BEFORE THE
STATE OF NEW JERSEY
BOARD OF PUBLIC UTILITIES

IN THE MATTER OF THE PETITION OF
NEW JERSEY-AMERICAN WATER COMPANY, INC.
FOR APPROVAL OF INCREASED TARIFF RATES AND
CHARGES FOR WATER AND WASTEWATER SERVICE, AND
OTHER TARIFF MODIFICATIONS

BPU Docket No. WR1912____

Direct Testimony of

GREGORY P. ROACH

Exhibit P-9

NEW JERSEY-AMERICAN WATER COMPANY, INC.

Direct Testimony of
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NEW JERSEY-AMERICAN WATER COMPANY, INC.

1. Q. Please state your name and business address.

A. My name is Gregory P. Roach. My business address is 555 East County Line Road, Suite 201, Greenwood, Indiana 46143.

2. Q. By whom are you employed and in what capacity?

A. I am employed by American Water Works Service Company, Inc. (the “Service Company”) as Manager of Revenue Analytics. My responsibilities include leading the Revenue Analytics group, whose main area of focus is the analysis and forecasting of system delivery, customer usage and revenue for the Service Company affiliates, including New Jersey-American Water Company, Inc. (“NJAWC” or the “Company”).

3. Q. What are your responsibilities in this position?

A. I manage and direct a team of financial and regulatory analysts whose responsibilities are to analyze and project customer water usage, system delivery, customer counts and water and sewer sales revenues for each of the American Water affiliate companies. As such, our group supports both the regulatory and financial functions of the Service Company organization and the affiliated American Water companies.

4. Q. Please describe your educational background and professional associations.

A. I graduated from Indiana University in 1980 with a Bachelor of Arts degree in Economics and Political Science. I graduated from Butler University in 1982 with a Master's Degree in Economics. I am a past member of the National Association of Business Economist and the American Economic Association.

5. Q. Please detail your business experience.

A. I have over 25 years of experience working in the electric, gas and water utility sectors as both a consultant and utility employee. I began my career with Public Service Indiana (now a part of Duke Energy) in January of 1980, continuing as an economist for a large consulting firm and a regulatory consultant through my own firm, and then joining the Service Company in 2011. The details of my professional experience are provided in Appendix A to this testimony.

6. Q. Have you previously testified before the New Jersey Board of Utilities, other regulatory agencies, or civil courts related to utility matters?

A. Yes, I provided testimony in the 2017 NJAWC rate case before the New Jersey Board of Public Utilities ("BPU" or the "Board") BPU Docket No. WR17090985. Additionally, I have provided testimony before the following regulatory bodies: the Indiana Utility Regulatory Commission, the Missouri Public Service Commission, the Illinois Commerce Commission, the Public Service Commission of New York, the Pennsylvania Public Utility Commission, the Public Utilities Commission of Ohio, the Iowa Utilities Board, the Public Service Commission of West Virginia, the Public Service Commission of Louisiana, the Council of the City of New Orleans, the Virginia State Corporation Commission, the Public Utility Commission of Texas, the Arkansas Public Service Commission, the Common

Pleas Court of Ohio, the Illinois Commerce Commission and the Federal Energy Regulatory Commission.

SCOPE OF TESTIMONY

7. Q. What is the purpose of your testimony in this proceeding?

A. My direct testimony supports the direct testimony of Mr. Charles Rea regarding NJAWC's Post-Test Year sales and revenue adjustments, and the direct testimony of Mr. John Watkins related to the need for a revenue stabilization mechanism ("RSM"). As occurs for most public utilities with service to residential customers, NJAWC's sales and resulting revenues are subject to seasonal and annual swings based on climatic changes that occur from month to month and year to year. As Mr. Watkins will testify, an RSM would allow NJAWC to stabilize its revenues from the effects of these climatic induced swings in sales and revenues. Further, NJAWC has experienced residential declining usage per customer since approximately the year 2003, and my analysis indicates it will continue to experience residential declining usage per customer for the foreseeable future. My testimony discusses the analyses we have performed that identify and define this declining usage historically and demonstrates that the trend of declining usage will continue beyond the Test Year. These analyses show there is a continuing annual decline in residential water use across all NJAWC districts averaging a combined approximate -1,203 gallons per customer per year ("gpcy"), or approximately -3.295 gallons per customer per day ("gpcd"). Furthermore, the ongoing and significant nature of the residential declining usage trend offers additional justification for the creation and application of a RSM that will allow NJAWC the opportunity to attain the revenues used to set rates in this proceeding ("Authorized Revenue").

8. Q. Have you prepared, or caused to be prepared, schedules in support of the Company's application to increase rates?

A. Yes, I am sponsoring the following schedules:

- Schedule GPR-1: AWK Residential Usage Trend 2007-2016;
- Schedule GPR-2: US Water Fixture Specifications;
- Schedule GPR-3: Reasonableness of NJAWC Residential Consumption Decline;
- Schedule GPR-4: State of New Jersey - Housing Stock Vintage;
- Schedule GPR-5: Effect of Tornado Rebuild on Water Usage; and
- Schedule GPR-6: Authorized and Actual Revenue & Water Sales.

9. Q. Were each of Schedules GPR-1 through GPR-6 prepared by you or under your direction and supervision?

A. Yes.

10. Q. What were the sources of the data used to prepare Schedules GPR-1 through GPR-6?

A. The data used to prepare these exhibits was obtained from the Company's SAP system, the US Bureau of Economic Analysis, the US Bureau of Labor Statistics, the US Bureau of the Census and the National Oceanic and Atmospheric Administration.

11. Q. Do Schedules GPR-1 through GPR-6, inclusive, accurately summarize such data and the results of analyses using such data?

A. Yes, they do.

12. Q. Have you prepared a glossary of the technical and statistical terms used in your testimony?

A. Yes, a Glossary of Technical and Statistical Terms is provided as Appendix B to my testimony.

13. Q. Please summarize your testimony.

A. My testimony presents the normalized usage for residential and commercial customers, which is subsumed in the econometric models developed for those customer classes. In addition to determining weather-normal levels of usage, the models also quantify and estimate the potential term and impact of the declining usage trend of NJAWC's residential customers. My analysis concludes the following:

1. There is a continuing annual decline of residential water use across all NJAWC districts averaging 1,203 gallons per customer.
2. The revised mandated efficiency standards for water fixtures will support the existing trend of declining usage into the foreseeable future.

3. Similar water use trends as are seen with NJAWC are occurring within affiliated American Water systems.
4. Empirical analysis indicates that the NJAWC use trend:
   a. Is projected to continue for up to the next 29 years.
   b. Is confirmed by the Joplin case study that illustrates that a significant reduction in usage per household (-8.4%) can rapidly occur due to water fixture replacement. This reduction is an amount equal to approximately an entire month's level of water sales.
   c. Is also confirmed by the permanent residential water use reductions that have endured following removal of mandatory state water use restrictions during the drought of 2016-2017.

NORMALIZED USAGE AND FORECASTS

14. Q. Do seasonal factors affect residential and commercial usage?

A. Yes. Outdoor usage by most residential customers and many commercial customers is seasonal. Generally, in the residential customer class, outdoor usage during the summer season includes discretionary usage including turf and landscape irrigation, car washing, swimming pool fills, and similar such activities. Many commercial customers also exhibit seasonal usage patterns similar to residential customers, although the class as a whole is somewhat less affected. Short-term summer weather patterns will influence outdoor water use; for instance, turf irrigation decreases during a rainy period and increases during a dry period. These weather-related fluctuations in usage can mask underlying trends that occur on a monthly and annual basis that require a weather normalization approach to residential customer usage modeling and forecasting to identify and capture long-term customer usage trends.

15. Q. Did you make a discrete weather normalization in this case to account for such seasonal weather adjustments?

A. No. As I explain in the succeeding sections concerning the regression analysis, due to the addition of two variables – cooling degree days and precipitation – to the regression models, we capture the effects of weather and need not make a separate adjustment to normalize revenue for weather, such as was made in the last case.

16. Q. Please describe your forecasting analysis.

A. I examined historical and forecasted sales by analyzing regression analyses for the Residential and Commercial classes and was able to model residential and commercial usage successfully using regression analysis. The Industrial, Sale for Resale and Other Public Authority classes' water usage, however, is significantly more heterogeneous as compared to NJAWC Residential and Commercial customer usage. Hence, it is difficult to apply statistical techniques to these classes as usage varies greatly from customer to customer in response to climatic conditions as well as efficiency improvements in water fixtures and appliances. In many cases, the use of water as part of a specific production process, such as with Industrial customers, tends to obscure the impact of either climate or water use efficiency standards on specific customers' usage patterns. Due to the heterogeneous customer mixtures of these groups, we have chosen to use a 36-

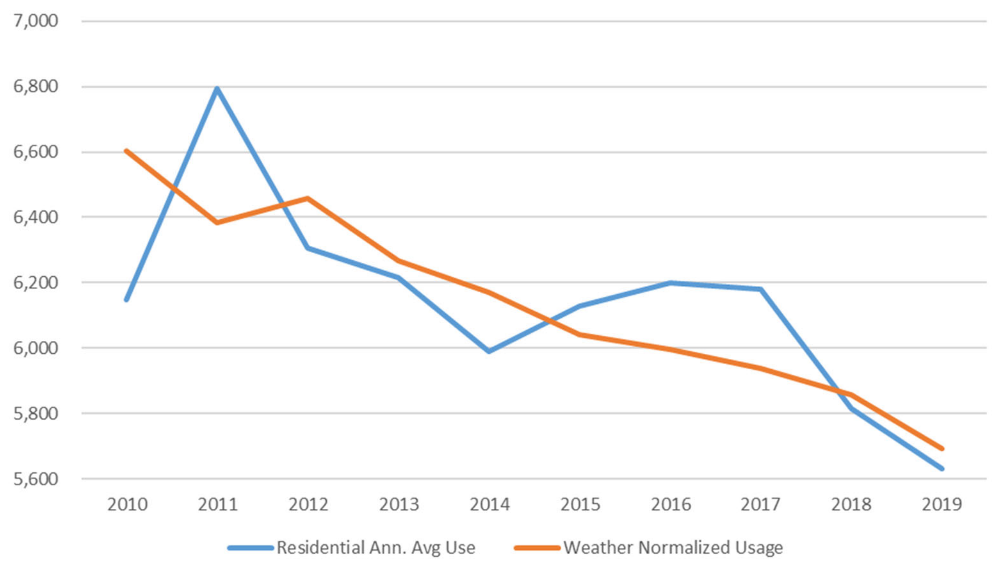
month average to forecast their future usage as described in the testimony of Mr. Charles Rea. The discussion that follows, therefore, focuses on the forecasted usage in the Residential and Commercial Classes. Mr. Rea also translates that declining usage into a revenue forecast for the Residential and Commercial classes based on, among other things, forecasted numbers of customers in that class.

RESIDENTIAL USAGE REGRESSION ANALYSIS

17. Q. Please describe the analytical methodology you employed related to NJAWC residential usage trends?

A. Our analysis examined the annual average of monthly per customer consumption by NJAWC's residential customers over the past ten years. Presented in Figure GPR-1 is the residential usage per customer data that formed the basis of the analysis. To this data, we applied standardized statistically linear regression analysis a) to estimate the residential customer usage trend over time and b) to normalize the residential customer usage data for the potential impact of weather. We analyzed the impact of time, cooling degree-days (CDD), days with 90 degree maximums, and precipitation (precip) as independent explanatory variables for the trend of residential usage per customer over the time series analyzed. Figure GPR-1 illustrates the residential average usage per customer trend over that same time frame.

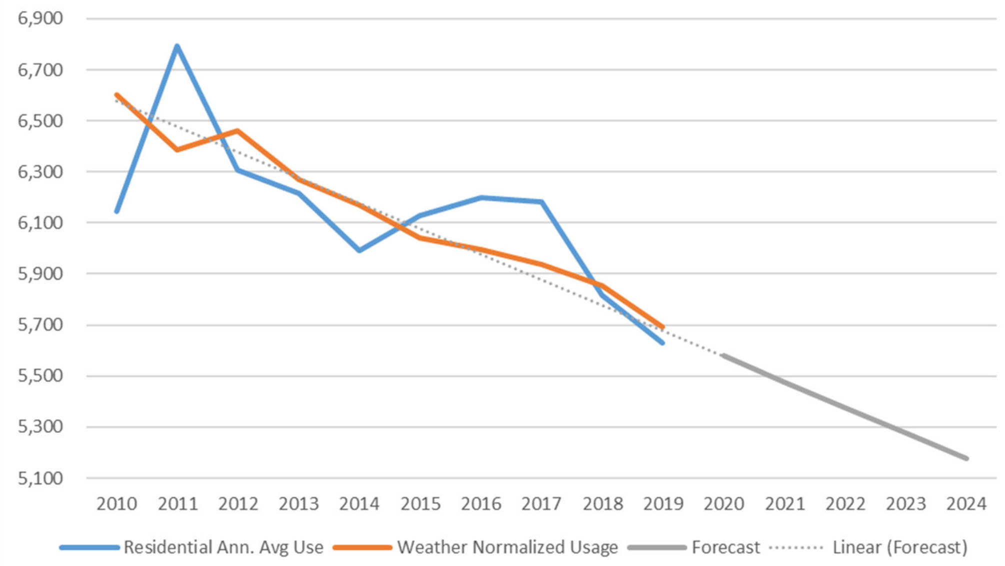
Figure GPR-1
NJAWC Residential Annual Average Usage Per Customer
Gallons Per Customer Month
2010-2019



18. Q. What are the results of your analysis?

A. The results of our linear regression analysis based on the explanatory variables time, precipitation and cooling degree days (July – Sept) indicate that residential usage per customer is declining at a rate of approximately 1.76% or 1,203 gallons per customer per year, which is equivalent to 3.30 gpcd. Figure GPR-2 graphically illustrates that residential average usage trend.

Figure GPR-2
NJAWC Residential Annual Average Usage Per Customer
Gallons Per Customer Month
2010-2024



My analysis employed the use of numerous regression models exploring varying combinations of potential explanatory variables including time and various climatic variables. Table GPR-1 below summarizes the types of models that we evaluated and their relative statistical merits. As delineated in Table GPR-1, all but two of the models resulted in a reasonable R-Square, meaning that each of the models explains in excess of 75% of the variance in NJAWC residential usage per customer over the period of 2010-2019. Three of the climatic variables – annual cooling degree days, precipitation and days with Maximums in excess of 90 degrees Fahrenheit were statistically significant or resulted in logically relevant explanatory variables for NJAWC residential average usage as delineated by the t-statistic results. For each of the other weather variables, the regression coefficients could not be estimated with anything less than a +/- 50% error or resulted in an illogical relationship with residential average usage (such as increases in precipitation illogically producing additional residential average usage when common knowledge would predict that water usage increases during periods of relatively lower precipitation). Hence variables with a positive coefficient related to precipitation and usage are both illogical from anecdotal experience and are statistically unsupportable. As a result, inclusion of these climatic variables in the final model was statistically unsupportable. Table GPR-1 illustrates the relevant statistical results of the models evaluated.

In summary, I have chosen to rely on the NJAWC residential average use model defined by the statistically significant explanatory variables time and the climatic explanatory variables; annual cooling degree days and precipitation (July – Sept) due to this model's highest R-Square and F-Statistic with minimizing the error of the estimate as compared to all the other residential models evaluated.

Table GPR-1
New Jersey American Water
Residential Usage Per Customer Model Summaries

					T-Statistic								
Model	Period Ending	R-2	F-Statistic	Durbin-Watson	Day	CDD	JLSRain	MORain	DX90	TMAX	TAVG	Lag	Custs
2017 Case													
NJAWC System	Dec	0.962			-13.25								566k
A-1 (SA1)	Dec	0.988			-23.6								347k
A-3 (SA2)	Dec	0.887			-7.31								206k
A-5 (Manville & 1-D)	Dec	0.769			-4.26								4.3k
A-8 (Southampton)	Dec	0.775			-4.91								0.4k
A-10 (Pennsgrove)	Dec	0.883			-7.2								4.0k
2019 Case													
Day, CDD, MORain	June	0.841	6.618	1.995	-2.469	2.689		-2.278				0.288	595k
Day, CDD, JLSRain	June	0.858	7.545	1.945	-2.870	2.797	-2.528					0.677	595k
Day, DX90	June	0.744	10.157	1.804	-3.759				2.505				595k
Day, TMAX	June	0.651	6.524	2.922	-3.358					1.656			595k
Day, TAVG	June	0.613	5.532	2.642	-3.149						1.334		595k

19. Q. Did you make any adjustments to your final model?

A. Yes, I have. The initial modeling reported a Durbin-Watson statistic of 1.823, which indicates the presence of autocorrelation of the error terms. I employed a standard statistical process to eliminate any potential coefficient estimate bias.

20. Q. Does your model imply that the mere passage of time is the major driver of declining use per customer?

A. No. Time simply captures the range of conservation effects, such as the installation of more water efficient fixtures and appliances that occur over time. Of course time, itself, is of no consequence, but it is a powerful variable because it is the medium for capturing the conservation effect. Further, as the models indicate, time is a very powerful statistical explanatory variable, as indicated by the high R-squared values. With the addition of the cooling degree day and precipitation variables in the final model, I am able to normalize residential average usage per customer for climatic variations that occur from year to year. Later in my testimony, I will describe some of the reasons for the declining usage per customer, explain how they affect consumption and show that this trend will not diminish any time soon. Suffice it to say at this point that, since approximately 2003, residential usage has declined on a per-customer basis in the NJAWC service territory and the slope, or change rate, of residential decline has accelerated since the passage of more stringent water fixture and appliance usage regulations in the 2000s. The decline is attributable to several key factors, including but not limited to the following: increasing prevalence of low flow (water efficient) plumbing fixtures and appliances in residential households; customers' conservation efforts; conservation programs implemented by the federal government, state government, NJAWC and other entities. Accordingly, this trend of declining use per residential customer should be employed to forecast residential usage though the end of NJAWC's Post-Test Year adjustment period.

21. Q. How does the residential usage modeling you are sponsoring in this case compare to the analysis you sponsored in NJAWC'S prior rate case?

A. The analyses in the two cases are similar in terms of methodology. The principle difference is that in the prior case, we separately normalized for weather based on a 10-year average. In this case, by the addition of two additional, weather-related variables to the regression analyses, (i.e., cooling degree days and precipitation) we no longer have to normalize for weather separately. The 2019 analysis continues to demonstrate that time is the main statistically significant explanatory variable but is also influenced by climatic indices. I found one modification to the 2017 analysis was warranted, however: due to billing and timing differences, using the bifurcated approach was complicated by billing data or events that may bleed into or outside of the "base period." Further, my previous analysis was complicated by the impact of the Polar Vortex influence during the winter of 2014. So, I determined that it was appropriate not to bifurcate the residential usage data into base (non-discretionary non-weather sensitive usage) and non-base (discretionary weather sensitive usage) water usage components in order to eliminate the possible impact of timing in billing, better simulate the impact of climatic conditions on usage, and rely on annual average usage for the analysis used in this case.

22. Q. How did the decision not to use a bifurcated analytical approach compare to NJAWC's 2017 rate case analysis?

A. Table GPR-2 illustrates the difference in results from the residential trend analytics I am sponsoring in this proceeding as compared to the approach used in the previous

Table GPR-2
New Jersey American Water
Residential Usage Per Customer Model Summaries

Model	Period Ending	Gal/Cust/Yr	% Annum	Custs
2017 Case				
NJAWC System	Dec	-1,080	-1.54%	566k
A-1 (SA1)	Dec	-912	-1.28%	347k
A-3 (SA2)	Dec	-1,344	-1.88%	206k
A-5 (Manville & 1-D)	Dec	-648	-1.14%	4.3k
A-8 (Southampton)	Dec	-1,188	-2.43%	0.4k
A-10 (Pennsgrove)	Dec	-1,416	-2.37%	4.0k
2019 Case				
Day, CDD, JLSRain	June	-1,203	-1.76%	595k

2017 NJAWC rate case. To summarize that table, the change in analytical approach results in an annual -0.22% or -123 gpcy difference in usage per residential customer as compared to the approach and period analyzed for the 2017 NJAWC rate case. The differences in the results of this analysis from those filed in the 2017 case are due mainly to incorporating and modeling the influence of climatic factors, particularly the impact of the 2014 data point, to our previously modeling results.

23. Q. Setting aside the weather normalization analysis you have performed for residential usage in this case and focusing on the actual NJAWC average residential usage per customer per month since 2016, what has been the trend of that usage?

A. Table GPR-2A shows that even with the influence of weather fluxuations impacting the actual data, residential average usage per month has been declining by 190 gpcm or -3.1% per annum over that time period.

Table GPR-2A
NJAWC Residential Customers
Average Usage Per Month
2016-2019

Year	Res Usage gpcm	Difference Gallons	Difference %
2016	6,200		
2017	6,181	-19	-0.3%
2018	5,815	-365	-5.9%
2019	5,631	-184	-3.2%
Average		-190	-3.1%

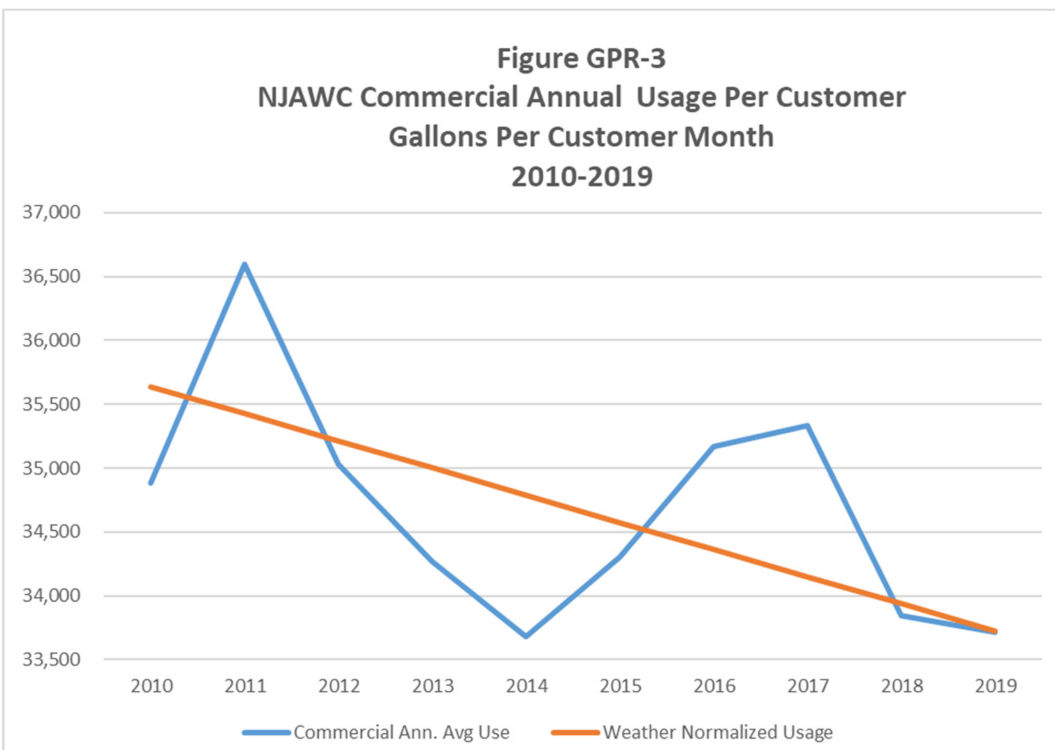
COMMERCIAL USAGE REGRESSION ANALYSIS

24. Q. Have you performed a similar analysis of commercial usage for NJAWC?

A. Yes, I have. Using the same regression type analysis described above to forecast NJAWC system-wide residential customer usage per customer, I have performed an analysis of the trend for commercial usage per customer inclusive of all NJAWC commercial customers.

25. Q. Please describe the water use trend among NJAWC's commercial customers.

A. Similar to the residential class, since the early 2000s, commercial usage has declined on a per-customer basis in the NJAWC service territory. The slope, or change rate, of residential decline has accelerated since the passage of more stringent water fixture and appliance usage regulations in the 2000s. As with the residential class, the decline is attributable to several key factors, including but not limited to the following: increasing prevalence of low flow (water efficient) plumbing fixtures and appliances in commercial establishments; customers' conservation efforts; conservation programs implemented by the federal government, state government, NJAWC and other entities; and price elasticity. The trend of this decline in Commercial usage per customer is illustrated in Figure GPR-3 below.

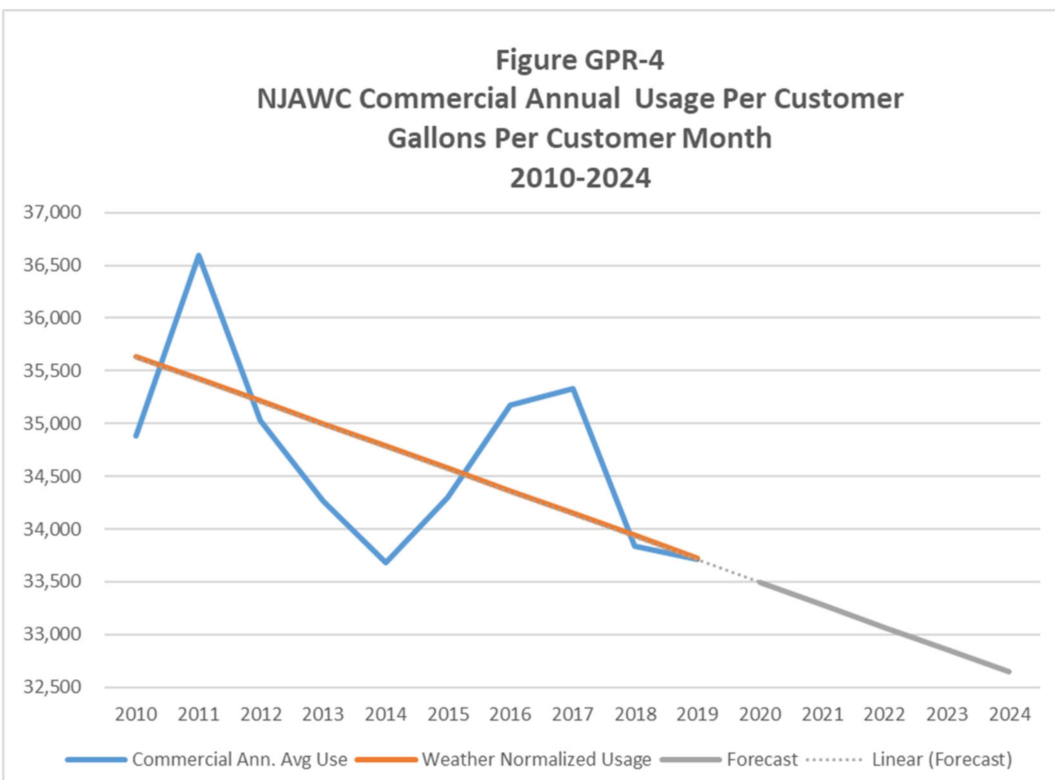


26. Q. Do seasonal factors affect commercial usage?

A. Yes. Similar to the residential class, outdoor usage by many commercial customers is seasonal and the regression analysis also included climatic variable in addition to the time variable that captures conservation. Also, just as with the residential class, these seasonal factors are captured by our models which do not require a separate step to normalize for weather variability.

27. Q. What are the statistical and forecast results of your analysis?

A. As graphically illustrated in Figure GPR-4 below, the results of our linear regression analysis based on the explanatory variables time, annual cooling degree days and precipitation (June – Sept) indicate that commercial usage per customer is declining at a rate of approximately -0.69% or -2,774 gallons per customer per



year, which is equivalent to -7.6 gallons gpcd. Figure GPR-4 graphically illustrates that residential average usage trend.

As with the residential analysis, I employed the use of numerous regression models exploring varying combinations of potential explanatory variables including time and various climatic variables. Table GPR-3, below, summarizes the types of models that we evaluated and their relative statistical merits. As delineated in Table

Table GPR-3
New Jersey American Water
Commercial Usage Per Customer Model Summaries

					T-Statistic									
Model	**Period Ending**	**R-2**	**F-Statistic**	**DW**	**Day**	**CDD**	**JLSRain**	**JSRain**	**MSRain**	**DX90**	**TMAX**	**TAVG**	**Lag**	**Custs**
2017 Case														
NJAWC System	Dec	0.554			-2.41									41k
A-1 (SA1)	Dec	0.828			-2.64									29k
A-3 (SA2)	Dec	0.761			-3.85									12k
2019 Case														
Day, CDD, MSRain	June	0.773	6.803	1.640	-3.066	3.464			-2.883					
Day, CDD, JSRain	June	0.808	5.257	1.865	-2.400	3.250		-2.982					0.973	45k
Day, DX90	June	0.727	9.325	1.456	-2.582					3.484				45k
Day, TMAX	June	0.486	3.315	2.295	-2.027						1.780			45k
Day, TAVG	June	0.466	3.060	2.203	-1.960							1.670		45k

GPR-3, all but two of the models resulted in a reasonable R-Square, meaning that each of the models explains in excess of 75% of the variance in NJAWC commercial usage per customer over the period of 2010-2019. Similar to the residential modeling, three of the climatic variables – annual cooling degree days, precipitation and days with Maximums in excess of 90 degrees F were statistically significant or resulted in logically relevant explanatory variables for NJAWC residential average usage as delineated by the t-statistic results. For each of the other weather variables, the regression coefficients could not be estimated with anything less than a +/- 50% error or resulted in an illogical relationship with commercial average usage (such as increases in precipitation illogically producing additional commercial average usage when common knowledge would predict that water usage increases during periods of relatively lower precipitation). Hence variables with a positive coefficient related to precipitation and usage are both illogical from anecdotal experience and are statistically unsupportable. As a result, inclusion of these climatic variables in the final model was statistically unsupportable. Table GPR-3 illustrates the relevant statistical results of the models we evaluated.

In summary, I chose to rely on the NJAWC commercial average use model defined by the statistically significant explanatory variables time and the climatic explanatory variables; annual cooling degree days and precipitation (June – Sept) due to this model's highest R-Square and F-Statistic with minimizing the error of the estimate as compared to all the other commercial models evaluated.

28. Q. How did the decision not to use a bifurcated analytical approach compare to the 2017 rate case commercial class analysis?

A. Table GPR-4 illustrates the difference in results from the commercial trend analytics I am sponsoring in this proceeding as compared to the approach used in the 2017 NJAWC rate case. To summarize that table, the change in analytical approach results in an annual -0.31% or -1,178 gpcy difference in usage per commercial customer as compared to the approach and period analyzed for the 2017 NJAWC rate case for all NJAWC commercial customers. The differences in the results of this analysis from those filed in the 2017 case are due mainly to incorporating and modeling the influence of climatic factors, particularly the impact of the 2014 data point, to my previous modeling results.

Table GPR-4
New Jersey American Water
Commercial Usage Per Customer Model Summaries

Model	Period Ending	Gal/Cust/Yr	% Annum	Custs
2017 Case				
NJAWC System	Dec	-1,596	-0.38%	41k
A-1 (SA1)	Dec	-1,140	-0.30%	29k
A-3 (SA2)	Dec	-3,264	-0.68%	12k
2019 Case				
Day, CDD, JSRain	June	-2,774	-0.69%	45k

DECLINING WATER CONSUMPTION

29. Q. You mentioned that the declining usage per customer experience of NJAWC is not unique among the companies of the American Water system. Have you studied water consumption trends for other American Water subsidiaries?

A. Yes, I have.

30. Q. Are the results of your analysis of NJAWC residential customers' usage consistent with the results of your analyses in other states?

A. Yes, they are consistent. I have studied the residential consumption patterns for other American Water state operating systems located in climates and geographies similar to New Jersey. The trend experienced by NJAWC is very similar to the trends experienced in other affiliate states including Missouri, Pennsylvania, Illinois and Indiana. The results of my analysis are shown on Schedule GPR-1, which illustrates that states in the American Water footprint have experienced a decline in residential consumption per customer averaging approximately -2.0% per year over the last 10 years. The estimated NJAWC system-wide reduction in residential customer usage per year of -1.76% falls close to the mean, appears reasonable, and is well within the bounds of the comparable rates of decline experienced by similar states in the American Water footprint.

31. Q. Is this trend being observed across the industry, beyond NJAWC and other American Water companies?

A. Yes. According to the 2010 Water Research Foundation ("WRF") report, "many water utilities across the United States and elsewhere are experiencing declining water sales among households."[1] The report further states: "A pervasive decline in household consumption has been determined at the national and regional levels.[2]

32. Q. What is causing the decline in residential customers' usage?

A. Several factors drive the decline in residential customers' usage. These factors include the incremental introduction of low-flow fixtures and appliances, new regulations that lead to further reductions in fixture flow-rates, conservation programs and public initiatives that have led to greater consumer water conservation awareness.

[1] Coomes, Paul et al., North America Residential Water Usage Trends Since 1992 – Project #4031, page 1 (Water Research Foundation, 2010).
[2] *Id.*, at xxviii.

33. Q. Please explain what you mean by the introduction of low-flow fixtures and appliances.

A. Plumbing fixtures such as toilets, showerheads, and faucets available to consumers today are more water-efficient than were those fixtures manufactured in the past. Similarly, appliances such as dishwashers and washing machines are also more water-efficient. When a customer replaces an older toilet, washing machine, or dishwasher with a new unit, the new unit will almost certainly use less water than the one it replaced. Similarly, construction of new homes or business establishments result in the installation of water efficient fixtures meeting new, more efficient, regulatory standards. Further, every time a customer remodels or installs new appliances in his or her kitchen, bathroom or laundry room, he or she will consume less water in the future.

34. Q. How much water do the new fixtures and appliances save?

A. The Energy Policy and Conservation Acts of 1992 and 2005 ("EPAct92" and "EPAct05," respectively) mandated the manufacture of water-efficient toilets, showerheads and faucet fixtures. For example, a toilet manufactured after 1994 must use no more than 1.6 gallons per flush, compared to a pre-1994 toilet, which typically used from 3.5 to 7 gallons per flush. In fact, toilets using only 1.28 gallons per flush or less are becoming more prevalent in the marketplace. Replacing an old toilet with a new one, therefore, can save from 2 to nearly 6 gallons per flush. The United States Environmental Protection Agency ("USEPA") estimates that there are more than 220 million toilets in the United States, and that approximately 10 million new toilets are sold each year for installation in new homes and businesses or replacement of aging fixtures in existing homes and businesses.

The Energy Independence & Security Act of 2007 ("EISA"), which established stringent efficiency standards for dishwashers and washing machines has further reduced indoor water consumption. Dishwashers manufactured after 2009 and washing machines manufactured after 2010 must use 54% and 30% less water, respectively. All other factors being equal, a typical residential household in a new home constructed in 2015, with water efficient toilets, washing machines, dishwashers and other fixtures, uses approximately 35% less water for indoor purposes than a non-retrofitted home built prior to 1994. Schedule GPR-2, pages 1-3 provides additional detail about the expected impact of water efficiency measures on residential water consumption.

35. Q. Please elaborate on other factors contributing to the continued decline in residential water consumption patterns.

A. Programs to raise customer awareness and interest in the benefits of conserving water and energy continue to increase. For example, WaterSense is a USEPA voluntary partnership program that seeks to protect the future of our water supply by offering people a simple way to use less water with water-efficient products, new homes, and services. Schedule GPR-2, pages 4-12 detail these program's specifications as well as others. This listing is a reproduction of the Alliance for Water Efficiency Water Products Standard Matrix, which was last updated in March 2010.

As awareness of water and energy efficiency increases, customers may decide to replace a fixture or appliance even before it has broken. Additionally, customers may further reduce consumption by changing their household water use habits in other various ways. Our analysis of declining usage per customer indicates that the Company's residential customers will continue to reduce their usage by approximately 3.3 gallons per customer per day on average. A 3.3 gallon per day decrease can be achieved by subtle changes in customer behavior. For instance, here are some ways a customer can reduce 3.3 gallons per day:

- Taking a shower that is 1 minute shorter;
- Flushing a low-flow toilet fixture instead of an older toilet just once per day;
- Running the dishwasher 5 times per week instead of 7; or
- Turning off the water for approximately 1 minute while brushing their teeth.

36. Q. Do you expect the NJAWC customer declining usage trend to continue in the future?

A Yes. Water efficient fixtures and other drivers such as conservation education and government-mandated standards will continue to drive further efficiency into residential usage per customer. In fact, the trend is well established and continues to affect water usage on the NJAWC system as well as most water utilities across the United States. The rate of the continued trend is dependent on the pace of fixture replacement within the NJAWC service footprint as well as the broadening acceptance of a conservation ethic through raised customer and business awareness programs, government conservation policy, and similar behavior modification related programs.

As I will explain further, below, many of the homes in New Jersey are older housing stock, built prior to 2000. These homes were constructed with toilets, washing machines, and dishwashers that are more water-intensive than newer fixtures and appliances now on the market. As turnover of household fixtures and appliances continues to occur over time, residential usage will continue to decline accordingly. The regulations mandating water efficient washing machines and dishwashers also are relatively new. Given the life expectancy of appliances, it is likely that the replacement of existing appliances, and the corresponding reduction in water used, will continue to occur over time for the indefinite future.

According to an American Water Works Association ("AWWA") Journal article dated February 2012, technology is now available for newer, more water efficient products that further improve on Energy Policy Act levels, and there is now a growing movement to codify these more stringent specifications. The introduction of progressive code modifications—such as the International Code Council's ("ICC's") International Green Construction Code ("IGCC") and the International Association of Plumbing and Mechanical Officials ("IAPMO") Green Plumbing and Mechanical Code Supplement (2011) support uniform implementation of increased water efficiency standards.[3] AWWA research also indicates that this

[3] Hoecker, Jay and Bracciano, David. Tampa Bay Water. "Passive Conservation: Codifying the use of Water-Efficiency Technologies" February 2012, Journal AWWA. 104:2.

decline in water consumption will continue. An article in the June 2012 issue of the AWWA Journal entitled "Insights into declining single-family residential water demands" states: "[r]educed residential demand is a cornerstone of future urban water resource management. Great progress has been made in the last 15 years and the industry appears poised to realize further demand reductions in the future." [4]

As I stated, the regulations mandating water efficient washing machines and dishwashers also are relatively new. Based solely on the life expectancy of appliances, it is likely that the replacement of existing appliances, and the corresponding reduction in water used, will continue to occur for at least the next 11 years or more (from compliance date for appliance manufactures to meet the new flow rates) if all appliances were replaced in their average life cycles.[5]

37. Q. Is the decline in residential water consumption showing any signs of reaching equilibrium?

A. No. New water efficiency technology and regulations are expected to continue to drive water use downward in the future. As explained by the American Council for Energy Efficiency:

> Home appliance manufacturers and energy efficiency advocates have recently agreed to improved efficiency standards and tax policies for refrigerators, freezers, clothes washers, clothes dryers, dishwashers, and room air conditioners. This agreement could save enough energy to meet the total energy needs of 40 percent of

[4] DeOreo, William and Mayer, Peter. American Water Works Association Journal. Vol. 104. Issue 6. http://apps.awwa.org/WaterLibrary/showabstract.aspx?an=JAW_0076117. June 2012

[5] The average life expectancy of a new dishwasher, clothes washer and gas water heater is 11 years. An electric water heater has an average life one year longer. http://www.statista.com/statistics/220020/average-life-expectancy-of-major-household-appliances/ Consequently, it should be obvious that the trend of declining use due to appliance replacement will continue for years to come.

> American homes for one year and the amount of water necessary to meet the current water needs of every customer in the City of Los Angeles for 25 years.[6]

These higher-efficiency dishwasher and washing machine standards include tax incentives for consumer purchases that became effective in January 2013 and January 2015, respectively.

38. Q. Have you researched and identified recent water conservation studies with similar conclusions to those cited in your testimony?

A. Yes, I have. The following studies reach similar conclusions as those cited above: Residential End Uses of Water, Version 2 by the Water Research Foundation dated April 2016; Study: Efficient Fixtures Cut US Indoor Water Use by Circle of Blue dated April 25, 2016; and Why Overall Water Use Is Declining in US Despite Population Growth, Environmental Leader dated January 2, 2019. The results of these contemporary studies affirm and support the original findings I have cited in detail. That is, there is a water industry-wide recognized trend of residential water usage reductions due to conservation effects from fixture/appliance regulation, consumer conservation behavior and the age of housing stock which influences the installation of water conserving devices throughout the United States. Further, these studies affirm that these trends are expected to continue into the foreseeable future. These contemporary studies provide further evidence illustrating a trend of residential customer water usage reductions going forward.

[6] American Council for Energy Efficiency, Major Home Appliance Efficiency Gains to Deliver Huge National Energy and Water Savings and Help to Jump Start the Smart Grid, available at http://aceee.org/press/2010/08/major-home-appliance-efficiency-gains-deliver-huge-natio. Date Accessed: 8/7/2012.

39. Q. Have you performed an analysis of the likely future of the declining use trend for NJAWC?

A. Yes, I have developed estimates of the usage impact of the WaterSense/Energy Star usage specifications for a family of four. The results of that analysis are depicted on Schedule GPR-3. Generally, the model multiplies the typical usage per capita by the estimated reduction for specific appliance usage from the pre-regulatory standard in place until 1994 to the WaterSense/Energy Star usage specifications in effect since 2010/2011, respectively, by the number of users in a proto-typical household (4 in this example), annualized. I then summed the various usage reductions for the sample four users across all fixtures that could be replaced to get an average total usage reduction. My analysis indicates that a set of four users would see a reduction of approximately 54,315 annual gallons over the course of a year, due to fixture and appliance replacement at the Water Sense/Energy Star specification levels.

The estimated reduction in usage analysis of the sample household of four allows for the estimation of the length of time over which all appliances in the NJAWC service territory will be converted to meet the Water Sense/Energy Star specifications. Dividing the total estimated annual residential usage decline for NJAWC of 705 million gallons by the estimated annual usage decline for the sample household of four of 54,315 gallons, reveals that 12,988 residential customers, or 2.21% of the 2019 year-to-date (June) average of 586,406 residential customers, would need to make these fixture changes to account for the estimated total annual residential declining usage. Further, taking the reciprocal of the 2.21% of residential customers needed to account for the annual usage decline reveals a theoretical term of 45 years to fully convert the installed fixture base to the Water Sense/Energy Star usage specifications, all other factors remaining equal. New water efficiency technology and regulations are expected to continue to drive water use downward

40. Q. Haven't new federal regulations related to efficiency standards for water-using fixtures and appliances already had their full impact on NJAWC residential customer usage?

A. No, not at all. Due to the age of the New Jersey residential housing stock, these water efficiency standards have only just begun to have an impact on New Jersey residential usage. The potential impact of replacing these fixtures is significant as, according to the 2017 American Housing Survey, 88.6% of the homes in New Jersey were built prior to the year 2000 [7] (79.2% of homes prior to 1990).[8] Schedule GPR-4 details this data, which is summarized in Table GPR-5, below. This data illustrates that 88.6% or more of the New Jersey housing stock was constructed with toilets, washing machines, and dishwashers that are much more water-intensive than newer fixtures and appliances now on the market that will eventually replace the existing fixture and appliance stock.

[7] U.S. Census Bureau, Selected Housing Characteristics. 2010 American Community Survey 5-Year Estimates (2006-2010), *http://factfinder2.census.gov/faces/nav/jsf/pages/index.xhtml.

[8] U.S. Census Bureau, Selected Housing Characteristics. 2017 American Community Survey 10-Year Estimates (1990-1999), *available at h*ttp://factfinder2.census.gov/faces/nav/jsf/pages/index.xhtml.

Table GPR-5
New Jersey American Water Company
Housing Stock Vintage
State of New Jersey

Year Structure Built		State of New Jersey Units	% Total
Built 2014 or later		21,897	0.61%
Built 2010 to 2013		51,031	1.42%
Built 2000 to 2009		334,957	9.32%
Built 1990 to 1999		341,793	9.51%
Built 1980 to 1989		427,942	11.90%
Built 1970 to 1979		458,582	12.76%
Built 1960 to 1969		486,259	13.53%
Built 1950 to 1959		547,187	15.22%
Built 1940 to 1949		269,846	7.51%
Built 1939 or earlier		655,561	18.24%
Total housing units		3,595,055	100.00%
Percentage Prior to 00			88.65%

41. Q. The Post-Test Year adjustment period in this case ends June 30, 2021. Given that the declining use trend has been progressing for over two decades, won't the majority of non-efficient fixtures and appliances already be replaced by the end of that period?

A. No, as illustrated above, the steady replacement of older fixtures due to remodel or failure as well as new construction will result in many years to achieve complete implementation and saturation of fixtures and appliances consistent with the current efficiency standards. This occurs over a very long period of time as housing stocks are remodeled and appliances and fixtures wear out, break or become obsolete. As explained later in my testimony, the decline in usage for the theoretical family of four indicates a 45-year term to reach total implementation of the current fixture standards and realize the total impact in reduced water usage. As mentioned earlier in my testimony, to date, we have observed an increasing trend of declining residential usage on the NJAWC system for approximately 16 years, leaving another 29 years for further reductions.

42. Q. You have explained the laws and programs that drive the water conservation trend. Can you identify a "real world" example of how these laws and programs actually affect usage per customer?

A. Yes. As a matter of fact, there was a situation in the American Water footprint that demonstrates this phenomenon in a rather dramatic fashion.

43. Q. Please describe it.

A. This phenomenon is illustrated by analyzing usage per customer in the Missouri-American Water Company ("MAWC") Joplin district, before and after the devastating EF5 tornado of May 22, 2011 ("Joplin Tornado"). Although this tornado affected the MAWC service area, the results of my analysis show the real world effects of the replacement of fixtures and appliances and are, thus applicable to New Jersey and NJAWC.

44. Q. Please describe your analysis of the pre- and post-2011 Joplin, MO Tornado residential customer usage.

A. I developed and compared the results of two regression models: the first estimates the trend in base residential usage per Joplin customer for the 10 years leading up to and including 2011; the second model estimates the trend in base residential usage per Joplin customer for the period 2012-2015. By comparing the results of those two regression models, we can see the impact on average residential customer usage due to the rebuilding of housing stock in Joplin to the enhanced water use standards.

45. Q. Please describe the statistical results of your analysis of the pre- and post-2011 Joplin tornado residential customer usage?

A. The results of the analysis are provided in Table GPR-6, below:

Table GPR-6
Joplin Declining Use Analysis
Usage Trend Pre / Post-2011 Tornado

Measure	Prior to 2011	Post 2011
R-Square	0.820	0.974
Usage Trend	-1.74%	-2.77%

Table GPR-6 illustrates the results of the regression analysis of average usage per customer both before and after the Joplin Tornado. It is clear from the statistical results of that regression analysis that the Joplin district's declining usage per customer trend has accelerated because residential customers have rebuilt using water use fixtures that meet or exceed the contemporary water efficiency standards and have replaced older, less efficient fixtures as part of the rebuilding process. The results show that the decline in the base residential usage per customer has increased from an annual rate of approximately -1.7% to approximately -2.8% due to the reconstruction of approximately 2,500 (13.8% of that system) residential dwellings since May 2011 in the Joplin district. This is an approximate 59%

acceleration of the rate of decline in Joplin post May 2011. NJAWC Schedule GPR-5 graphically illustrates the acceleration of the trend.

46. Q. What do the results of the analysis of pre- and post-2011 Joplin tornado usage trends reveal about residential customers usage and what does the data imply about future water usage declines?

A. The statistical results of the Joplin Tornado analysis, when combined with the results of the four-user energy star analysis detailed in Schedule GPR-3, offer compelling empirical evidence as to the potential scope and duration of continued reductions in customer water use patterns. First, as discussed, the rebuilding of homes in the Joplin district resulted in a 59% acceleration of the annual usage per customer reduction from approximately -1.7% to approximately -2.8%. Second, those 2,500 rebuilt customer dwellings experienced an annual usage reduction of approximately 3,200 gallons, or roughly an 8.4% reduction in usage, from their 2011 pre-Joplin tornado levels. That 3,200-gallon annual average residential usage reduction by the rebuilt customers is nearly equal to the loss of an entire month's worth of water sales to a typical Joplin residential customer (based on average usage in Joplin post-2011).

47. Q. Mr. Roach, are there other American Water affiliated companies that have experienced extraordinary reductions in residential water usage resulting in lasting modifications to customer water consumption behavior?

A. Yes. The trend of California-American Water ("Cal-AM") residential customer usage since 2013 both during and post removal of drought related state mandated usage restrictions is one instance in particular that must be noted. In summary, in response to state mandatory 25% water reductions established in June 2015, Cal-AM residential usage per customer fell 26% from 2013 annual average levels to 2015 annual average levels. Following removal of the state mandated 25% water usage reductions on April 1, 2017, Cal-AM residential usage per customer remains 21% lower than the annual average 2013 levels. Hence, 20 months following removal of state mandated water usage reductions, Cal-AM's residential customers have incorporated water conservation behavior such that their water usage remains 21% lower than it was in 2013 at the end of 2018. This reflects a real and significant and apparently permanent incorporation of water conservation behavior by Cal-AM customers since 2013. This trend is detailed below in Figure GPR-5 and Table GPR-7, below.

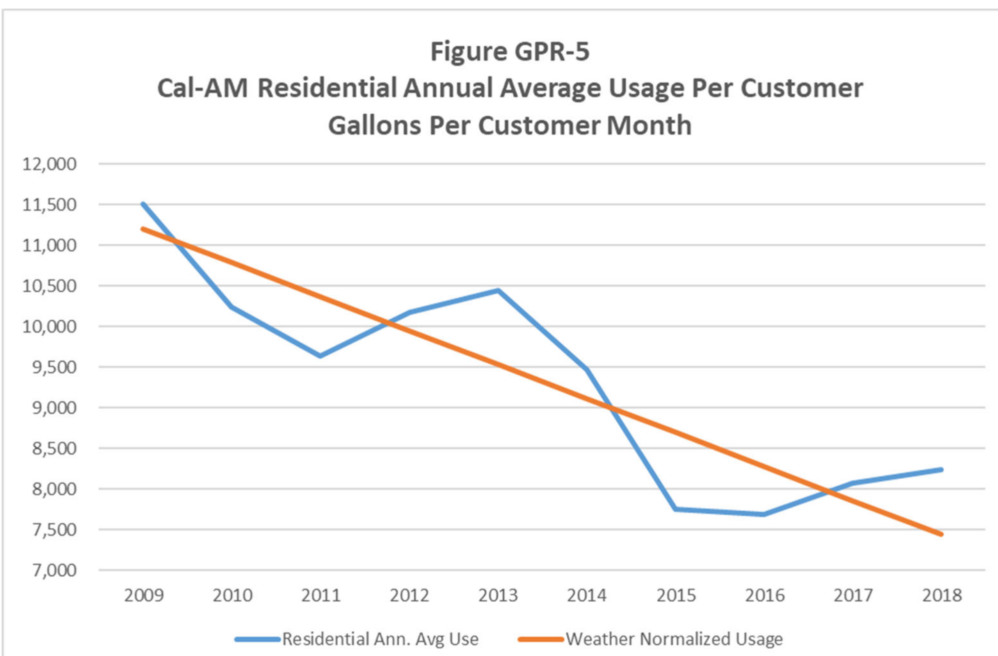


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Table GPR-7
California American Water
Residential Annual Average Usage Per Customer
Gallons Per Customer Month

Year	Annual Avg. Usage	% of 2013	Reduction From 2013
2013	10,443		
2014	9,468	90.7%	-9.3%
2015	7,751	74.2%	-25.8%
2016	7,685	73.6%	-26.4%
2017	8,070	77.3%	-22.7%
2018	8,237	78.9%	-21.1%

48. Q. What is your conclusion related to the continuation of reductions in residential water usage on the NJAWC system?

A. Typically, households replace appliances and fixtures on a sporadic basis, as they break or become obsolete. As they are installed over time, the replacement appliances being more efficient then the originals, result in reductions in usage due to increased efficiency that are spread out over time making it difficult to isolate the impact of any increase in the efficiency of a single appliance or fixture on overall water usage. In contrast, households affected by the Joplin Tornado replaced all of their appliances and fixtures at a single point in time. Therefore, by analyzing the decline in usage in Joplin after the tornado, we can assess the total impact that installation of the most recent, efficient, available technology will have on usage over time. In other words, as NJAWC customers replace their appliances and fixtures, usage on the NJAWC system is likely to decline at the rate I have estimated and potentially up to the rate of usage decline in Joplin following the tornado rebuild. On this basis, and in conjunction with the results of the energy star four user analysis (see Schedule GPR-3), I conclude that residential water use reductions will continue to be significant well into the near future for the NJAWC system. Lastly, the steady year-to-year water use decline attributed to federally mandated water using appliance and fixture usage reductions detailed herein notwithstanding, the permanent effect of state mandated water usage restrictions on Cal-AM residential customers water usage illustrate the potential for significant and dramatic water use reductions in response to state regulated water use restrictions on any of the American Water affiliated systems going forward.

AUTHORIZED REVENUE AND DECLINING CONSUMPTION

49. Q. The Company is requesting an RSM in this case. Are there reasons why a water company's actual revenue could deviate significantly from its Authorized Revenue?

A. Water utility revenue forecasts are properly based on normal weather. Weather, however, is seldom normal. Therefore there is an equal chance that the utility will exceed the forecast due to abnormally warm and dry weather or fall short of the revenue forecast due to cooler and wetter summer weather. Usage per customer results that capture several years of abnormally hot and dry weather will represent usage per customer that simply cannot be achieved in a year of normal weather. In addition, the failure of a forecast to capture the full effect of a trend of reduced usage per customer will result in the adoption of a faulty forecast that improperly captures a usage trend.

This variability in customer usage patterns and weather can have a substantial effect on a water company's actual revenues. Changes in customer usage patterns can reflect seasonal variation in usage as well long term water use trends (for example as a result of sustained water efficiency and conservation efforts). This is true for NJAWC as well as other water utilities across the country. Although the effect of weather can be random and work either in favor of or against the Company from a financial standpoint, the declining use per customer is another factor, altogether, because customers are using less water every year.

50. Q. Have you analyzed the impact of water usage on NJAWC's actual water sales and revenues, as compared to levels authorized for the Company since 2008?

A. Yes, I have. NJAWC Schedule GPR-6, page 1 of 2 and Table GPR-8 below, illustrates that NJAWC has collected revenue that is less than the revenue levels used to set revenue requirements in rate cases since 2009 for each post-case year of those proceedings from 2009 to 2018 except for 2015-2017, when sales were driven by unusually dry and or warmer than average summer climate as visually illustrated on Schedule GPR-6, page 2 of 2. Clearly, therefore, actual revenue can deviate

Table GPR-8
New Jersey American Water Company
Actual Revenue/Water Sales Compared to Utilized
(2009-2018)

	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	Total 2009-2018
NJWC Total Billed Annual Revenue*	410,469,866	432,198,459	439,676,035	461,162,881	450,704,130	457,426,392	485,970,924	522,731,814	502,384,314	514,115,359	4,676,840,174
Total Authorized Revenue**	439,739,115	439,739,115	454,158,610	467,686,598	473,360,865	473,360,865	479,895,096	501,344,725	501,344,725	516,018,955	4,746,648,670
Revenue Recovery to Authorized (Under)/Over	(29,269,249)	(7,540,656)	(14,482,575)	(6,523,717)	(22,656,735)	(15,934,473)	$6,075,828	$21,387,089	$1,039,589	($1,903,596)	($69,808,496)
	-6.66%	-1.71%	-3.19%	-1.39%	-4.79%	-3.37%	1.27%	4.27%	0.21%	-0.37%	-1.47%
NJWC Total Annual Water Sales (000 Gallons)	62,198,523	68,349,122	63,430,775	63,855,472	60,752,397	61,405,819	64,430,499	63,682,367	61,401,684	60,648,710	630,155,367
Total Authorized Water Sales*	68,557,095	68,557,095	65,194,420	64,517,922	64,234,167	64,234,167	63,324,154	60,336,896	60,336,896	60,340,356	639,633,168
Water Sales to Authorized (Under)/Over	(6,358,572)	(207,973)	(1,763,645)	(662,450)	(3,481,770)	(2,828,348)	1,106,345	3,345,471	1,064,788	308,354	(9,477,801)
	-9.27%	-0.30%	-2.71%	-1.03%	-5.42%	-4.40%	1.75%	5.54%	1.76%	0.51%	-1.48%
											Average 2009-2018
Annual Cooling Degree Days	791	1,285	1,218	1,142	1,029	869	1,051	1,233	1,014	1,249	1,088
Percipitation June-Sept	17.7	8.9	24.4	11.7	9.5	9.0	6.6	10.9	11.1	17.5	12.7

*GMS only. Exclusive of DSIC and Surcharge and Other Water Revenue
**GMS only. Per Commission Orders Exclusive of Other Water Revenue

significantly from Authorized Revenue. Specifically, for the period of 2009 through 2018, NJAWC realized actual revenues that combined were approximately $69.8 million less than those revenue used to establish rates. Similarly, for that same period, NJAWC realized total water sales that were approximately 9.477 billion gallons less than used to establish rates. There is direct linkage between the inability of NJAWC to collect this revenue level over the period of 2009-2018 and water usage reductions attributed to the 9.477 billion-gallon short fall in total sales levels utilized in the NJAWC cases over the period of 2009 through 2018.

51. Q. Has NJAWC factored the observed trend of declining residential and commercial customer usage into its pro-forma revenues in this case?

A. Yes. Company witness Mr. Rea addresses the development of NJAWC's revenue requirement and pro-forma revenues at present rates, including the Post-Test Year adjustment period data to reflect the observed trend of declining usage for residential and commercial customers. Moreover, as I explained, this trend is not going to abate for many years and so it will continue throughout the Post-Test Year adjustment period and beyond. This is important because, if the RSM is instituted to operate beyond the Post-Test Year adjustment period to ensure that the Company continues to collect its authorized revenue, the Company will not have to file a rate case simply to recover the revenue shortfall due to the trend of declining use per customer.

52. Q. Are there other benefits to an RSM besides maintaining the level of revenue authorized by the BPU?

A. Yes, by decoupling revenue from usage, the Company avoids the so-called "conservation conundrum" wherein it is rewarded for higher sales and punished for lower sales. This allows the Company to embrace fully the wise use of water and to support the conservations programs promoted by this State.

53. Q. Have the Company's customers received any benefits from their reduced water usage?

A. Yes. Our customers share in various environmental and operational benefits from lower water usage. For example, reduced usage helps maintain source water supplies, lessening diversions from supply sources, leaving more water for passing flows or drought reserve. Reductions in power consumption, chemical usage, and waste disposal not only reduce water utility operating costs, but also provide environmental benefits such as reduced carbon footprint from lower power usage for treatment and pumping and reduced waste streams. Reduced water usage by customers also reduces energy consumption within the customer's home, for instance, through lower hot water heating needs. In addition, on a case-specific basis, reduced water usage has the potential to enable the utility to delay or downsize a capacity addition. In systems where demand is approaching the capacity of water supplies or treatment facilities, the water saved through efficient usage by customers can be a preferred alternative to a supply-side expansion, with a resulting lower cost to customers. Over the long term, reduced usage per residential customer has helped lower operating costs, and has helped avoid some capacity-related needs. These savings and avoided costs have benefitted customers through the ratemaking process.

54. Q. Can declining usage and water conservation activities result in certain avoided capital costs?

A. Yes. Reductions in water usage can avoid the need to build supply, treatment, and transmission facilities to meet those now avoided additional usage demands. The impact of reduced usage per customer on supply and large transmission investment notwithstanding, the ongoing decline of usage per customer does not delay nor mitigate the on-going need for NJAWC to continue replacing its aging distribution infrastructure in order to continue providing its customers with reliable and safe drinking water.

55. Q. Please summarize why a RSM makes sense for NJAWC and its customers.

A. As the data show, the Company's revenue is affected by two distinct matters. First, the variability of weather and, second, the trend of declining use per customer. The RSM removes the unpredictability of weather from the rate equation, providing that the Company collects its Authorized Revenue, no more and no less. The RSM will also allow NJAWC to continue to collect those Authorized Revenue following the expiration of the first year that rates are in effect. Given the demonstrated potential for the trend of declining use per residential and commercial customers to continue for many years, the implementation of an RSM will mean that NJAWC would not have to file for base rate relief solely to recover the revenue shortfall due to this trend. For all of these reasons, an RSM is in the best interest of all stakeholder, the Company, its customers and the State of New Jersey.

56. Q. Does this conclude your direct testimony?

A. Yes it does.

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Appendix A

Professional Experience of Gregory P. Roach

I have over 25 years of experience working in the electric, gas and water utility sectors as both a consultant and utility employee, beginning with Public Service Indiana (now Duke Energy) in January 1980, where my responsibilities were focused on transforming PSI's load forecasting processes from time series to econometric based models. In May 1982, I accepted the position of Senior Economist with the management-consulting firm of R. W. Beck and Associates ("Beck") (now part of Science Applications International Corporation, "SAIC"). I received numerous promotions through my career with Beck to the eventual position of Principal Economist. During my career at Beck, I was responsible for the management of all rates/regulatory, load forecasting and financing feasibility client engagements managed by the Indianapolis office. As such, I delivered testimony on behalf of agency, municipal and co-op clients throughout the United States related to cost of service, rate design, load forecasting, system planning, electric and gas production plant economic feasibility, revenue requirement pro-forma adjustments, production cost optimization and cost of capital to state regulatory commissions and the Federal Energy Regulatory Commission.

In May 1991 I took the position of Principal Economist with the regulatory management consulting firm of SVBK Consulting Group ("SVBK") (now part of Alliant Energy Integrated Services, "Alliant"). In that position, I was responsible for all consulting engagements executed from the Indianapolis regional office on

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Appendix A

behalf of SVBK's national utility clients. In addition to the regulatory matters that I testified to while at SVBK, I offered testimony related to merger & acquisition cost reductions/synergies, large power pool generation and transmission dispatch strategies, power pool generation/transmission pricing schemes, price elasticity sales adjustments and retail rate impact of specific power/transmission pooling cost minimization arrangements and payments.

In July 1993, I became owner and president of a retail operations holding company with three franchise store outlets. In that position, I was responsible for all management, operation, sales and financial functions of the firm.

In November 1998, I sold the retail holding company to begin operations of the Roach Consulting Group, Ltd as Principal Consultant. In that position I advised industrial and utility clients related to business intelligence systems, enterprise/manufacturing resource planning systems, customer information systems as well as general accounting systems. I also appeared as an expert witness providing testimony related to economic and punitive damages in personal injury and wrongful death legal proceedings. In July 2011, I joined the Service Company as Manager of Rates and Regulation, supporting Indiana-American and Michigan-American Water Company. In August 2014, I accepted the position of Manager of Revenue Analytics with the Service Company. In November 2017, I was promoted to the position of Senior Manager of Revenue Analytics with the Service Company.

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Appendix B

Glossary of Technical and Statistical Terms

Autocorrelation - Autocorrelation is a characteristic of data in which the correlation between the values of the same variables is based on related objects. Informally, it is the similarity between observations as a function of the time lag between them. In regression modeling, the estimate errors follow a pattern, showing that something is wrong with the regression model. ... If this assumption is violated and the error term observations are correlated, autocorrelation is present.

Cooling Degree Day – ("CDD") A cooling degree day (CDD) is a measurement designed to quantify the demand for energy needed to cool a building. It is the number of degrees that a day's average temperature is above 65º Fahrenheit (18º Celsius), which is the temperature above which buildings need to be cooled. Annual CDD would be the sum of all CDD occurring in a calendar year.

Durbin-Watson Statistic - The Durbin Watson statistic is a number that tests for autocorrelation in the residuals from a statistical regression analysis. The Durbin-Watson statistic is always between 0 and 4. A value of 2 means that there is no autocorrelation in the sample.

F-Statistic - The F value is the ratio of the mean regression sum of squares divided by the mean error sum of squares. Its value will range from zero to an arbitrarily large number. The value of Probability (F) is the probability that the null hypothesis for the full model is true (i.e., that all of the regression coefficients are zero). The higher the F value, the greatest confidence that the null hypothesis can be rejected.

Heating Degree Day – ("HDD") A heating degree day (HDD) is a measurement designed to quantify the demand for energy needed to heat a building. It is the number of degrees that a day's average temperature is below 65 º Fahrenheit (18 º Celsius), which is the temperature below which buildings need to be heated. Annual HDD would be the sum of all HDD occurring in a calendar year.

R-Squared - In statistics, the coefficient of determination, denoted R2 or r2 and pronounced "R squared", is the proportion of the variance in the dependent variable that is predictable from the independent variable(s).

T- Statistic - The t statistic is the coefficient divided by its standard error. The standard error is an estimate of the standard deviation of the coefficient, the amount it varies across cases. It can be thought of as a measure of the precision with which the regression coefficient is measured. The higher the t statistic, the greater probability is that the regression coefficient has been estimated precisely.

American Water Works Company
Residential Water Usage Forecasts Based on 10 year history
Based on Weather Normalized Trends except where noted below

State	Annual Decline (GPCY) 10-year (2009-2018)	Rate of Decline (%) 10-year (2009-2018)
Illinois	-1,368	-2.8%
Indiana	-965	-2.0%
Iowa	-879	-1.9%
Kentucky	-1,046	-2.2%
Maryland	-740	-1.7%
Missouri	-1,529	-2.1%
New Jersey*	-1,203	-1.8%
Pennsylvania	-871	-2.1%
Tennessee	-643	-1.4%
Virginia	-733	-1.4%
West Virginia	-576	-1.5%
Weighted Average	-1,095	-2.0%

Notes:
California & Michigan used three year average per customer
New York is aligned to Revenue Stabilization Mechanism
New Jersey based on 10 years ending June, 2019
Weighted average based on 2018 average residential customer connections

The following regulations are listed in the "*Energy Independence & Security Act of 2007,"* Public Law 110–140 – Dec. 19, 2007:

1. A top-loading or front-loading standard-size residential clothes washers manufactured on or after January 1, 2011 shall have a water factor of not more than 9.5. (water factor is equal to gallons/cycle/cubic feet)

2. Dishwashers manufactured on or after January 1, 2010, shall—
   a. for standard size dishwashers (≥ 8 place settings + six serving pieces) not exceed **6.5 gallon per cycle**; and
   b. for compact size dishwashers (< 8 place settings + six serving pieces) not exceed **4.5 gallons per cycle**.

TABLE 1
Flow rates from typical fixtures and appliances before and after Federal Standards

Type of Use	Pre-Regulatory Flow*	New Standard (maximum)	Federal Standard	Year Effective	WaterSense / ENERGY STAR Current Specification+ (maximum)
Toilets	3.5 gpf	1.6 gpf	**U.S. Energy Policy Act**	1994	**1.28 gpf**
Clothes washers**	41 gpl (14.6 WF)	Estimated 26.6 gpl (9.5 WF)	**Energy Independence & Security Act of 2007**	2011	**Estimated 16.8 gpl (6.0 WF)**
Showers	2.75 gpm	2.5 gpm	**U.S. Energy Policy Act**	1994	**2.0 gpm**
Faucets***	2.75 gpm	2.5 gpm (1.5 gpm)	**U.S. Energy Policy Act**	1994	**1.5 gpm at 60 psi**
Dishwashers	14.0 gpc	6.5 gpc for standard; 4.5 gpc for compact	**Energy Independence & Security Act of 2007**	2010	**4.25 gpc for standard; 3.5 gpc for compact**
Commercial Pre Rinse Spray Valves	1.8 to 6 gpm	1.6 gpm	**U.S. Energy Policy Act of 2005**	2006	**1.28 gpm**

* Source: *Handbook of Water Use and Conservation*, Amy Vickers, May 2001
** Average estimated gallons per load and water factor (see calculations)
*** Regulation maximum of 2.5 gpm at 80 psi, but lavatory faucets available at 1.5 gpm maximum (see calculations)
+Source: http://www.epa.gov/watersense/ and http://www.energystar.gov websites

ABBREVIATIONS USED	
gpcd	gallons per capita per day
gpf	gallons per flush
gpl	gallons per load
gpm	gallons per minute
gpc	gallons per cycle
WF	water factor, or gallons per cycle per cubic feet capacity of the washer (the smaller the water factor, the more water efficient the clothes washer)

TABLE 2
Daily indoor per capita water use from various fixtures and appliances in a typical single family home before and after Federal Regulations

Type of Use	Pre-Regulatory Standards Amount** (gpcd)	Post-Regulatory Standards Amount** (gpcd)	Savings from Pre-Reg	Water Sense/ Energy Star Amount** (gpcd)	Additional Savings from Post-Reg
Toilets	17.9	8.2	54%	6.5	21%
Clothes washers*	15	9.8	35%	6.2	37%
Showers	9.7	8.8	9%	7.1	19%
Faucets	14.9	10.8	28%	8.1	25%
Dishwashers*	1.4	0.65	54%	0.43	34%
Total Indoor Water Use	**58.9**	**38.3**	**35%**	**28.3**	**26%**

Note: List only includes common household fixtures and appliances and excludes leaks and "other domestic uses" in order to be conservative.

*Regulatory Standards effective in 2010 and 2011. For calculations of amount in gpcd, refer to the calculation below.
**Source: *Handbook of Water Use and Conservation*, Amy Vickers, May 2001

CALCULATIONS

Clothes washer (pre-regulatory):

Number of times clothes washer used everyday *	= 0.37 loads per day
Clothes washer water use rate range *	= 39 gpl to 43 gpl
Average water use rate	= **41 gpl**
Water usage per capita	= 41 gpl * 0.37 loads/day
	= **15 gpcd**
Water factor (WF) as gallons/cycle/cu. ft	= 41 gpl / 2.8 cu. ft (assuming capacity of an average washer to be 2.8 cu. ft, most washers range between 2.7 – 2.9 cu. ft)
	= **14.6**

Clothes washer (new standard):

Number of times clothes washer used everyday *	= 0.37 loads per day
New regulatory standard	= **9.5 WF**
	= 9.5 gallons/per cycle/cubic feet

	= **26.6 gpl** (Assuming capacity of an average washer to be 2.8 cu. ft, most washers range between 2.7 – 2.9 cu. ft)
Therefore, new usage per capita	= 26.6 gpl * 0.37 loads/day
	= **9.8 gpcd**

Clothes washer (WaterSense/Energy Star):

Number of times clothes washer used everyday *	= 0.37 loads per day
New regulatory standard	= **6 WF**
	= 6 gallons/per cycle/cubic feet
	= **26.6 gpl** (Assuming capacity of an average washer to be 2.8 cu. ft, most washers range between 2.7 – 2.9 cu. ft)
Therefore, new usage per capita	= 16.8 gpl * 0.37 loads/day
	= **6.2 gpcd**

Dishwasher:

Number of times dishwasher used everyday*	= 0.10 times
New regulatory standard	= **6.5 gallons/per cycle** (for standard dishwashers only)
Therefore, new usage per capita	= 6.5 gallons/per cycle * 0.1
	= **0.65 gpcd**

Dishwasher (WaterSense/Energy Star):

Number of times dishwasher used everyday*	= 0.10 times
New regulatory standard	= **4.25 gallons/per cycle** (for standard dishwashers only)
Therefore, new usage per capita	= 4.25 gallons/per cycle * 0.1
	= **0.43 gpcd**

Faucet:

Actual faucet flow during use*	= 67% rated flow
Rated flow*	= **1.5 gpm** to **2.5 gpm**
Frequency of faucet use*	= 8.1 min/day
Range of usage per capita	= 8.1 gpcd to 13.5 gpcd
Assume average of range for estimated gpcd	= **10.8 gpcd**

Faucet (WaterSense/Energy Star):

Actual faucet flow during use*	= 67% rated flow
Rated flow*	= **1.5 gpm**
Frequency of faucet use*	= 8.1 min/day
Usage per capita	= 8.1 gpcd
Assume average of range for estimated gpcd	= **8.1 gpcd**

*Source: *Handbook of Water Use and Conservation,* Amy Vickers, May, 2001

Adapted from information provided by the U.S. EPA Office of Water, the Alliance for Water Efficiency, and other sources)

Fixtures and Appliances	EPAct 1992, EPAct 2005, "Energy Independence and Security Act of 2007" *(or backlog NAECA updates)*		WaterSense® or Energy Star®		Consortium for Energy Efficiency	
	Current Standard	**Proposed/Future Standard**	**Current Specification**	**Proposed/Future Specification**	**Current Specification**	**Proposed/Future Specification**
Residential Toilets	1.6 gpf[1]	1.28 gpf/ 4.8 Lpf proposed by efficiency advocates for tank-type only	Tank-type toilets: WaterSense = 1.28 gpf (4.8L) with at least 350 gram waste removal + LA Spec.		No specification	
Residential Lavatory (Bathroom) Faucets	2.2 gpm at 60 psi[2]	1.5 gpm/ 5.7 Lpm proposed by efficiency advocates	WaterSense = 1.5 gpm maximum & 0.8 gpm minimum at 20 psi		No specification	
Residential Kitchen Faucets				None proposed at this time	No specification	
Residential Showerheads	2.5 gpm at 80 psi		WaterSense = 2.0 gpm		No specification	
Residential Clothes Washers	MEF ≥ 1.26 ft^3/kWh/cycle *No specified water use factor Note: MEF measures energy consumption of the total laundry cycle (wash + dry). The higher the number, the greater the energy efficiency	Energy Independence and Security Act of 2007 specified effective in 2011: MEF ≥ 1.26 ft^3/kWh/cycle WF ≤ 9.5 gal/cycle/ft^3 Also specified: DOE shall publish final rule by Dec 31, 2011, determining if standards will change effective 1/1/2015.	Energy Star (DOE) effective July 1, 2009: MEF ≥ 1.8 ft^3/kWh/cycle WF ≤ 7.5 gal/cycle/ ft^3	Energy Star (DOE) To be effective Jan 1, 2011: MEF ≥ 2.0 WF ≤ 6.0 gal/cycle/ft^3	Tier 1: MEF ≥ 1.80 ft^3/kWh/cycle; WF ≤ 7.5 gal/cycle/ft^3 Tier 2: MEF ≥ 2.00 ft^3/kWh/cycle; WF ≤ 6.0 gal/cycle/ft^3 Tier 3: MEF ≥ 2.20 ft^3/kWh/cycle; WF ≤ 4.5 gal/cycle/ft^3	

[1] EPAct 1992 standard for toilets applies to both commercial and residential models.
[2] EPAct 1992 standard for faucets applies to both commercial and residential models.

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EPAct 2005: Energy Policy Act of 2005
EF: energy factor
ft^3: cubic feet
gal: gallons
gpm: gallons per minute
gpf: gallons per flush
kWh: kilowatt hour
MEF: modified energy factor
MaP: maximum performance
NAECA: National Appliance Energy Conservation Act
psi: pounds per square inch
WF: water factor
Lpf: Litres per flush

Updated March 2010
Koeller/Dietemann

National Efficiency Standards and Specifications for Residential and Commercial Water-Using Fixtures and Appliances

Adapted from information provided by the U.S. EPA Office of Water, the Alliance for Water Efficiency, and other sources)

Fixtures and Appliances	EPAct 1992, EPAct 2005, "Energy Independence and Security Act of 2007" *(or backlog NAECA updates)*		WaterSense® or Energy Star®		Consortium for Energy Efficiency	
	Current Standard	**Proposed/Future Standard**	**Current Specification**	**Proposed/Future Specification**	**Current Specification**	**Proposed/Future Specification**
Standard Size and Compact Residential Dishwashers[3]	*Standard models*: Energy Independence and Security Act of 2007 specified: effective 1/1/2010: Standard Size: 355 KWh/year (.62 EF + 1 watt standby) WF ≤ 6.5 gallons/cycle Compact Size: 260 kWh WF ≤ 4.5 gallons/cycle EF is the number of cycles the machine can run for each kWh of electricity	Also specified by the Act: DOE shall publish final rule by 1/1/2015 determining if dishwasher standards will change effective 1/1/2018.	Energy Star (DOE) Effective since July 1, 2009 Standard Size: 324 kWh/year WF ≤ 5.8 gallons/cycle Compact Size: 234 kWh/year WF ≤ 4.0 gallons/cycle kWH/yr is replacing EF since it includes the cycles the machine can run for each kWh, but also includes up to 8 kWh/yr of standby power (when the machine isn't cycling)	Energy Star effective July 1, 2011: Standard Size: 307 kWh/yr 5.0 gallons per cycle Compact Size: 222 kWh/yr 3.5 gallons per cycle	*Effective Aug. 11, 2009:* *Standard models*: EF; maximum kWh/year Tier 1: EF ≥ 0.72 cycles/kWh; and 307 max kWh/year; 5.0 gallons per cycle Tier 2: EF ≥ 0.75 cycles/kWh; 295 max kWh/year; 4.25 gallons per cycle *Compact models*: Tier 1: EF ≥ 1.0 cycles/kWh; 222 max kWh/year; 3.5 gallons per cycle	Could adjust Tiers after July 1, 2011 when new Energy Star becomes effective

[3] ***Standard models***: capacity is greater than or equal to eight place settings and six serving pieces; **C*ompact models***: capacity is less than eight place settings and six serving pieces

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Fixtures and Appliances	EPAct 1992, EPAct 2005 *(or backlog NAECA updates)*		WaterSense® or Energy Star®		Consortium for Energy Efficiency	
	Current Standard	Proposed/ Future Standard	Current Specification	Proposed/Future Specification	Current Specification	Proposed /Future Specification
Commercial Toilets	1.6 gpf[4]/6.0 Lpf Except blow-out fixtures: 3.5-gpf/13 Lpf Note: Some states prohibit blow-out at 3.5 gpf	1.28 gpf/ 4.8 Lpf proposed by efficiency advocates for tank-type only	Tank-type only: WaterSense at 1.28 gpf (4.8L) with at least 350 gram waste removal + LA Spec.	Flushometer valve/ bowl combinations: WaterSense specification in development. No release date promised.	No specification	
Commercial Urinals	1.0 gpf	0.5 gpf/ 1.9 Lpf proposed by efficiency advocates	WaterSense = 0.5 gpf/1.9Lpf (flushing urinals only)		No specification	
Commercial Faucets	Private faucets: 2.2 gpm at 60 psi[5] Public Restroom faucets: 0.5 gpm at 60 psi[5] Metering (auto shut of) faucets: 0.25 gallons per cycle[6]			WaterSense draft specification now under consideration	No specification	

[4] EPAct 1992 standard for toilets applies to both commercial and residential models.
[5] In addition to EPAct requirements, the American Society of Mechanical Engineers standard for public lavatory faucets is 0.5 gpm at 60 psi (ASME A112.18.1-2005). This maximum has been incorporated into the national Uniform Plumbing Code and the International Plumbing Code for all except private applications, private being defined as residential, hotel guest rooms, and health care patient rooms. All other applications subject to the 0.5 gpm/1.9 Lpm flow rate maximum.
[6] Metering faucets not subject to flow rate maximum

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Fixtures and Appliances	EPAct 1992, EPAct 2005 *(or backlog NAECA updates)*		WaterSense® or Energy Star®		Consortium for Energy Efficiency	
	Current Standard	Proposed/ Future Standard	Current Specification	Proposed/Future Specification	Current Specification	Proposed /Future Specification
Commercial Clothes Washers (Family-sized)	MEF ≥ 1.26 ft^3/kWh; WF ≤ 9.5 gal/cycle/ft^3	New standards under development: DOE scheduled final action: January 2010; Rulemaking process postponed by DOE in 2008; began again in Dec. 2009.	Energy Star (DOE) MEF ≥ 1.72 ft^3/kWh/cycle; WF ≤ 8.0 gal/cycle/ft^3		Adopted Jan 1, 2007 (Note: this spec covers only normal capacity family washers, NOT large capacity commercial washers) Tier 1: 1.80 MEF 7.5 gal/cycle/ft^3 Tier 2: 2.00 MEF 6.0 gal/cycle/ft^3 Tier 3: 2.20 MEF 4.5 gal/cycle/ft^3	

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Fixtures and Appliances	EPAct 1992, EPAct 2005 *(or backlog NAECA updates)*		WaterSense® or Energy Star®		Consortium for Energy Efficiency	
	Current Standard	Proposed/ Future Standard	Current Specification	Proposed/Future Specification	Current Specification	Proposed /Future Specification
Commercial Dishwashers	No standard		Energy Star (EPA) using NSF/ANSI standards for water use and ASTM standards for energy use Effective **10/11/2007** *Under counter*: Hi Temp: 1.0 gal/rack; <= 0.90 kW; Lo Temp 1.70 gal/rack <= 0.5 kW *Stationary Single Tank Door*: Hi Temp: 0.95 gal/rack; <= 1.0 kW Lo Temp: 1.18 gal/rack; <= 0.6 kW *Single Tank Conveyor*: Hi Temp: 0.70 gal/rack; <= 2.0 kW; Lo Temp: 0.79 gal/rack; <= 1.6 kW *Multiple Tank Conveyor*: Hi Temp: 0.54 gal/rack; <= 2.6 kW Lo Temp: 0.54 gal/rack; <= 2.0 kW		No specification	

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Adapted from information provided by the U.S. EPA Office of Water, the Alliance for Water Efficiency, and other sources)

Fixtures and Appliances	EPAct 1992, EPAct 2005 *(or backlog NAECA updates)*		WaterSense® or Energy Star®		Consortium for Energy Efficiency	
	Current Standard	Proposed/ Future Standard	Current Specification	Proposed/Future Specification	Current Specification	Proposed /Future Specification
Automatic Commercial Ice Makers[7]	Effective 1/1/2010: Energy and condenser water efficiency standards vary by equipment type on a sliding scale depending upon harvest rate and type of cooling (see link to additional information at end of this table)		Energy Star (EPA) Energy and water efficiency standards vary by equipment type on a sliding scale depending upon harvest rate and type of cooling (see link to additional information at end of this table). Water cooled machines excluded from Energy Star		Energy and water (potable and condenser) standards are tiered and vary by equipment type on a sliding scale depending upon harvest rate and type of cooling (see link to additional information at end of this table)	
Commercial Pre-rinse Spray Valves (for food service appli-cations)	Flow rate ≤ 1.6 gpm (no pressure specified; no performance requirement)		No specification	Proposed Energy Star specification abandoned after standard established in EPAct 2005; WaterSense specification in development in conjunction with Energy Star	No specification (program guidance recommends 1.6 gpm at 60 psi and a cleanability requirement)	

[7] Optional standards for other types of automatic ice makers are also authorized under EPAct 2005.

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Fixtures and Appliances	EPAct 1992, EPAct 2005 *(or backlog NAECA updates)*		WaterSense® or Energy Star®		Consortium for Energy Efficiency	
	Current Standard	Proposed/ Future Standard	Current Specification	Proposed/Future Specification	Current Specification	Proposed /Future Specification
Commercial Steam Cookers[8]	No standard		Energy Star (EPA) *Electric*: 50% cooking energy efficiency; idle rate 400–800 Watts *Gas*: 38% cooking energy efficiency; idle rate 6,250–12,500 British thermal units/hour *No specified water use factor		*Electric*: 50% cooking energy efficiency; idle rate 400–800 Watts *Gas*: 38% cooking energy efficiency; idle rate 6,250–12,500 British thermal units/hour Water Use Factor (for both electric and gas models): Tier 1A: ≤ 15 gal/hr Tier 1B: ≤ 4 gal/hr	

[8] Idle rate standards vary for 3-, 4-, 5-, and 6-pan commercial steam cooker models.

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National Efficiency Standards and Specifications for Residential and Commercial Water-Using Fixtures and Appliances
Adapted from information provided by the U.S. EPA Office of Water, the Alliance for Water Efficiency, and other sources)

Information/materials on EPAct 2005/NAECA standards:

Schedule for development of appliance and commercial equipment efficiency standards:
http://www.eere.energy.gov/buildings/appliance_standards/2006_schedule_setting.html

Commercial Clothes Washers and Dishwashers (agenda/presentations at 4/27/06 DOE public meeting on rulemaking):
http://www.eere.energy.gov/buildings/appliance_standards/residential/home_appl_mtg.html

Automatic Commercial Ice Maker Standards:
http://www.eere.energy.gov/buildings/appliance_standards/pdfs/epact2005_appliance_stds.pdf (Page 18)

Pre-rinse Spray Valves
http://www.eere.energy.gov/buildings/appliance_standards/pdfs/epact2005_appliance_stds.pdf (Page 10)

Information/materials on WaterSense specifications:

Toilets
http://www.epa.gov/watersense/products/toilets.html

Urinals
http://www.epa.gov/watersense/products/urinals.html

Bathroom Lavatory Faucets
http://www.epa.gov/watersense/products/bathroom_sink_faucets.html

Information/materials on Energy Star specifications:

Residential Clothes Washers
http://www.energystar.gov/index.cfm?c=clotheswash.pr_crit_clothes_washers

Commercial Clothes Washers
http://www.energystar.gov/index.cfm?fuseaction=clotheswash.display_commercial_cw

Residential Dishwashers
http://www.energystar.gov/index.cfm?c=dishwash.pr_dishwashers

Commercial Dishwashers
http://www.energystar.gov/index.cfm?c=new_specs.comm_dishwashers

Automatic Commercial Ice Makers
http://www.energystar.gov/index.cfm?c=new_specs.ice_machines

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Commercial Steam Cookers
http://www.energystar.gov/index.cfm?c=steamcookers.pr_steamcookers

Information/materials on CEE specifications:

Residential Clothes Washers
http://www.cee1.org/resid/seha/rwsh/rwsh-main.php3

Residential Dishwashers
http://www.cee1.org/resid/seha/dishw/dishw-main.php3

Commercial, Family-Sized Clothes Washers
http://www.cee1.org/com/cwsh/cwsh-main.php3

Commercial Ice-Makers
http://www.cee1.org/com/com-ref/ice-main.php3; Spec Table: http://www.cee1.org/com/com-kit/ice-specs.pdf

Pre-rinse Spray Valves
http://www.cee1.org/com/com-kit/prv-guides.pdf

Commercial Steam Cookers
http://www.cee1.org/com/com-kit/sc-hc-specs.pdf

New Jersey American Water Co.
Reasonableness of Consumption Decline Calculation
1,203 Gallons Per Customer Per Year

Illustrating: Replacement of Clothes Washing, Toilet, Fixtures and Dishwashers Based on Family of Four

Washer:			
Old: Usage per load - gallons	41	Average Use Per Capita Per Day	0.37
New: Usage per load - gallons	17	Average Loads per week - 4 People	10
Usage decline	24	Savings per week	251
		Savings per year - Gallons	**13,037**
Toilet:			
Old: Usage per flush - gallons	3.5	Flush per person per day	5
New: Usage per flush - gallons	1.3	Household number	4
Usage decline	2.2		
		Flush per day per household	20
		Flush per year per household	7,300
		Savings per year - Gallons	**16,206**
Fixtures (Showers):			
Old: Gallons/min flow	2.75	Flow Minutes Per Person Day	8
New: Gallons/min flow	2.00	Household Number	4
Usage Decline	0.75		
		Total Flow Minutes Per Day	32
		Total Flow Savings Per Day	24
		Savings per year - Gallons	**8,870**
Fixtures (Faucets):			
Old: Gallons/min flow	2.75	Flow Minutes Per Person Day	8
New: Gallons/min flow	1.50	Household Number	4
Usage Decline	1.25		
		Total Flow Minutes Per Day	32
		Total Flow Savings Per Day	41
		Savings per year - Gallons	**14,783**
Dish Washer:			
Old: Gallons/cycle	14	Average Use Per Capita Per Day	0.10
New: Gallons/cycle	4	Average Loads per week - 4 People	3
Usage decline	10	Savings per week	27
		Savings per year - Gallons	**1,420**

Total Impact of All Appliances:

Total Calculated Annual NJAWC Decrease in Usage @ 1,203 ppcy (Gallons)	**705,446,418**
Divided by: Total Estimate Water Usage Savings For Family of Four (Gallons)	**54,315**
Implied Number of Toilet, Clothes Washer, Fixture and Dish Washer Changes Accounting For Annual Usage Reduction NJAWC (Number of Customers)	**12,988**
NJAWC - Average Number of Residential Customers (2016)	**586,406**
Maximum number of Customers in a single year contributing to decline	**2.21%**
Implied Years For Complete Impact of Appliance Replacement	**45**

*1 Source: Handbook of Water Use and Conservation, Amy Vickers, May, 2001
*2 Source: www.home-water-works.org, A project of the Alliance for Water Efficency, 2011.

Advanced Search - Search all data in American FactFinder

DP04

SELECTED HOUSING CHARACTERISTICS
2013-2017 American Community Survey 5-Year Estimates

Although the American Community Survey (ACS) produces population, demographic and housing unit estimates, it is the Census Bureau's Population Estimates Program that produces and disseminates the official estimates of the population for the nation, states, counties, cities, and towns and estimates of housing units for states and counties.

A processing error was found in the Year Structure Built estimates since data year 2008. For more information, please see the errata note #110.

Versions of this table are available for the following years:

- 2017
- 2016
- 2015
- 2014
- 2013
- 2012
- 2011
- 2010

1 - 143 of 143

Subject	New Jersey			
	Estimate	Margin of Error	Percent	Percent Margin of Error
HOUSING OCCUPANCY				
Total housing units	3,595,055	+/-1,051	3,595,055	(X)
Occupied housing units	3,199,111	+/-7,594	89.0%	+/-0.2
Vacant housing units	395,944	+/-6,831	11.0%	+/-0.2
Homeowner vacancy rate	1.7	+/-0.1	(X)	(X)
Rental vacancy rate	5.5	+/-0.2	(X)	(X)
UNITS IN STRUCTURE				
Total housing units	3,595,055	+/-1,051	3,595,055	(X)
1-unit, detached	1,928,527	+/-5,414	53.6%	+/-0.1
1-unit, attached	341,204	+/-3,091	9.5%	+/-0.1
2 units	337,149	+/-4,266	9.4%	+/-0.1
3 or 4 units	231,044	+/-3,446	6.4%	+/-0.1
5 to 9 units	172,161	+/-2,301	4.8%	+/-0.1
10 to 19 units	177,064	+/-2,935	4.9%	+/-0.1
20 or more units	373,391	+/-3,165	10.4%	+/-0.1
Mobile home	33,830	+/-1,087	0.9%	+/-0.1
Boat, RV, van, etc.	685	+/-182	0.0%	+/-0.1
YEAR STRUCTURE BUILT				
Total housing units	3,595,055	+/-1,051	3,595,055	(X)
Built 2014 or later	21,897	+/-923	0.6%	+/-0.1
Built 2010 to 2013	51,031	+/-1,524	1.4%	+/-0.1
Built 2000 to 2009	334,957	+/-3,841	9.3%	+/-0.1
Built 1990 to 1999	341,793	+/-3,772	9.5%	+/-0.1
Built 1980 to 1989	427,942	+/-3,806	11.9%	+/-0.1
Built 1970 to 1979	458,582	+/-4,487	12.8%	+/-0.1
Built 1960 to 1969	486,259	+/-4,424	13.5%	+/-0.1
Built 1950 to 1959	547,187	+/-4,479	15.2%	+/-0.1
Built 1940 to 1949	269,846	+/-2,989	7.5%	+/-0.1
Built 1939 or earlier	655,561	+/-3,964	18.2%	+/-0.1
ROOMS				
Total housing units	3,595,055	+/-1,051	3,595,055	(X)
1 room	82,288	+/-2,003	2.3%	+/-0.1
2 rooms	75,914	+/-1,718	2.1%	+/-0.1
3 rooms	365,580	+/-3,838	10.2%	+/-0.1
4 rooms	551,012	+/-4,479	15.3%	+/-0.1
5 rooms	606,675	+/-4,949	16.9%	+/-0.1
6 rooms	581,199	+/-5,089	16.2%	+/-0.1
7 rooms	449,904	+/-3,573	12.5%	+/-0.1
8 rooms	370,796	+/-3,598	10.3%	+/-0.1

9 rooms or more	511,687	+/-4,691	14.2%	+/-0.1
Median rooms	5.7	+/-0.1	(X)	(X)
BEDROOMS				
Total housing units	3,595,055	+/-1,051	3,595,055	(X)
No bedroom	88,360	+/-1,946	2.5%	+/-0.1
1 bedroom	501,473	+/-4,332	13.9%	+/-0.1
2 bedrooms	941,607	+/-5,379	26.2%	+/-0.2
3 bedrooms	1,174,917	+/-5,790	32.7%	+/-0.2
4 bedrooms	689,802	+/-4,920	19.2%	+/-0.1
5 or more bedrooms	198,896	+/-2,939	5.5%	+/-0.1
HOUSING TENURE				
Occupied housing units	3,199,111	+/-7,594	3,199,111	(X)
Owner-occupied	2,052,073	+/-10,470	64.1%	+/-0.2
Renter-occupied	1,147,038	+/-5,890	35.9%	+/-0.2
Average household size of owner-occupied unit	2.84	+/-0.01	(X)	(X)
Average household size of renter-occupied unit	2.57	+/-0.01	(X)	(X)
YEAR HOUSEHOLDER MOVED INTO UNIT				
Occupied housing units	3,199,111	+/-7,594	3,199,111	(X)
Moved in 2015 or later	259,044	+/-2,934	8.1%	+/-0.1
Moved in 2010 to 2014	876,162	+/-5,934	27.4%	+/-0.2
Moved in 2000 to 2009	1,001,095	+/-5,559	31.3%	+/-0.2
Moved in 1990 to 1999	511,827	+/-4,581	16.0%	+/-0.1
Moved in 1980 to 1989	255,127	+/-2,866	8.0%	+/-0.1
Moved in 1979 and earlier	295,856	+/-2,471	9.2%	+/-0.1
VEHICLES AVAILABLE				
Occupied housing units	3,199,111	+/-7,594	3,199,111	(X)
No vehicles available	364,966	+/-3,209	11.4%	+/-0.1
1 vehicle available	1,096,118	+/-6,467	34.3%	+/-0.2
2 vehicles available	1,158,192	+/-6,617	36.2%	+/-0.2
3 or more vehicles available	579,835	+/-3,915	18.1%	+/-0.1
HOUSE HEATING FUEL				
Occupied housing units	3,199,111	+/-7,594	3,199,111	(X)
Utility gas	2,396,108	+/-6,157	74.9%	+/-0.2
Bottled, tank, or LP gas	61,831	+/-1,738	1.9%	+/-0.1
Electricity	397,564	+/-4,564	12.4%	+/-0.1
Fuel oil, kerosene, etc.	298,525	+/-3,045	9.3%	+/-0.1
Coal or coke	1,306	+/-300	0.0%	+/-0.1
Wood	14,505	+/-722	0.5%	+/-0.1
Solar energy	2,337	+/-307	0.1%	+/-0.1
Other fuel	12,924	+/-692	0.4%	+/-0.1
No fuel used	14,011	+/-743	0.4%	+/-0.1
SELECTED CHARACTERISTICS				
Occupied housing units	3,199,111	+/-7,594	3,199,111	(X)
Lacking complete plumbing facilities	9,151	+/-682	0.3%	+/-0.1
Lacking complete kitchen facilities	23,530	+/-1,012	0.7%	+/-0.1
No telephone service available	56,439	+/-1,625	1.8%	+/-0.1
OCCUPANTS PER ROOM				
Occupied housing units	3,199,111	+/-7,594	3,199,111	(X)
1.00 or less	3,099,268	+/-7,746	96.9%	+/-0.1
1.01 to 1.50	66,988	+/-1,737	2.1%	+/-0.1
1.51 or more	32,855	+/-1,281	1.0%	+/-0.1
VALUE				
Owner-occupied units	2,052,073	+/-10,470	2,052,073	(X)
Less than $50,000	62,199	+/-1,482	3.0%	+/-0.1
$50,000 to $99,999	63,801	+/-1,519	3.1%	+/-0.1
$100,000 to $149,999	120,820	+/-2,396	5.9%	+/-0.1
$150,000 to $199,999	209,336	+/-3,017	10.2%	+/-0.1
$200,000 to $299,999	480,964	+/-4,306	23.4%	+/-0.2
$300,000 to $499,999	675,916	+/-5,074	32.9%	+/-0.2
$500,000 to $999,999	370,890	+/-3,560	18.1%	+/-0.2
$1,000,000 or more	68,147	+/-1,224	3.3%	+/-0.1
Median (dollars)	321,100	+/-871	(X)	(X)
MORTGAGE STATUS				
Owner-occupied units	2,052,073	+/-10,470	2,052,073	(X)
Housing units with a mortgage	1,394,121	+/-7,250	67.9%	+/-0.2
Housing units without a mortgage	657,952	+/-5,449	32.1%	+/-0.2
SELECTED MONTHLY OWNER COSTS (SMOC)				
Housing units with a mortgage	1,394,121	+/-7,250	1,394,121	(X)
Less than $500	4,410	+/-394	0.3%	+/-0.1
$500 to $999	46,090	+/-1,343	3.3%	+/-0.1

$1,000 to $1,499	158,998	+/-2,501	11.4%	+/-0.2
$1,500 to $1,999	265,558	+/-3,376	19.0%	+/-0.2
$2,000 to $2,499	279,158	+/-3,141	20.0%	+/-0.2
$2,500 to $2,999	230,345	+/-3,473	16.5%	+/-0.2
$3,000 or more	409,562	+/-3,944	29.4%	+/-0.3
Median (dollars)	2,398	+/-6	(X)	(X)
Housing units without a mortgage	657,952	+/-5,449	657,952	(X)
Less than $250	13,783	+/-786	2.1%	+/-0.1
$250 to $399	20,441	+/-853	3.1%	+/-0.1
$400 to $599	53,975	+/-1,378	8.2%	+/-0.2
$600 to $799	102,703	+/-2,042	15.6%	+/-0.3
$800 to $999	135,619	+/-2,093	20.6%	+/-0.3
$1,000 or more	331,431	+/-3,653	50.4%	+/-0.3
Median (dollars)	1,005	+/-4	(X)	(X)
SELECTED MONTHLY OWNER COSTS AS A PERCENTAGE OF HOUSEHOLD INCOME (SMOCAPI)				
Housing units with a mortgage (excluding units where SMOCAPI cannot be computed)	1,388,139	+/-7,228	1,388,139	(X)
Less than 20.0 percent	459,180	+/-4,808	33.1%	+/-0.3
20.0 to 24.9 percent	228,447	+/-3,417	16.5%	+/-0.2
25.0 to 29.9 percent	172,421	+/-2,730	12.4%	+/-0.2
30.0 to 34.9 percent	121,972	+/-2,434	8.8%	+/-0.2
35.0 percent or more	406,119	+/-3,920	29.3%	+/-0.3
Not computed	5,982	+/-585	(X)	(X)
Housing unit without a mortgage (excluding units where SMOCAPI cannot be computed)	651,706	+/-5,427	651,706	(X)
Less than 10.0 percent	160,156	+/-2,863	24.6%	+/-0.3
10.0 to 14.9 percent	128,064	+/-2,288	19.7%	+/-0.3
15.0 to 19.9 percent	86,909	+/-1,641	13.3%	+/-0.2
20.0 to 24.9 percent	61,615	+/-1,440	9.5%	+/-0.2
25.0 to 29.9 percent	43,581	+/-1,263	6.7%	+/-0.2
30.0 to 34.9 percent	31,691	+/-1,105	4.9%	+/-0.2
35.0 percent or more	139,690	+/-2,172	21.4%	+/-0.3
Not computed	6,246	+/-507	(X)	(X)
GROSS RENT				
Occupied units paying rent	1,108,584	+/-5,902	1,108,584	(X)
Less than $500	89,566	+/-1,948	8.1%	+/-0.2
$500 to $999	224,027	+/-2,821	20.2%	+/-0.2
$1,000 to $1,499	447,592	+/-4,147	40.4%	+/-0.3
$1,500 to $1,999	212,848	+/-3,407	19.2%	+/-0.3
$2,000 to $2,499	78,850	+/-1,976	7.1%	+/-0.2
$2,500 to $2,999	30,364	+/-1,186	2.7%	+/-0.1
$3,000 or more	25,337	+/-1,031	2.3%	+/-0.1
Median (dollars)	1,249	+/-4	(X)	(X)
No rent paid	38,454	+/-1,411	(X)	(X)
GROSS RENT AS A PERCENTAGE OF HOUSEHOLD INCOME (GRAPI)				
Occupied units paying rent (excluding units where GRAPI cannot be computed)	1,084,961	+/-5,773	1,084,961	(X)
Less than 15.0 percent	126,573	+/-2,792	11.7%	+/-0.2
15.0 to 19.9 percent	129,423	+/-2,470	11.9%	+/-0.2
20.0 to 24.9 percent	133,489	+/-2,673	12.3%	+/-0.2
25.0 to 29.9 percent	122,603	+/-2,471	11.3%	+/-0.2
30.0 to 34.9 percent	99,641	+/-2,255	9.2%	+/-0.2
35.0 percent or more	473,232	+/-4,617	43.6%	+/-0.4
Not computed	62,077	+/-1,848	(X)	(X)

Source: U.S. Census Bureau, 2013-2017 American Community Survey 5-Year Estimates

Explanation of Symbols:
An '**' entry in the margin of error column indicates that either no sample observations or too few sample observations were available to compute a standard error and thus the margin of error. A statistical test is not appropriate.
An '-' entry in the estimate column indicates that either no sample observations or too few sample observations were available to compute an estimate, or a ratio of medians cannot be calculated because one or both of the median estimates falls in the lowest interval or upper interval of an open-ended distribution.
An '-' following a median estimate means the median falls in the lowest interval of an open-ended distribution.
An '+' following a median estimate means the median falls in the upper interval of an open-ended distribution.
An '***' entry in the margin of error column indicates that the median falls in the lowest interval or upper interval of an open-ended distribution. A statistical test is not appropriate.
An '*****' entry in the margin of error column indicates that the estimate is controlled. A statistical test for sampling variability is not appropriate.
An 'N' entry in the estimate and margin of error columns indicates that data for this geographic area cannot be displayed because the number of sample cases is too small.
An '(X)' means that the estimate is not applicable or not available.

Schedule GPR-5
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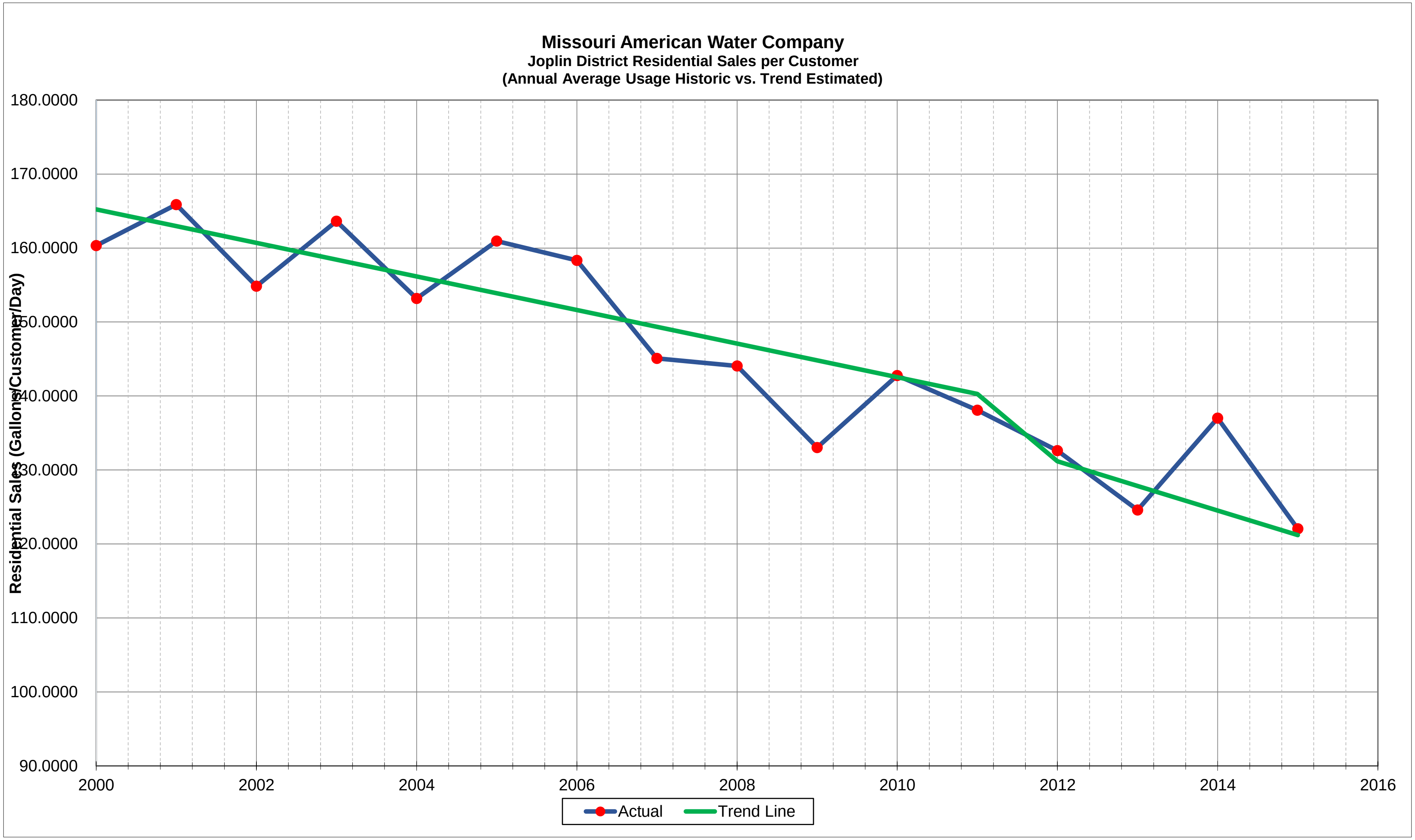

New Jersey American Water Company
Actual Revenue/Water Sales Compared to Utilized
(2009-2018)

	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	Total 2009-2018
NJWC Total Billed Annual Revenue*	410,469,866	432,198,459	439,676,035	461,162,881	450,704,130	457,426,392	485,970,924	522,731,814	502,384,314	514,115,359	4,676,840,174
Total Authorized Revenue**	439,739,115	439,739,115	454,158,610	467,686,598	473,360,865	473,360,865	479,895,096	501,344,725	501,344,725	516,018,955	4,746,648,670
Revenue Recovery to Authorized (Under)/Over	(29,269,249)	(7,540,656)	(14,482,575)	(6,523,717)	(22,656,735)	(15,934,473)	$6,075,828	$21,387,089	$1,039,589	($1,903,596)	($69,808,496)
	-6.66%	-1.71%	-3.19%	-1.39%	-4.79%	-3.37%	1.27%	4.27%	0.21%	-0.37%	-1.47%
NJWC Total Annual Water Sales (000 Gallons)	62,198,523	68,349,122	63,430,775	63,855,472	60,752,397	61,405,819	64,430,499	63,682,367	61,401,684	60,648,710	630,155,367
Total Authorized Water Sales*	68,557,095	68,557,095	65,194,420	64,517,922	64,234,167	64,234,167	63,324,154	60,336,896	60,336,896	60,340,356	639,633,168
Water Sales to Authorized (Under)/Over	(6,358,572)	(207,973)	(1,763,645)	(662,450)	(3,481,770)	(2,828,348)	1,106,345	3,345,471	1,064,788	308,354	(9,477,801)
	-9.27%	-0.30%	-2.71%	-1.03%	-5.42%	-4.40%	1.75%	5.54%	1.76%	0.51%	-1.48%

	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	Average 2009-2018
Annual Cooling Degree Days	791	1,285	1,218	1,142	1,029	869	1,051	1,233	1,014	1,249	1,088
Percipitation June-Sept	17.7	8.9	24.4	11.7	9.5	9.0	6.6	10.9	11.1	17.5	12.7

*GMS only. Exclusive of DSIC and Surcharge and Other Water Revenue
**GMS only. Per Commission Orders Exclusive of Other Water Revenue

Figure-1
New Jersey American Water Company
Water Sales and Revenues
2009-2018

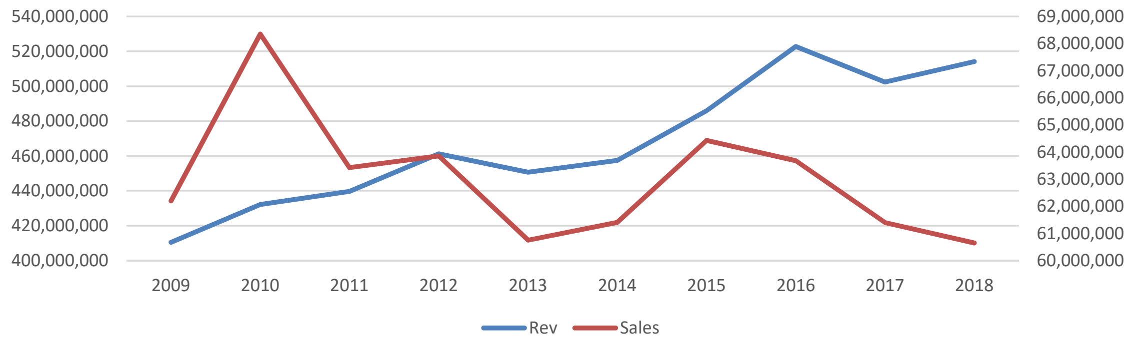

Figure-2
New Jersey American Water Company
Water Sales and Percipitation
2009-2018

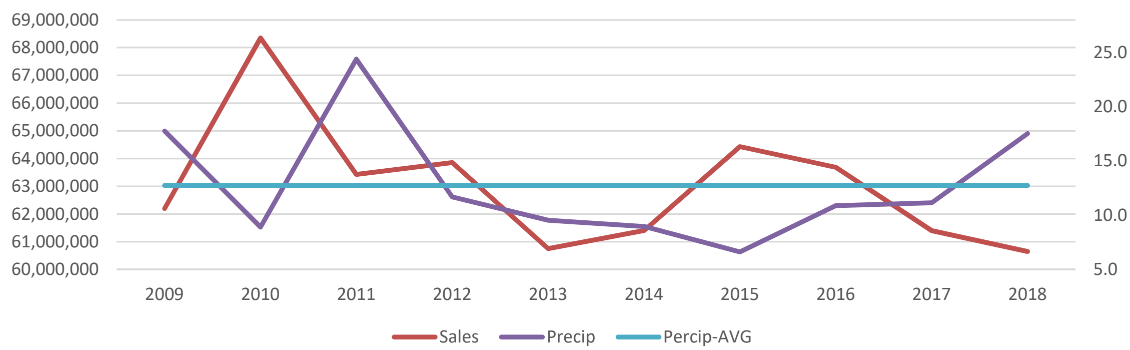

Figure-3
New Jersey American Water Company
Water Sales and Cooling Degree Days
2009-2018