 gallons)
			$1.08 per 1,000 gallons (3,000 to 10,000 gallons)
			$1.19 per 1,000 gallons (10,001 to 25,000)
			$1.38 per 1,000 gallons (25,001 to 50,000 gallons)
			$1.54 per 1,000 gallons (50,001 to 100,000 gallons)
			$1.75 per 1,000 gallons (100,001 to 500,000 gallons)
			$1.93 per 1,000 gallons (500,001 gallons and Over)
Clovis	Increasing Block Rate (WIBP)	$14.34	$3.64 per 1,000 gallons (0 to 4,500 gallons)
			$4.55 per 1,000 gallons (4,501 to 15,000 gallons)
			$5.24 per 1,000 gallons (15,001 gallons and Over)
Deming*	Uniform Rate (WOIBP)	$3.00	$1.99 per 1,000 gallons
Las Cruces	Seasonal Increasing Block Rate (WIBP)	$6.84	$.70 per 1,000 gallons (0 to 3,000 gallons) June through September
			$2.08 per 1,000 gallons (3,0001 gallons and Over)
			$.70 per 1,000 gallons (0 to 3,000 gallons) November through May
			$1.89 per 1,000 gallons (3,001 gallons and Over) November through May
Lovington	Uniform Rate (WOIBP)	$15.91	$15.91 (Up to 3,000 gallons)
			$1.41 per 1,000 gallons (3,001 gallons and Over)
Portales	Increasing Block Rate (WIBP)	$15.13	$15.13 (Up to 3,000 gallons)
			$2.06 per 1,000 gallons (3,000 to 10,000 gallons)
			$2.45 per 1,000 gallons (11,000 to 30,000 gallons)
			$2.77 per 1,000 gallons (31,000 to 100,000 gallons)
			$3.03 per 1,000 gallons (101,000 gallons and Over)
Roswell	Uniform Rate (WOIBP)	$13.00	$13.00 (Up to 3,000 gallons)
			$1.60 per 1,000 gallons (3,001 gallons and Over)
Ruidoso	Increasing Block Rate (WIBP)	$28.00	$28.00 (0 to 3,000 gallons)
			$6.00 per 1,000 gallons (3,001 to 5,000 gallons)
			$7.00 per 1,000 gallons (5,001 to 7,000 gallons)
			$14.00 per 1,000 gallons (7,001 to 11,000 gallons)
			$20.00 per 1,000 gallons (11,001 to 15,000 gallons)
			$30.00 per 1,000 gallons (15,001 to 20,000 gallons)
			$42.00 per 1,000 gallons (20,001 gallons and Over)

*Data for the fixed monthly charge for Deming may be misrepresented due to inability to collect accurate amount.

Table 8

Rate Structure and Consumption Rates for Selected Municipalities, Year 2014

Municipality	Rate Structure Type	Fixed Monthly Charge	Consumption Rate
Gallup	Increasing Block Rate (WIBP)	$8.84	$0.020 per cubic foot (0 to 5,000 cubic feet)
			$0.031 per cubic foot (501 to 1,000 cubic feet)
			$0.052 per cubic foot (1,001 to 2,000 cubic feet)
			$0.083 per cubic foot (2,001 to 5,000 cubic feet)
			$0.096 per cubic foot (over 5,000 cubic feet)
Los Alamos	Uniform Rate (WOIBP)	$7.55	$4.19 per 1,000 gallons
Clayton	Uniform Rate (WOIBP)	$16.10	$16.10 (up to 2,000 gallons)
			$1.48 per 1,000 gallons
Truth or Consequences	Increasing Block Rate (WIBP)	$8.15	$1.75 per 1,000 gallons (0 to 7,000 gallons)
			$1.93 per 1,000 gallons (7,001 to 29,000 gallons)
			$2.12 per 1,000 gallons (29,001 to 50,000 gallons)
			$2.33 per 1,000 gallons (50,001 gallons and Over)
Moriarty	Increasing Block Rate (WIBP)	$10.17	$10.17 (Up to 4,000 gallons)
			$2.14 per 1,000 gallons (4,001 to 16,000 gallons)
			$2.41 per 1,000 gallons (16,001 to 30,000 gallons)
			$2.70 per 1,000 gallons (30,001 gallons and Over)
Edgewood	Increasing Block Rate (WIBP)	$16.50	$5.97 per 1,000 gallons (0 to 4,000 gallons)
			$8.00 per 1,000 gallon (4,001 to 10,000 gallons)
			$9.00 per 1,000 gallon (10,001 gallons and Over)
Silver City	Increasing Block Rate (WIBP)	$10.25	$10.25 (Up to 2,000 gallons)
			$3.74 per 1,000 gallons (2,001 to 10,000 gallons)
			$4.51 per 1,000 gallons (10,001 gallons and Over)

As seen in Table 9 below, the majority of the sample of 30 communities have an IBP rate structure. It is worth noting that only two municipalities have been identifyed as having a seasonal rate structure (Santa Fe and Las Cruces). As previously mentioned, one could argue that Albuquerque has a seasonal change in rate; however, due to the unique aspects of the seasonal rate changes, it is not included in this category. (Because the seasonal change in rate is based on the use of the individual household rather than use across the board, a household that uses more

water during the winter will have a greater conservation average and will be able to use more water during the summer before having a rate increase than a houshold that conserves during the winter months.)

Table 9

Rate Structure Type by Rural or Urban Designation

Rate Structure Type	Rural	Urban	Total Sample Population
Uniform Rate Structure	40%	14%	33%
Increasing Block Rate	60%	57%	60%
Seasonal Increasing Block Rate	0%	29%	7%
Total	100%	100%	100%

When the municipalities are defined by geographical category, the Northern municipalities differ slightly relative to the remaining regions. As seen in Table 10, 50% of the selected Northern municipalties incorporate IBP and 50% do not. The Southern and Central municipalities in this sample mirror eachother with the majority (73%) utilizing IBP rate structures. The selected sample size is small with only 30 municipalities; however, as previously noted, in terms of population it does represent 57% of the State.

Table 10

Rate Structure Type by Regional Designation

Rate Structure Type	Northern	Central	Southern
Uniform Rate Structure	50%	27%	27%
Increasing Block Rate	50%	64%	64%
Seasonal Increasing Block Rate	0%	9%	9%
Total	100%	100%	100%

Figure 5 below depicts the monthly adminstered price or charge to consumers set by each municipality at a select set of representative volumes of use: 3,000 gallons, 10,000 gallons, 25,000 gallons, and 50,000 gallons. The adminstered prices or charges to customers were calculated by including the various consumption charges and the monthly fixed service charge. These charges do not include taxes, additional surcharges, or conservation fees. They are refelctive of residential, single-family customer charges for residents within the limits of the municipality. In addition, the calculated costs to consumers represent monthly winter rates. As illustrated in Figure 5, the majority of the rate structures are fairly flat on the left-hand side. In other words, for the majority of the selected municipalities, the adminstered price does not change much until customers use over 10,000 gallons.

For a low to very low level of health concern, the World Health Organization (WHO) recommends that people have access to an average of 13.2 to 26.4 gallons of water per day. At 26.4 gallons per capita per day, all consumption needs (hydration) are met and all hygiene (food preparation, laundry, and bathing) needs are met (WHO, 2003). At these levels, arguably, a family of four could potentially meet their needs at 4,000 gallons a month. The average U.S. family uses 300 gallons of water per day in the home (EPA, 2014). This amounts to approximately 9,000 gallons of water per month. To put this in perspective in NM,[6] for the estimated average NM household size of 2.63 persons (US Census Bureau, 2014) in the year 2012, 10,000 gallons represents an estimated 127 gallons per capita per day (GPCD) per household. The ABCWUA stated that Albuquerque and Bernalillo County residents used 135 gallons per capita per day in 2013 (ABCWUA, 2013) (this is the total municipal use divided by

[6] For a more detailed account of per capita water use by utilities, counties, and watersheds in New Mexico for the year 2010, please refer to Longworth et al., 2013.

the population); and the average household monthly use is 8,000 gallons of water per month (McGuckin, 2012). In 2012, Rio Rancho residents used 159 gallons per capita per day (Rio Rancho Water Conservation Office, 2013). In comparision, Santa Fe residents used an average 101 gallons per capita per day in 2013 (Save Water Santa Fe, 2014); single family households use an estimated 4,000 gallons per month, far below the 10,000 gallon amount (McGuckin et al, 2012).While many NM households are likely using more than 10,000 gallons a month (e.g., Las Cruces has a typical single family residential usuage of 12,000 gallons per month (McGuckin et al., 2012)), using under this amount would be quite reasonable and affordable. The average administered price across our sample for 10,000 gallons is $44 a month or $528 a year, which represents 1.2% of the estimated NM median household income ($44,886) for the year 2012 (US Census Bureau, 2013). Most unit price increases in the selected municipalities (WIBP) would not affect households with relatively conservative or average use and are far above WHO minimum hygiene guidelines.

As seen in in Figure 5 and Figure 6 below, there are a few municipalities that are outliers in terms of adminstered prices. Ruidoso, Las Vegas, Edgewood, and Santa Fe have much higher charges to consumers after and/or up to 10,000 gallons of use. As previously mentioned, these high charges are unlikely to affect the majority of consumers. For these municipalities, water will only be costly for households that use significantly higher than average use. As can be seen in Figure 6, aside from three outliers, the majority of municipalities charge less than $100 dollars per month for 10,000 gallons of use, and all charge less than $180.

Figure 5. Estimated 2014 Monthly Consumption Charges in Selected Municipalities at 3,000, 10,000, 25,000, and 50,000 gallons. This figure illustrates the estimated costs (the monthly service charge and the monthly commodity charges) to residential consumers in selected municipalities at selected gallons amounts.

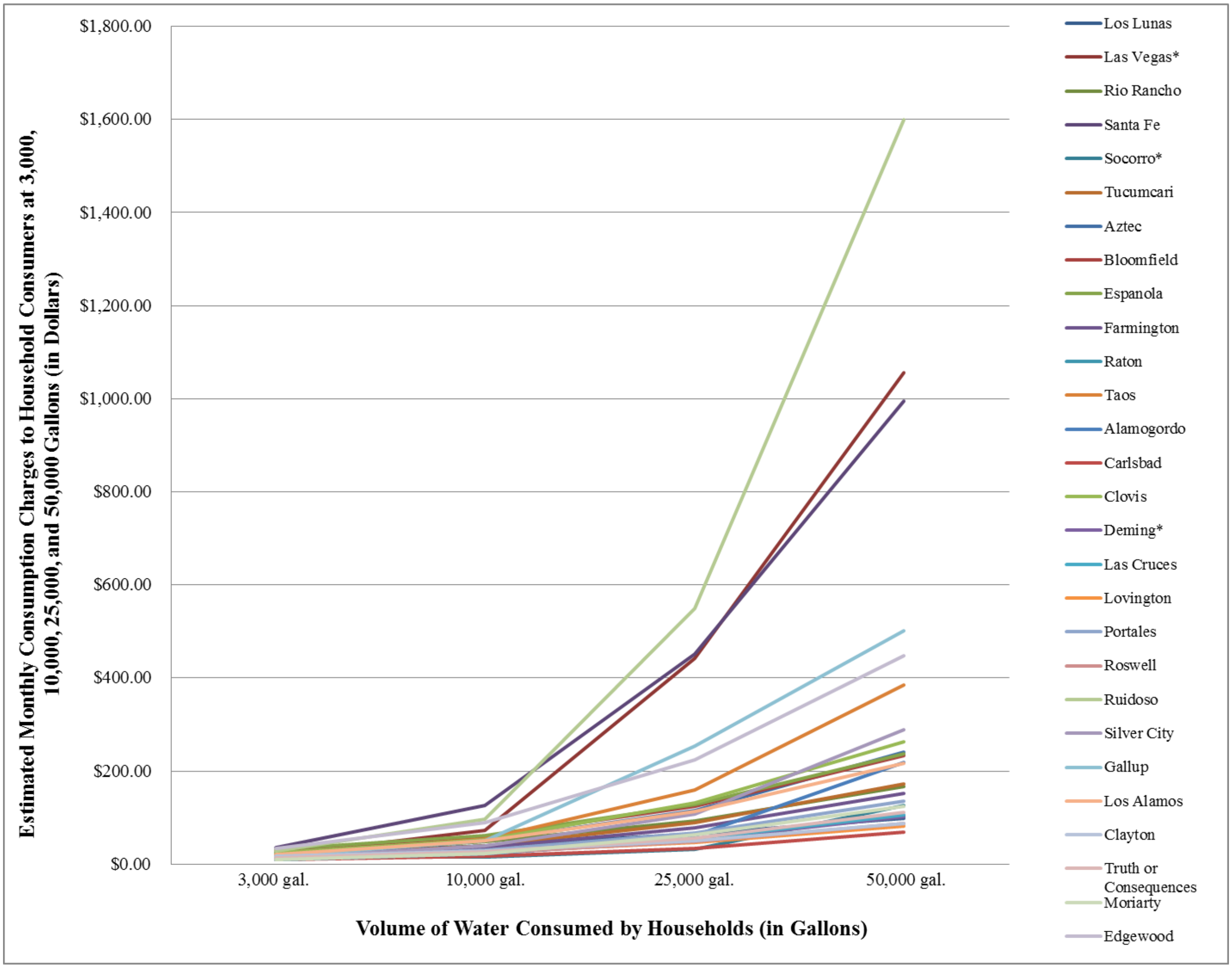


Figure 6. Estimated 2014 Monthly Consumption Charges in Selected Municipalities at 3,000 and 10,000 gallons. This figure illustrates the estimated costs (the monthly service charge and the monthly commodity charges) to residential consumers in selected municipalities at 3,000 and 10,000 gallon amounts.

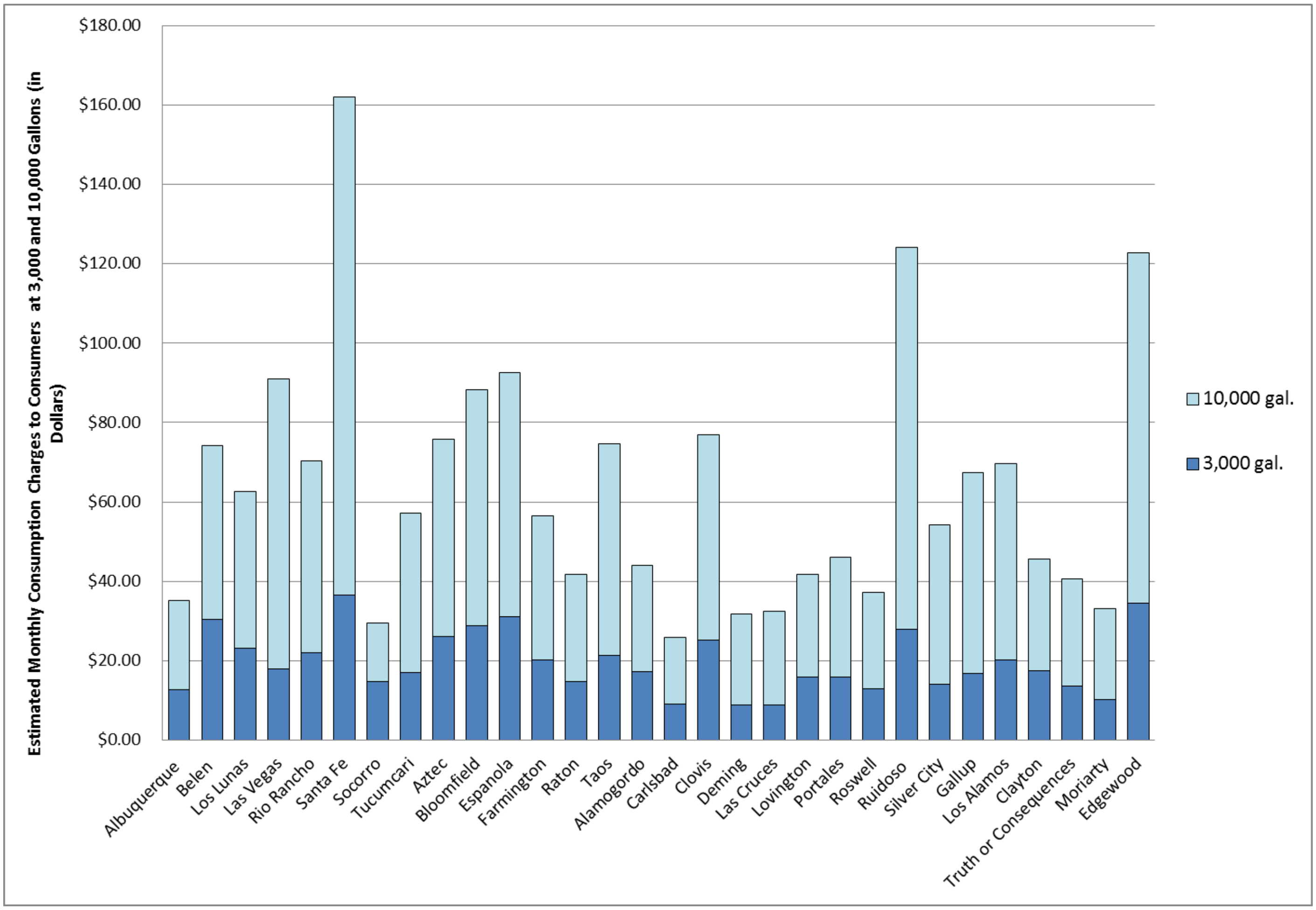
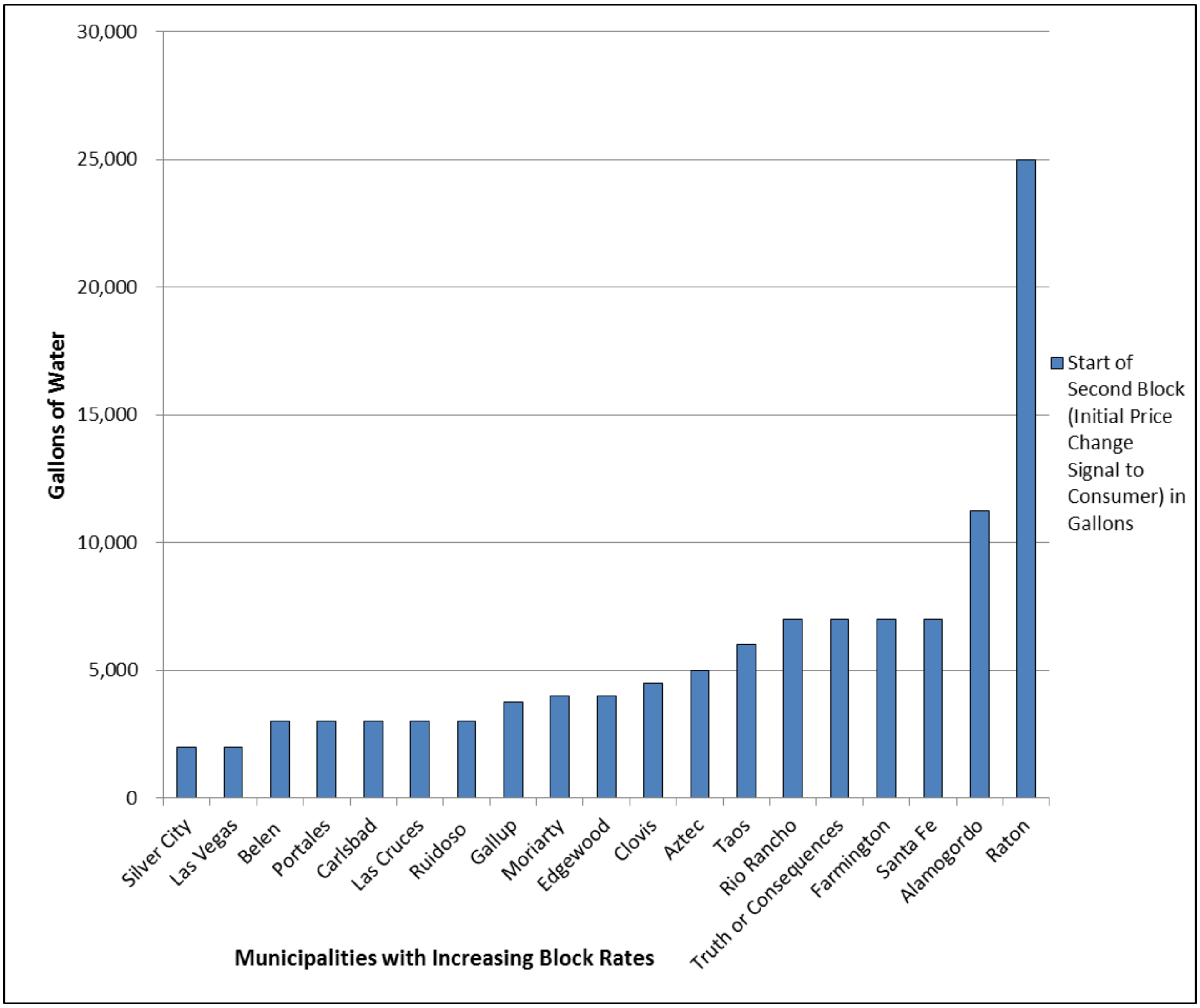


Figure 7 illustrates the gallon amount at which the second price block begins; in other words, this is the gallon amount at which consumers receive their initial conservation incentive price signal or experience their first change in price for each unit of water. As can be seen in the figure, the majority of municipalities do begin to increase the unit price before 10,000 gallons.

Alamogordo does not change the unit price until a household uses more than 11,221 gallons of water per month. This is well over the WHO guidelines of 4,000 gallons per month as well as the average US household use of 9,000 gallons per month. The average monthly household use in Alamogordo in 2010 (when prices were increased), was 11,220 gallons of water per month (London, 2010). This conservation price signal then, perhaps deliberately, is never received by the average consumer. So while technically an increasing block rate, the rate structure in Alamogordo, for example, is likely largely ineffective in encouraging conservation to levels below 10,000 gallons. As seen in Figure 7, Raton residents do not receive a signaled increase in price until they use an excess of 25,000 gallons of water per month. This is over 6 times the WHO guideline amount of 4,000 gallons and nearly three times the average US use of 9,000 gallons. A consumer can use up to 25,000 gallons of water per month in Raton and pay an estimated $53.25. If a consumer in Raton uses 50,000 gallons of water per month, the estimated monthly charge is only $104.13. To put this in perspective, 10,000 gallons of water per month costs a resident an estimated $125.65 in Santa Fe (winter), $96.00 in Ruidoso, and $72.88 in Las Vegas. 50,000 gallons of water in Ruidoso is 15 times more expensive than in Raton at $1600 and $104 respectively. While Raton has technically implemented an increasing block rate, it is doubtful that residents receive a price signal to conserve under Raton's rate structure.

Figure 7. Start of Second Block and Initial Price Change Signal to Consumers, in Gallons. This Figure illustrates the gallons amount at which the second price block begins. This is the first price signal that the consumer experiences.



Municipality rate structures shouldn't only be evaluated based on the gallon amount at which a consumer receives a price signal. As seen in Figure 7, several municipalities have rate structures that deliver a conservation incentive price signal to consumers well before 10,000 gallons; however, many of their rate structures do not actually increase very much in price. As

seen in Figure 8, the percent changes from the unit price of the first block to the unit price of the last block were calculated for municipalities with increasing block rates. The unit price does not increase by 100% for the majority of the municipalities listed (12 out of 19). In fact, unit prices in Raton, Rio Rancho, Silver City, Moriarty, Truth or Consequences, Belen, Clovis, and Portales increase by less than 50% from the unit price of the initial block to the unit price of the last block.

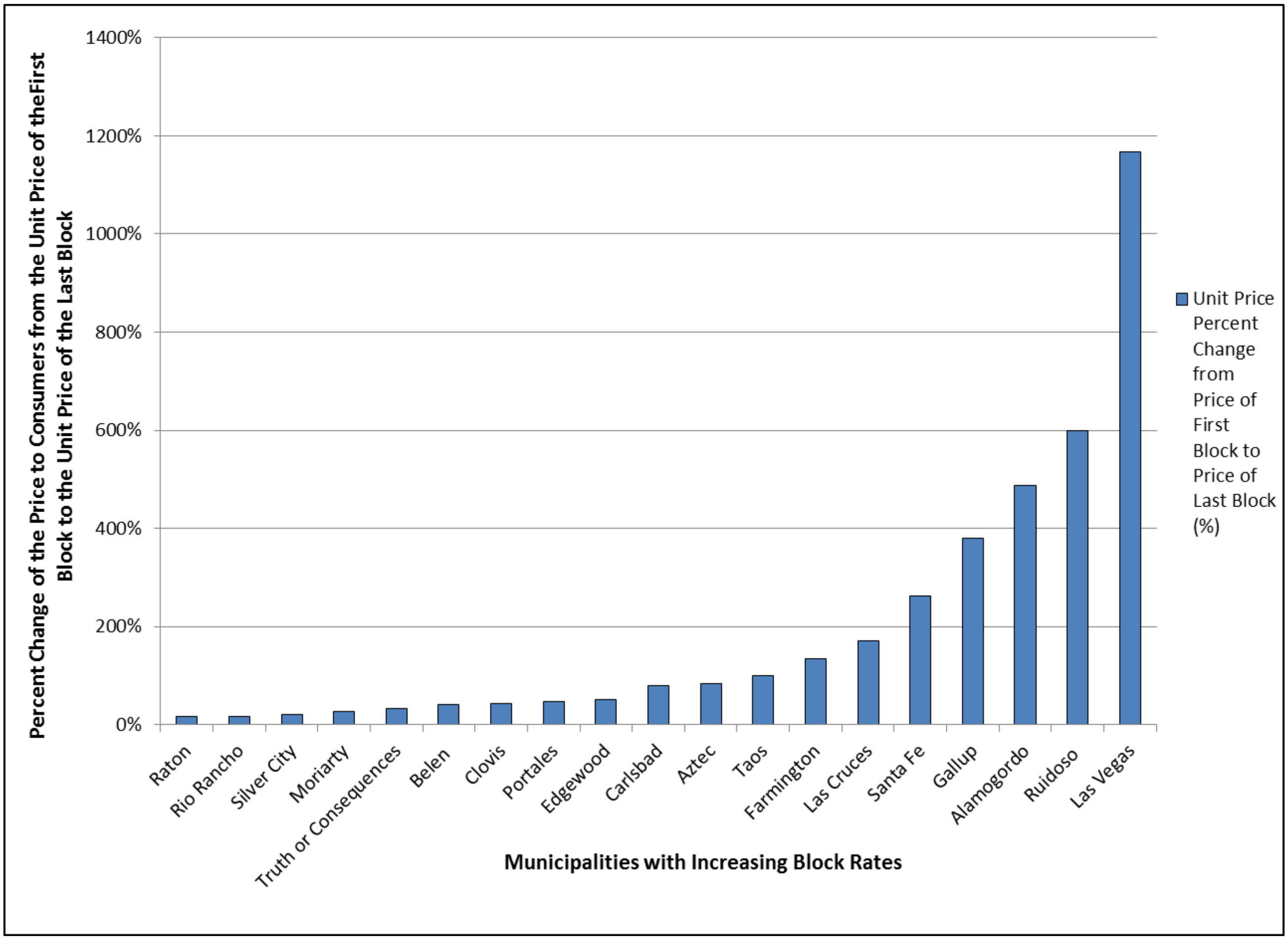
Furthermore, it is important to consider all of the information provided in Figures 5 through 8 in a comprehensive manner. For example, Alamogordo has an increase in unit price from the first block to the last block of 488%; however, the second block for Alamogordo doesn't begin until a resident uses over 11,221 gallons in a month. At 50,000 gallons of water month, a resident in Alamogordo would only be charged an estimated $218 dollars per month. Thus, despite a significant change in price (moving from $1.35 to $7.95), the costs to consumers are still quite low. As another example, the second block starts at 3,000 gallons for Belen; however, the unit price change from the first block to the last block is only 41%. A resident in Belen can use 10,000 gallons in a month and pay an estimated $42; they can use 25,000 gallons a month and pay an estimated $100 or use 50,000 gallons and only pay an estimated $207.

Both of these examples illustrate that the initial price must also be taken into consideration in addition to price changes over blocks and the start of the second block (the first change in costs to the consumer). For example, Santa Fe has an overall change in unit price of 261% which is significant, especially when considering that the initial cost per unit, $6.01, is much higher than the initial unit costs for the majority of the sample municipalities. The first unit price change occurs at 7,000 gallons; however, this unit price increases by 261% from $6.01(winter) per unit to $21.72. Consumers receive a very significant conservation price signal

well before using 10,000 gallons. Santa Fe has been successful in household conservation; as previously mentioned, the typical monthly residential use in Santa Fe is only 4,000 gallons, well below the dramatic change in unit price at 7,000 gallons. As another example, the Las Vegas unit price increases by a full 1168% from the first block to the last block. The first price signal to the consumer is experienced at 2,000 gallons (see Figure 7) and the cost of 10,000 gallons of water per month is $73 while 50,000 gallons of water per month is an estimated $1,056.

What this indicates is that some municipalities with increasing block rates have rate structures where unit price increases substantially over the blocks, consumers are significantly encouraged to use less than 10,000 gallons of water a month (in other words, the cost to consumers at an excess of 10,000 gallons per month is significantly higher), and consumers are receiving a price signal at or before use of 10,000 gallons per month; on the other hand, some municipalities may have effectively implemented an increasing block rate structure that appears to be largely for show rather than for the actual encouragement of water conservation.

Figure 8. Percent change of the unit price to consumers from the unit price of the first block to the unit price of the last block. This figure illustrates the percent that the unit price changes from the first block of the rate structure to the last block of the rate structure.



When comparing the current rate structures (2014) to the rate structures collected by the Western Resource Advocates in 2005, several municipalities have made changes toward establishing IBP structures. As seen in Tables 11 through 13 below, Farmington and Las Cruces have moved from a uniform rate structure to an IBP rate structure. Rio Rancho has added an additional price block. In contrast, Roswell has maintained a uniform rate structure. It is also

interesting that when 2005 prices are adjusted to 2014 dollars, a few municipalities (Albuquerque, Rio Rancho, and Las Cruces) appear to be charging less for water in 2014 (through June 2014). However, the Albuquerque prices included in this comparison do not include the various surcharges (e.g., the Sustainable Water Supply Program charge, the State Water Conservation Fee, etc.) that Albuquerque residents currently pay.

Table 11

Rate Structure Type and Price Comparison, 2014 and 2005

Municipality	Rate Structure Type	Fixed Monthly Charge	Consumption Rate
Albuquerque 2014	Uniform Rate/Seasonal Rate Structure	$8.63	$1.025 per Unit (1 Unit is equal to 748 gallons) $1.53 per Unit, 2X to 3X the conservation rate (April through October) $2.05 per Unit, 3X to 4X the conservation rate (April through October) $2.56 per Unit, over 4X conservation rate (April through October)
Albuquerque 2005	Uniform Rate/Seasonal Rate Structure	$9.47 (Converted into 2014 Dollars)	$1.48 per Unit (1 Unit is equal to 748 gallons) $2.22 per Unit, 2X to 3X the conservation rate (April through October) $2.96 per Unit, 3X to 4X the conservation rate (April through October) $3.70 per Unit, over 4X conservation rate (April through October) (Converted into 2014 Dollars)
Rio Rancho 2014	Increasing Block Rate	$9.20	$4.25 per 1,000 gallons (0 to 6,000 gallons) $4.60 per 1,000 gallons (7,000 to 10,000 gallons) $4.96 per 1,000 gallons (More than 10,000 gallons)
Rio Rancho 2005	Increasing Block Rate	$10.04 (Converted into 2014 Dollars)	$2.81 per 1,000 gallons (0 to 2,000 gallons) $3.18 per 1,000 gallons (More than 20,000 gallons) (Converted into 2014 Dollars)

Sources: 2005 rates were sourced from the Western Resource Advocates (2006) report. Dollar conversions were converted using the Consumer Price Index (CPI) (a measure of the average change in prices over time in a market) calculator. The CPI is updated monthly by the Bureau of Labor Statistics. The CPI calculator was provided by the Federal Reserve Bank of Minneapolis website (Federal Reserve Bank of Minneapolis, 2014).

Table 12

Rate Structure Type and Price Comparison, 2014 and 2005

Santa Fe 2014	Seasonal Increasing Block Rate	$18.42 (Converted into 2014 Dollars)	$6.01 per 1,000 gallons (0 to 7,000 gallons) September through April $21.72 per 1,000 gallons (More than 7,000 gallons) September through April $6.06 per 1,000 gallons (0 to 10,000 gallons) May through August $21.72 per 1,000 gallons (More than 10,000 gallons) May through August
Santa Fe 2005	Seasonal and Increasing Block Rate	$15.97 (Converted into 2014 Dollars)	$4.95 per 1,000 gallons (November through April) $4.95 per 1,000 gallons (0 to 12,000 gallons) May through October $ 7.97 per 1,000 gallons (12,000 to 20,000 gallons) May through October $11.00 per 1,000 gallons (More than 20,000 gallons) May through October (Converted into 2014 Dollars)
Alamogordo 2014	Increasing Block Rate	$13.30	$1.35 per 1,000 gallons (Up to 11,220 gallons) $2.15 per 1,000 gallons (11,221 to 22,441 gallons) $3.35 per 1,000 gallons (22,442 to 29,922 gallons) $5.50 per 1,000 gallons (29,923 to 37,402 gallons) $7.95 per 1,000 gallons (37,403 gallons and Over)
Alamogordo 2005	Increasing Block Rate	$11.87 (Converted into 2014 Dollars)	$1.66 per 1,000 gallons (Up to 11,220 gallons) $2.50 per 1,000 gallons (11,221 to 22,441 gallons) $3.99 per 1,000 gallons (22,442 to 29,922 gallons) $6.31 per 1,000 gallons (29,923 to 37,402 gallons) $8.84 per 1,000 gallons (37,403 gallons and Over) (Converted into 2014 Dollars)

Sources: 2005 rates were sourced from the Western Resource Advocates (2006) report. Dollar conversions were converted using the Consumer Price Index (CPI) (a measure of the average change in prices over time in a market) calculator. The CPI is updated monthly by the Bureau of Labor Statistics. The CPI calculator was provided by the Federal Reserve Bank of Minneapolis website (Federal Reserve Bank of Minneapolis, 2014).

Table 13

Rate Structure Type and Price Comparison, 2014 and 2005

Las Cruces 2014	Seasonal Increasing Block Rate	$6.84	$.70 per 1,000 gallons (0 to 3,000 gallons) June through September $2.08 per 1,000 gallons (3,0001 gallons and Over) $.70 per 1,000 gallons (0 to 3,000 gallons) November through May $1.89 per 1,000 gallons (3,001 gallons and Over) November through May
Las Cruces 2005	Uniform Rate Structure	$8.25 (Converted into 2014 Dollars)	$ 1.06 per 1,000 gallons (0 to 3,000 gallons) $2.10 per 1,000 gallons (3,001 gallons and Over) (Converted into 2014 Dollars)
Roswell 2014	Uniform Rate	$13.00	$13.00 (Up to 3,000 gallons) $1.60 per 1,000 gallons (3,001 gallons and Over)
Roswell 2005	Uniform Rate Structure	$9.98 (Converted into 2014 Dollars)	$1.21 per 1,000 gallons (3,001 gallons and Over) (Converted into 2014 Dollars)
Farmington 2014	Increasing Block Rate	$13.90	$2.09 per 1,000 gallons (0 to 7,000 gallons) $2.61 per 1,000 gallons (7,001 to 20,000 gallons) $3.26 per 1,000 gallons (20,001 to 40,000 gallons) $4.90 per 1,000 gallons (40,000 gallons and Over)
Farmington 2005	Uniform	$9.81 (Converted into 2014 Dollars)	$$1.96 per 1,000 gallons (Converted into 2014 Dollars)

Sources: 2005 rates were sourced from the Western Resource Advocates (2006) report. Dollar conversions were converted using the Consumer Price Index (CPI) (a measure of the average change in prices over time in a market) calculator. The CPI is updated monthly by the Bureau of Labor Statistics. The CPI calculator was provided by the Federal Reserve Bank of Minneapolis website (Federal Reserve Bank of Minneapolis, 2014).

Hypotheses

As previously mentioned, there are often legal/regulatory and financial constraints that can affect a municipality's ability to implement an IBP structure (McGuckin et al., 2012). Examples might include limits on attempts to include scarcity surcharges that raise prices to account for future opportunity costs of using water now, when a municipal charter may only allow for recovery of current costs, or is restricted to average cost pricing. Another limitation

may be legal constraints. For example, the Albuquerque Bernalillo County Water Utility (ABCWUA) met legal challenges regarding the diversion of water for the San Juan-Chama (SJC) Drinking Water Project. The project required large capital investments to be paid for over seven consecutive rate increase cycles (McGuckin et al., 2012). This legal challenge was sent to the New Mexico Court of Appeals and was resolved this year after almost a decade of controversy.

However, community and political will can greatly influence the decision for a municipality to adopt IBP (McGuckin et al., 2012), and regulatory constraints, for example, are always open to political change.[7] Why do some municipalities (such as Las Cruces or Farmington) make changes to implement IBP while other municipalities do not? To better understand this issue, one starting point may be to examine community characteristics. In

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[7] An example of a political move toward an increase in water rates is Santa Fe. From 2001 to 2003, the city held a series of events that included political, environmental, hydrological, financial, and planning oriented events to address community and political concern for the sustainability of groundwater supplies (McGuckin et al., 2012). The events galvanized efforts to both dramatically increase the city's water rates and to develop necessary infrastructure to divert water through the Buckman Direct Diversion (BDD) (McGuckin et al, 2012). However, in this case, the City was met with financial constraints and had to address the rate covenant requirements in the master bond ordinance for the water system; rate increases addressed the immediate bond compliance issues that were raised by the BDD (McGuckin et al., 2012). In addition, the city began a comprehensive financial planning process that evaluated rate-design in the long term (McGuckin et al., 2012).

addition to cataloguing current IBP implementation, an objective of this analysis was to address the following research question:

> What characteristics best differentiate those New Mexico municipalities that have chosen to adopt incentive-based pricing structures from those that have not chosen to adopt incentive-based pricing structures?

Against a null hypothesis in each case of no difference between those communities that adopt incentive-based pricing and those that don't, and using a chosen set of community characteristics, this analysis tested the following alternative hypothesis:

> The mean (or median) difference between the characteristic value of those municipalities that do not adopt incentivize-based pricing structures and those municipalities that do adopt incentivize-based pricing structures will not be equal to zero.

These alternative hypotheses are as follows: (i) the mean percentage of individuals employed in agriculture, forestry, fishing and hunting, and mining will be higher for municipalities WOIBP than for municipalities WIBP; (ii) the mean percentage of individuals who voted Democrat in the 2012 election will be higher for municipalities WIBP than for municipalities WOIBP; (iii) the mean percentage of individuals who voted for the Green Party in the 2012 election will be higher for municipalities WIBP than municipalities WOIBP; (iv) the mean population for municipalities WIBP will be higher than the mean population for municipalities WOIBP; (v) the mean percentage of individuals born in New Mexico will be higher for municipalities WOIBP than for municipalities WIBP; (vi) the mean percentage of individuals employed in manufacturing will be higher for municipalities WOIBP than for municipalities WIBP; (vii) the mean per capita income will be higher for municipalities WIBP than for municipalities WOIBP; (viii) the mean median

income will be higher for municipalities WIBP than for municipalities WOIBP; (ix) the mean percentage of individuals with a high school diploma will be higher for municipalities WIBP than for municipalities WOIBP; (x) the mean percentage of individuals with a Bachelor's degree will be higher for municipalities WIBP than for municipalities WOIBP; (xi) the mean percentage of individuals who speak Spanish and speak English less than "very well" will be higher for municipalities WOIBP than for municipalities WIBP; (xii) the mean elevation will be higher for municipalities WIBP than for municipalities WOIBP.

These characteristics were chosen because they represent an array of variables that may illuminate differences in socio-economic status (i.e., educational attainment, income) or the prevalence of certain industries that may be more water intensive (i.e., agriculture and manufacturing). Additionally, they may be representative of environmental activism (i.e., Green Party voters); traditional acequia agriculture communities (percentage of Spanish speakers); communities with established tenure in the State (percentage of individuals born in NM); population; and physical or geographic differences (elevation).

The purpose of this analysis is not meant to somehow draw judgments on those municipalities that have not yet chosen to adopt IBP. Some of the municipalities WOIBP may not have experienced significant water shortage, may be implementing other demand-side conservation management strategies, or may have legal/regulatory or financial constraints. However, considering that IBP may become even more important as a conservation tool in the future, it will be helpful to planners and policy makers to know whether there are statistically significant characteristic differences between those municipalities WIBP and WOIBP.

Analysis of Differences in Select Community Characteristics

Characteristics that may differentiate a community's decision to adopt IBP may include socio-economic status, origin and language, geographical characteristics, environmental activism, and/or the prevalence of particular industries. The focus here is on socioeconomic/demographic characteristics. As such, municipality characteristics evaluated include: educational attainment, political affiliation, industry, income, state of birth, language spoken at home, and population. As an example of a physical /geographical municipality characteristic, elevation was also evaluated. In order to test this hypothesis, data for several different municipality characteristics were collected from the 2008-2012 American Community Survey (ACS) 5-Year estimates and the Associated Press. These characteristics include:

1) Percent of individuals employed in agriculture, forestry, fishing and hunting, and mining—this "sector comprises establishments primarily engaged in growing crops, raising animals, harvesting timber, and harvesting fish and other animals from a farm, ranch, or their natural habitats" (US Census Bureau, 2013).
2) Percent of individuals employed in manufacturing—this "sector comprises establishments engaged in the mechanical, physical, or chemical transformation of materials, substances, or components into new products. Establishments in the Manufacturing sector are often described as plants, factories, or mills and characteristically use power-driven machines and materials-handling equipment. However, establishments that transform materials or substances into new products by hand or in the worker's home and those engaged in selling to the general public products made on the same premises from which they are sold, such as bakeries, candy stores, and custom tailors, may also be included in this sector" (US Census Bureau, 2013).

3) Percent of individuals that voted Democrat in the 2012 Election—these data represent the percentage of the popular vote (of the County in which the municipality is located) that voted for Democratic Party candidate, President Barack Obama (Politico, 2013).
4) Percent of Individuals that voted Green in the 2012 Election—these data represent the percentage of the popular vote (of the County in which the municipality is located) that voted for Green Party candidate, Jill Stein (Politico, 2013).
5) Population of municipalities—these data reflect the total number of people estimated to live in a municipality as of July 1, 2012 based on the 2010 Census. These values are representative of the "Annual Estimates of Resident Population: April 1, 2010 to July 1, 2012" (US Census Bureau, 2013).
6) Percentage of individuals born in New Mexico—these data represent the estimated percentage of Native born individuals in the municipality ("anyone who was a U.S. citizen or a U.S. national at birth") that were born in New Mexico (US Census Bureau, 2013).
7) Mean per capita income—these data represent the "mean income computed for every man, woman, and child in a geographic area. It is derived by dividing the total income of all people 15 years old and over in a geographic area by the total population in that area. This measure is rounded to the nearest whole dollar. Unlike median household income, which is estimated annually for states and counties, per capita income is derived from the American Community Survey, and thus refers to a 5-year period" (US Census, 2013).
8) Median household income—these data reflect "the income of the householder and all other individuals 15 years old and over in the household, whether they are related to the householder or not. The median divides the income distribution into two equal parts: one-

half of the cases falling below the median income and one-half above the median. For households and families, the median income is based on the distribution of the total number of households and families including those with no income. The median income for individuals is based on individuals 15 years old and over with income. Median income for households, families, and individuals is computed on the basis of a standard distribution" (US Census Bureau, 2013).

9) Percentage of individuals with a Bachelor degree—these data represent the percentage of people who attended college and received a bachelor's degree but did not receive a master's, professional or doctorate degree (US Census Bureau, 2013).

10) Percentage of individuals with a high school diploma or equivalent—these data represent those individuals whose highest degree was a high school diploma or its equivalent, e.g., people who have passed the General Educational Development (G.E.D.) and did not attend college (US Census Bureau, 2013).

11) Percentage of individuals who speak Spanish and speak English 'less than very well'—this characteristic is representative of the percentage of people who speak Spanish and speak English less than "very well" in the home (Us Census Bureau, 2013).

12) Elevation of municipality—these data are reflective of a municipality's height (in feet) above sea level.

Tables 14 and 15 provide the mean values (and their standard deviations) for these 12 characteristics for both WIBP (n= 20) and WOIBP (n= 10). These characteristics were then analyzed through a statistical test of the means, or a 't-test'. Note, before calculating the t-test for all characteristics that are expressed as percentages, percentage values were transformed into 'arcsine values'. Because percentages cannot be less than 0 or more than 100, they need

to be transformed in order to give the values more theoretical freedom to vary. Arcsine transformations are appropriate for data on proportions or percentages of count data in order to make the distribution normal (Trochim, 2007). The t-test is used in analytical research to test whether the means from two groups of data differ significantly (Trochim, 2007). The chosen version of the t-test for this analysis is for two populations with unequal sample sizes; the transformed percentage scores were evaluated by assuming equal variances, and all other variables were evaluated assuming unequal variances.

Table 14

Sample Means and Standard Deviations for Selected Characteristics for Communities WOIBP

	WOIBP (n=10)		
Characteristic	Sample Mean	Transformed Arcsine Score Mean	Sample Standard Deviation
% Individuals Employed in Agriculture, Forestry, Fishing & Hunting & Mining	0.07%	13.8	8.5
% Individuals Voted Democrat in 2012 Election (by County)	43.8%	26.0	10.3
% Individuals Voted Green Party in 2012 Election (by County)	0.25%	0.14	0.1
Population of Municipalities (2012)	15,376	N/A	12,678
% Individuals Born in New Mexico	55.4%	34.1	8.7
% Individuals Employed in Manufacturing	3.7%	2.1	1.4
Mean Per Capita Income	$21,251.00	N/A	10798.7
Mean Per Capita Income (Excluding Los Alamos)	$17,926.00	N/A	2605.7
Median Household Income	$43,428.10	N/A	22939.1
% Individuals with High School Diploma or Equivalent	30.30%	17.7	5.9
% Individuals with Bachelor Degree	11.20%	6.5	3.9
% Individuals Speak Spanish (Speak English Less than Very Well)	8.90%	5.1	3.6
Elevation of Municipality	4,874 ft	N/A	1081.4

Table 15

Sample Means and Standard Deviations for Selected Characteristics for Communities WIBP

Characteristic	WIBP (n=20) Sample Mean	Transformed Arcsine Score Mean	Sample Standard Deviation
% Individuals Employed in Agriculture, Forestry, Fishing & Hunting, &Mining	0.04%	10.9	5.4
% Individuals Voted Democrat in 2012 Election (by County)	49.6%	30.51	12.3
% Individuals Voted Green Party in 2012 Election (by County)	0.38%	0.21	0.1
Population of Municipalities (2012)	52,386	N/A	122036
% Individuals Born in New Mexico	52.6%	32.0	7.8
% Individuals Employed in Manufacturing	4.4%	2.5	1.6
Mean Per Capita Income	$22,157.70	N/A	5172.8
Median Household Income	$39,962.20	N/A	10786.5
% Individuals with High School Diploma or Equivalent	27.60%	16.1	3.4
% Individuals with Bachelor Degree	14.00%	8.1	2.9
% Individuals Speak Spanish (Speak English Less than Very Well)	5.50%	3.2	1.6
Elevation of Municipality	5,5589 ft	N/A	1359.5

The t-test results in a t-critical value, which allows for a determined level of significance. This significance value allows one to determine whether the difference in means is due to chance or an actual difference between the groups; in order to determine significance, it must be compared to a set risk level, or level of significance (the ‘alpha’ value). Typically, an alpha level of 0.05 is selected to compare the t-test significance level to. If the t-test value is less than 0.05, then this means that five times out of one hundred, one would find a statistically significant difference between the means (Trochim, 2007). However, in small sample statistics, it is acceptable to also use an alpha level of 0.10. In this case, in ten out of 100 times, one would find significant differences between the means (Trochim, 2007).

For this analysis, percentages were transformed to arcsine values and were tested for statistically significant differences, at the 0.10 level. All other variables were analyzed without any transformation. Each characteristic variable was tested at a one-tailed directional hypothesis and a two-tailed non-directional hypothesis. The characteristic values (percentage

of Democratic voters, median household income, etc.) were tested for difference between the means of WOIBP and WIPB.

After conducting statistical t-tests of the hypotheses, a number of the null hypotheses were supported and several of the null hypotheses were rejected (the evidence supported the alternative hypothesis). Results are provided in Table 15. Please note that "μ" indicates the sample mean for a characteristic. As shown, the evidence supports the rejection of the null hypothesis for the following characteristics:

1) The evidence supports that the mean of the percentage of individuals who voted for the Green party in the 2012 election for communities WIBP is not equal to the mean of the percentage for communities WOIBP. This is statistically significant at a level of 0.06. When this is further refined in a one-tailed directional hypothesis, the evidence supports that communities WIBP are more likely to have a higher percentage of Green party voters than communities WOIBP. This is significant at a level of 0.03.
2) When tested as a one-tailed directional hypothesis, the evidence supports that the mean of the percentage of individuals with Bachelor degrees for communities WIBP is higher than the mean of the percentage for communities WOIBP. This is significant at a level of 0.10.
3) The evidence supports that the mean of the percentage of individuals who speak Spanish at home (and speak English "less than very well") for communities WIBP is not equal to the mean of the percentage for communities WOIBP. This is statistically significant at a level of 0.04. When this is further refined in a one-tailed directional hypothesis, the evidence supports that communities WOIBP are more likely to have a higher percentage

of individuals who speak Spanish at home (and speak English "less than very well") than communities WIBP. This is highly significant at a level of 0.02.

4) When tested at a one-tailed directional hypothesis, the evidence supports that the mean of the elevation for communities WIBP is higher than the mean of the elevation for communities WOIBP. This is significant at a level of 0.06.
5) When tested at a one-tailed directional hypothesis, the evidence supports that the mean of the population for communities WIBP is higher than the mean of the population for communities WOIBP. This is significant at a level of 0.09.
6) When Los Alamos is excluded from the WOIBP sample, the evidence supports that the mean per capita income for communities WIBP is not equal to the mean for communities WOIBP. This is statistically significant at a level of 0.01. When this is further refined in a one-tailed directional hypothesis, the evidence supports that communities WIBP are more likely to have a higher per capita income than communities WOIBP. This is highly significant at a level of 0.00. The average per capita income for the entire sample (municipalities WIBP and WOIBP) is $21,855, and the median per capita income for the sample is $20,610. Los Alamos is an outlier in the State with a per capita income of $51,179; this is over two times the average per capita income for the sample. This outlier was skewing the sample mean of per capita income of municipalities WOIBP to be greater, as such, Los Alamos was removed from the sample for further analysis of per capita income.

Table 16

T-Test Results for the Means of Characteristic Values for Municipalities WIBP and WOIBP

Characteristic	Hypothesis	Type of Test (No. of Tails)	Result	T-Test alpha Value
Percent of Individuals Employed in Agriculture,	μ (WIBP) ≠μ (WOBP)	Two-tailed	Accept Null	0.26
Forestry, Fishing and Hunting, and Mining	μ (WIBP) > μ (WOBP)	One-tailed	Accept Null	0.13
Percent of Individuals Voted Democrat in 2012 Election	μ (WIBP) ≠μ (WOIBP)	Two-tailed	Accept Null	0.32
(by County)	μ (WIBP) > μ (WOIBP)	One-tailed	Accept Null	0.16
Percent of Individuals Voted Green Party in 2012 Election	μ (WIBP) ≠μ (WOIBP)	Two-tailed	**Reject Null**	**0.06****
(by County)	μ (WIBP) > μ (WOIBP)	One-tailed	**Reject Null**	**0.03***
Population of Municipalities	μ (WIBP) ≠μ (WOIBP)	Two-tailed	Accept Null	0.19
	μ (WIBP) > μ (WOIBP)	One-tailed	**Reject Null**	**0.09****
Percentage of Individuals Born in New Mexico	μ (WIBP) ≠μ (WOIBP)	Two-tailed	Accept Null	0.52
	μ (WIBP) < μ (WOIBP)	One-tailed	Accept Null	0.26
Percentage of Individuals Employed in Manufacturing	μ (WIBP) ≠μ (WOIBP)	Two-tailed	Accept Null	0.52
	μ (WIBP) > μ (WOIBP)	One-tailed	Accept Null	0.26
Per Capita Income (2012)	μ (WIBP) ≠μ (WOIBP)	Two-tailed	Accept Null	0.8
	μ (WIBP) > μ (WOIBP)	One-tailed	Accept Null	0.4
Per Capita Income (2012)	μ (WIBP) ≠μ (WOIBP)	Two-tailed	**Reject Null**	**0.01***
(Excluding Los Alamos)	μ (WIBP) > μ (WOIBP)	One-tailed	**Reject Null**	**0.00***
Median Household Income (2012)	μ (WIBP) ≠μ (WOIBP)	Two-tailed	Accept Null	0.66
	μ (WIBP) > μ (WOIBP)	One-tailed	Accept Null	0.32
Percentage of Individuals with High School Diploma or Equivalent	μ (WIBP) ≠μ (WOIBP)	Two-tailed	Accept Null	0.33
	μ (WIBP) > μ (WOIBP)	One-tailed	Accept Null	0.16
Percentage of Individuals with Bachelor Degree	μ (WIBP) ≠μ (WOIBP)	Two-tailed	Accept Null	0.21
	μ (WIBP) > μ (WOIBP)	One-tailed	**Reject Null**	**0.10****
Percentage of Individuals Speak Spanish	μ (WIBP) ≠μ (WOIBP)	Two-tailed	**Reject Null**	**0.04***
(Speak English Less than Very Well)	μ (WIBP) < μ (WOIBP)	One-tailed	**Reject Null**	**0.02***
Elevation of Municipality	μ (WIBP) ≠μ (WOIBP)	Two-tailed	Accept Null	0.12
	μ (WIBP) > μ (WOIBP)	One-tailed	**Reject Null**	**0.06****

*-Significant at the .05 level; ** Significant at .10

Community Example for Further Analysis

Because the municipality sample size is so small, there is greater variability; in other words, there is a greater risk that differences among the samples are due to chance. As such, this section will explore a prominent example, Santa Fe, in a bit more depth.

Santa Fe. One of the more successful cities in reducing water use, both within New Mexico and nationally, Santa Fe first gained more control over its water resources in 1995 through the purchasing of the Sangre de Cristo Water Company; since purchasing the water utility, the City has taken great strides in planning and implementing solutions to drought, addressing long-term sustainability regarding water resources, and considering both population growth and water equity (McGuckin, 2012). Due to an extreme drought in 2002 and historic surface water lows, Santa Fe decided to address its water future through a series of hydrologic, policy, financial, and planning events from 2001 to 2003 (McGuckin, 2012). During this time, the City both made plans to develop the Buckman Direct Diversion (BDD) to divert, treat, and deliver Rio Grande water to Santa Fe for municipal uses and to raise water rates significantly (McGuckin 2012). A new rate structure was implemented in 2009 which required an 8.2 percent increase per year for each of the fiscal years from 2008-2009 to 2012-2013; additionally, Santa Fe reviewed low-income water use rate structure tiers and currently offers assistance for qualifying households. Interestingly, the Santa Fe utility is not planning on using the BDD water for expansion of service (McGuckin, 2012). In terms of water conservation, Santa Fe has been very successful. Average annual single-family residential use fell by 31 percent from 1998 to 2008, and by 2009, residential use had been reduced to 60 GPCD (McGuckin, 2009).

As discussed prior in this analysis, Santa Fe has a very robust incentive-based pricing system. The rate structure is one of two that implements a traditional seasonal rate; it also signals a price change to encourage use under 10,000 gallons, encourages residents to use less than 10,000 gallons (as exceeding this amount can be costly), and has a significant change in unit price from the first block to the second.

In terms of the statistically significant characteristics in the sample, Santa Fe County had a much higher percentage of Green party voters (0.7) than the sample average (0.3). Santa Fe is also one of the more populated communities in New Mexico with a population of 69,204 (compared to the sample average of 40,050). Santa Fe also has a relatively higher annual per capita income ($34,143) compared to the average sample per capita income ($21,855) and the New Mexico per capita income ($23,749). The City also has a higher percentage of individuals with bachelor degrees with 21.6% of individuals being college educated compared to the sample average (13.1%) and to the State (14.6%). Interestingly, Santa Fe actually has a higher percentage of the population who speaks Spanish in the home and speaks English “less than very well”, with 11.1%; this higher than both the sample average (8.93%) and the percentage for the State (7.9%). Finally, Santa Fe also has a much higher elevation than the sample average with an elevation of 6,756ft compared to 5,347ft.

Discussion and Conclusions

In summary, the results indicate that the majority of the sample municipalities (67%, or 20 out of 30) incorporate some type of IBP structure. However, as seen in Figures 5 and 6, regardless of type of structure, the majority of charges to consumers remain relatively flat (and below $100 dollars per month) until consumers greatly exceed use of 10,000 gallons monthly.

Furthermore, signaled changes in price (the start of the second price block) do not occur until after residents have used over 10,000 gallons in both Raton (25,000 gallons) and Alamogordo (11,221 gallons). That is, a household does not receive any signal to conserve water until an excess of 10,000 gallons is used. However, as seen in Figure 8, while the majority of the second blocks begin well under 10,000 gallons, the change in prices from the first unit price to the last unit price for many municipalities is relatively insignificant (less than 50%).

To put this in perspective, for the estimated average NM household size of 2.63 persons (US Census Bureau, 2014) in year 2012, 10,000 gallons represents an estimated residential 127 gallons per capita per day (GPCD). Again, the World Health organization recommends that people have access to an average of 13.2 to 26.4 gallons of water per day. All consumption needs (hydration) and all hygeine needs (food preparation, laundry, and bathing) are met at 26.4 GPCD (WHO, 2003). Thus, with an estimated 127 GPCD and 10,000 gallons per month, the average New Mexico household member would still use nearly five times (4.8) the amount of water to meet all consumption and sanitation needs. Yet many consumers in the sample municipalities with incentive-based pricing structures are either not receiving any signal to conserve until after 10,000 gallons are used; or, consumers may technically be seeing a change in unit price before 10,000 gallons; however, they are seeing relatively little change in price whether using 10,000 gallons or 25,000 gallons or even 50,000 gallons a month. It would effectively appear that a majority of the incentive-based rate structures evaluated in the analysis appear to be largely for show; the unit price changes either likely do not affect the typical consumer because they occur after 10,000 gallons or average use (e.g., Almogordo and Raton) or the unit price changes are relatively insignificant (e.g., Raton, Rio Rancho, Silver City, Moriarty, Truth or Consequences, Belen, Clovis, and Portales).

There are outliers in this sample. Santa Fe, Las Vegas, and Ruidoso all have much steeper customer charges for water use in excess of 10,000 gallons, relative to the other municipalities. For example, Santa Fe charges an estimated $125.65 for 10,000 gallons; this is nearly three times the sample population average at $43.98. Ruidoso charges 2 times the amount of the sample average at an estimated $96.00 per 10,000 gallons, and Las Vegas charges an estimated $72.88, or 1.7 times the average. At 25,000 gallons, Ruidoso charges an estimated $550; this is just over 4 times the amount of the sample population average ($130.60). Santa Fe charges an estimated $451.45 at 25,000 gallons (3.5 times the average), and Las Vegas charges an estimated $441.88 (3.4 times the average). At 50,000 gallons, Ruidoso charges an estimated $1600; this is 5.5 times the sample average of $292.51. Las Vegas charges an estimated $1056.88 (3.6 times the average), and Santa Fe charges an estimated $994.45 (3.4 times the average). As mentioned prior, Santa Fe exemplifies that a robust incentive-based rate-structure can be very effective in encouraging residential water conservation.

It is also worth noting that only two municipalities incorporate a seasonal rate structure (again, excluding Albuquerque). As discussed prior, climate change will increase temperatures, decrease snowpack, and decrease surface water availability in New Mexico. Municipalities in New Mexico rely on both surface and ground water supplies, and municipal uses are expected to increase during the summer months. As such, municipalities in New Mexico should consider the implementation of seasonal rate structures. Seasonal rate structures can be much easier to monitor and enforce than non-price solutions, such as restrictions of lawn watering (Olmstead & Stavins, 2007).

In addition, the t-test analysis shows that there are statistically significant differences in the characteristics of those municipalities WIBP and WOIBP. Some socio-economic and

political characteristics differed significantly as did origin and language characteristics. As shown, there is a possibility that physical municipality characteristics, such as elevation, may also influence a community's decision to adopt IBP. However, elevation may be serving as a proxy for another characteristic; such as, proximity or access to river surface water, social isolation, economic ties to snowpack tourism (e.g., skiing), etc. The characteristics examined only represent a preliminary investigation into the possible differences between municipalities WOIBP and WIBP.

Given that the adoption of IBP will likely be affected by community and political will, it is important to know what socio-economic and demographic factors may influence a municipality's decision to adopt. Knowing what differences likely exist may aid planners in helping municipalities to develop IBP for conservation in the future by tailoring conservation or rate structure education to the specific needs of municipalities WOIBP.

Both state and federal planners must assess the needs of individual municipalities in moving forward with conservation efforts. On the state level, an important example is helping New Mexico municipalities apply for funding for water infrastructure with the Water Trust Board. The Water Trust Board recommends the funding of projects to the New Mexico Legislature and funds projects through the 2001 Water Project Finance Act and the Water Project Fund. According to the 2001 Water Project Finance Act, five types of projects can be funded: water conservation, treatment, recycling, and reuse projects; flood prevention projects; Endangered Species Act collaborative projects; water storage, conveyance and delivery projects; and watershed restoration and management projects (New Mexico Finance Authority, 2013).

On May 22, 2013, the Water Trust Board amended the application process to better encourage best practices management of water projects and water resources. In order for a Fundable Application to be considered eligible, each of the following conditions must be met and certified: the Safe Drinking Water Act, the Sanitary Projects Act, the State Audit Rule, the Open Meeting Act Resolution, a Certified Operator, and the inclusion of an approved operating budget, water rights, conservation plans, and financial statements (New Mexico Water Trust Board, 2014). The presence of an articulated IBP rate structure can help meet the requirement of having a water conservation plan in place. New Mexico municipalities and relevant planners might take advantage of implementing IBP in order to help secure funding for water infrastructure repair and maintenance.

At the combined state and federal level, an example for planners is the Arizona Water Settlements Act (AWSA). In addition to distributing water resources to Native American tribe members, the AWSA allows New Mexico up to $66 million in non-reimbursable federal support to divert and store up to 14,000 acre feet of high flow surface water from the Gila River, for economic development projects (Oglesby, 2011; OSE, 2005, Oglesby, 2012). The AWSA funds may be used for projects relating to diverting water from the Gila River, or they may be used for "other water utilization alternatives to meet water demands in the Southwest Planning Region" (Oglesby, 2011). Currently, 20 tier 2 final proposals are being reviewed and evaluated for use of funding (NMWASA, 2012). The AWSA has remained a point of contention in New Mexico for several reasons. For one, the development, diversion, and water supply storage projects of the Gila River will require additional fees in taxes and/or water rates for New Mexican residents (i.e., the costs are projected to be greater than $66 million). Second, developing the Gila River will potentially cause ecological damage, which is not only unfortunate for the most biologically

diverse river system in New Mexico, but could also negatively impact the local economies that rely on the river for tourism purposes (Oglesby, 2011).

However, among the 20 tier 2 proposals, 16 do not propose a diversion of the river, but rather a variety of non-diversion solutions including watershed restoration, effluent reuse, water harvesting, ditch lining or reconstruction, forest thinning, and others (NMWASA, 2012). While these proposals may be successful in increasing available supply, the majority still evaluate issues of water scarcity from an engineering or supply-side perspective. Having an inventory of the communities that could implement conservation through IBP and possible different community characteristics may have aided planners in including economic or behavioral solutions in conjunction with or in addition to supply-side non-diversion proposals. While conserving water resources through habitat restoration, ditch lining, water reuse, etc., are all important endeavors, incentivizing municipal water users to use less water is also imperative. As noted earlier, finding additional water supplies will become increasingly difficult, particularly with climate change. Considering the needs and the community differences between communities willing to adopt IBP or other conservation measures, and those not willing, can be a very important tool for conservation planners now and in the future.

In terms of future research, in addition to rate structure type and consumption charges, the current use of all other demand-side conservation strategies should be inventoried in NM. A broader set of physical, political, economic, and social characteristics should also be expanded upon and evaluated. While costly in terms of time and effort, the sample of communities could be expanded, which might require visiting smaller communities whose information is unlikely to be easily publicly available, or posted on the internet, or who may not have full time staff devoted to municipal water programs. Further, it is recommended that this preliminary

cataloging and statistical analysis be expanded to develop a full regression-based model that relates the probability that a municipality adopts IBP, or other demand-side measures, with a broader set of characteristics from a fuller sample of communities (which might not be restricted to NM). Both developing a predictive model of municipality characteristics and inventorying conservation measures across the State (both IBP and other strategies) would be a helpful tool for municipalities, planners, environmental activists, politicians, and stakeholders in managing water in New Mexico, and more broadly in the Southwest. Additionally, it is recommended that further research incorporates the analysis of residential water demand and the efficacy of current incentive-based water rate structures. It is hoped that this professional project spurs additional investigation into this critical area.

References

Albuquerque Bernalillo County Water Utility Authority (ABCWUA). (2014). *Learning to Save Water*. Retrieved June 15, 2014, from http://www.abcwua.org/education/consumers.html

Borisova, T., Asci, S., Unel, B., & Rawls, C. (2008). *Conservation Pricing for Residential Water Supply*. Gainesville: Food and Resource Economic Department University of Florida.

Carter, D., & Millon, J. (1999). Average Costs vs. Marginal Oppotunity Cost Pricing for Water Service: Timing Issues for Pricing Reform. *Food and Resource Economics*, 98-119.

Elnaboulsi, J. (2008). An Optimal Pricing Approach for the Control of EU Urban Pollution: Implementation of the Urban Wastewater Treatment Directive. *CRESE, UniversitÈ de Franche-ComtÈ*, 1-37.

Federal Reserve Bank of Minneapolis. (2014). *What is a Dollar Worth?* Retrieved June 15, 2014, from Community & Education: http://www.minneapolisfed.org/

Field, B. C. (2008). *Natural Resource Economics: An Introduction.* Waveland Press Inc.

Food and Agriculture Organization of the United Nations. (2004). *Economics of Water Allocation.* Natural Resources Management and Environment Department.

Gutzler, D. (2012). Climate and Drought in New Mexico. In D. Brookshire, H. Gupta, &. O. Matthews, *Water Policy in New Mexico:Addressing the Challenge of an Uncertain Future* (pp. 56-68). New York City: RFF Press.

Gutzler, D., & Robbins, T. (2010). Climate Variablity and Projected Change in the Western United States: Regional Downscaling and Drought Statistics. *Springer*, 1-15.

London, L. (2010, December 8). City Raising Water Rates. *Alamogordo News.*

Longworth, J. W., Valdez, J. M., Magnuson, M. L., & Richard, K. (2013). *New Mexico Water Use by Categories.* Santa Fe: New Mexico Office of the State Engineer Water Use and Conservation Bureau.

MacDonald, G. M. (2010). Water, Climate Change, and Sustainability in the Southwest. *Proceedings of the National Academy of Sciences*, 21256-21262.

McGuckin, J. T., Kelly, S., & Harwood, K. (2012). The Pricing and Conservation of Water in Urban Areas. In D. Brookshire, H. Gupta, & O. P. Matthews, *Water Policy in New Mexico:Addressing the Challenge of an Uncertain Future* (pp. 203-214). New York City: RFF Press.

New Mexico Office of the State Engineer. (2005). *Colorado River Basin*. Retrieved April 28, 2014, from Office of the State Engineer: http://www.ose.state.nm.us/isc_colorado_gila_sanfran_committee.html

New Mexico Water Trust Board. (2013, May 22). *New Mexico Water Trust Board Application Process 2014.* Retrieved April 1, 2014, from file:///C:/Users/UNM/Downloads/2014%20App%20-%20Sequence%20of%20Events%20word%20version%207-2013.pdf

NMAWSA. (2012). *NM AWSA Proposals*. Retrieved April 29, 2014, from NM AWSA: http://nmawsa.org/

Oglesby, A. (2011). *Implementation of the Arizona Water Settlements Act in New Mexico: An Overview of Legal Considerations.* The Gila Conservation Coalition.

Oglesby, A. (2012). Implementation of the Arizona Water Settlements Act in New Mexico: An Overview of Legal Considerations. *Natural Resources Journal*, 215-235.

Olmstead, S. M., & Stavins, R. N. (2007). *Managing Water Demand.* Massachusetts: A Pioneer Institute White Paper.

Olmstead, S. M., Hanemann, M., & Stavins, R. (2005). *Do Consumers React to the Shape of Supply? Water Demand under Heterogenous Price Structures.* Washington, D.C.: Resources for the Future.

Politico. (2012, November 19). *2012 New Mexico Presidential Results*. Retrieved January 25, 2014, from U.S. Election Maps: http://www.politico.com/2012-election/results/president/new-mexico/

Price, J., Chermak, J., & Felardo, J. (2014). Low-flow Appliances and Household Water Demand: An Evaluation of Demand-side Management Policy in Albuquerque, New Mexico. *Environmental Management*, 37-44.

Rio Rancho Water Conservation Office. (2013). *Water Usage Data*. Retrieved June 15, 2014, from Utilities Operations Division: http://www.ci.rio-rancho.nm.us/index.aspx?NID=180

Save Water Santa Fe. (2014). *Water Conservation*. Retrieved June 15, 2014, from Save Water Santa Fe: Conserve, Educate, Lead: http://savewatersantafe.com/

Thomson, B. (2012). Water Resources in New Mexico. In D. Brookshire, H. Gupta, &. O. Mathews, *Water Policy in New Mexico: Addressing the Challenge of an Uncertain Future* (pp. 25-55). New York City: RFF Press.

Trochim, W., & Donnelly, J. (2007). *The Research Methods Knowledge Base, Third Edition.* New York : Cornell University.

Tsishchanka, K. (2010). *Exponential Growth and Decay.* New York City: New York University.

U.S.Global Change Research Program. (2014). *National Climate Assesment.* D.C.: Federal Advisory Committee.

United States Census Bureau. (2013). *American Fact Finder.* Retrieved 2014, from American Community Survey Five-Year Estimates: http://factfinder2.census.gov/faces/nav/jsf/pages/index.xhtml

US Environmental Protection Agency (EPA). (2012, September 14). *Pricing Structures*. Retrieved January 12, 2014, from Water: Sustainable Infrastructures: http://water.epa.gov/infrastructure/sustain/pricing_structures.cfm

Western Water Resource Advocates. (2006). *Water Rate Structures in New Mexico: How New Mexico Cities Compare Using this Important Efficiency Tool.*

Wild, L., Chambers, V., King, M., & Harris, D. (2012). *Common Constraints and Incentive Problems in Service Delivery.* London: Overseas Development Institute.

World Health Organization. (2003). *Domestic Water Quantity, Service, Level, and Health.* Geneva: World Health Organization.

Zetland, D. (2011). *The End of Abundance: Economic Solutions to Water Scarcity.* Aguanomics Press.