

Section 3: WATER DEMAND FORECASTS

INTRODUCTION

This Section documents the methodology used to develop water demand forecasts. The “Demand Side Management Least Cost Planning Decision Support System” (DSS) computer model developed by Maddaus Water Management was updated and used to forecast water demands and assess water conservation measures. The model uses current water production and billing data provided by most local water providers, along with population and employment forecasts, to estimate water demands through 2035.

Using two distinct approaches, “top-down” and “bottom-up”, the model calculates indoor and outdoor anticipated demands for each of the customer categories: single-family residential, multi-family residential, commercial, industrial, institutional and other categories as established by the local water provider. The “top-down” approach breaks overall water usage by total consumed/billed, by customer category, and by indoor and outdoor usage. The “bottom-up” approach examines the frequency of use for a particular end use (such as toilets, showers, faucets, etc.) and aggregates them to total water usage for each customer category. To calibrate the model, the two approaches are adjusted and reconciled as needed. Each county’s specific conditions were calibrated using this approach, and then the model was used to forecast future water demands and to assess the water conservation measures.

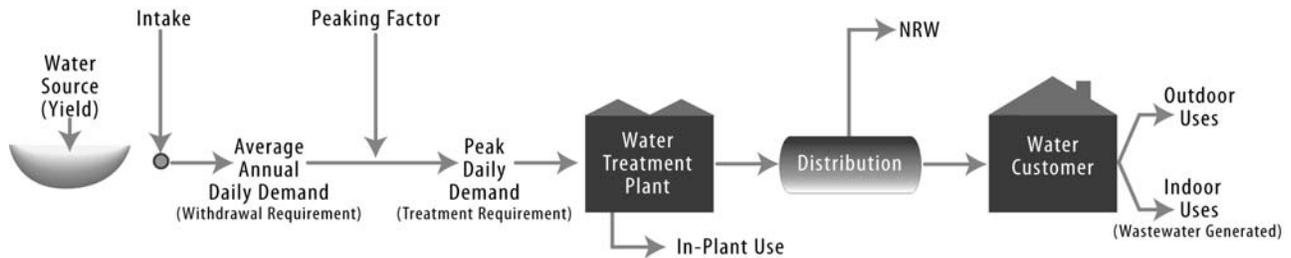
DATA COLLECTED

Water demand forecasts for the Metro Water District were based on three main data inputs: 1) billing and production data, 2) population and employment forecasts, and 3) estimates of the current stock of plumbing fixtures and appliances for each county. The first input enables the model to build a water use profile by customer category for existing conditions. The second input is used to project current unit-based demands forward through the planning horizon. The third input is used to quantify the expected reduction in current water use trends based on natural conversion of inefficient plumbing fixtures resulting from the existing State plumbing code. Other demographic data used in the model was obtained from the 2000 and 2006 US Census.

WATER BILLING AND PRODUCTION DATA

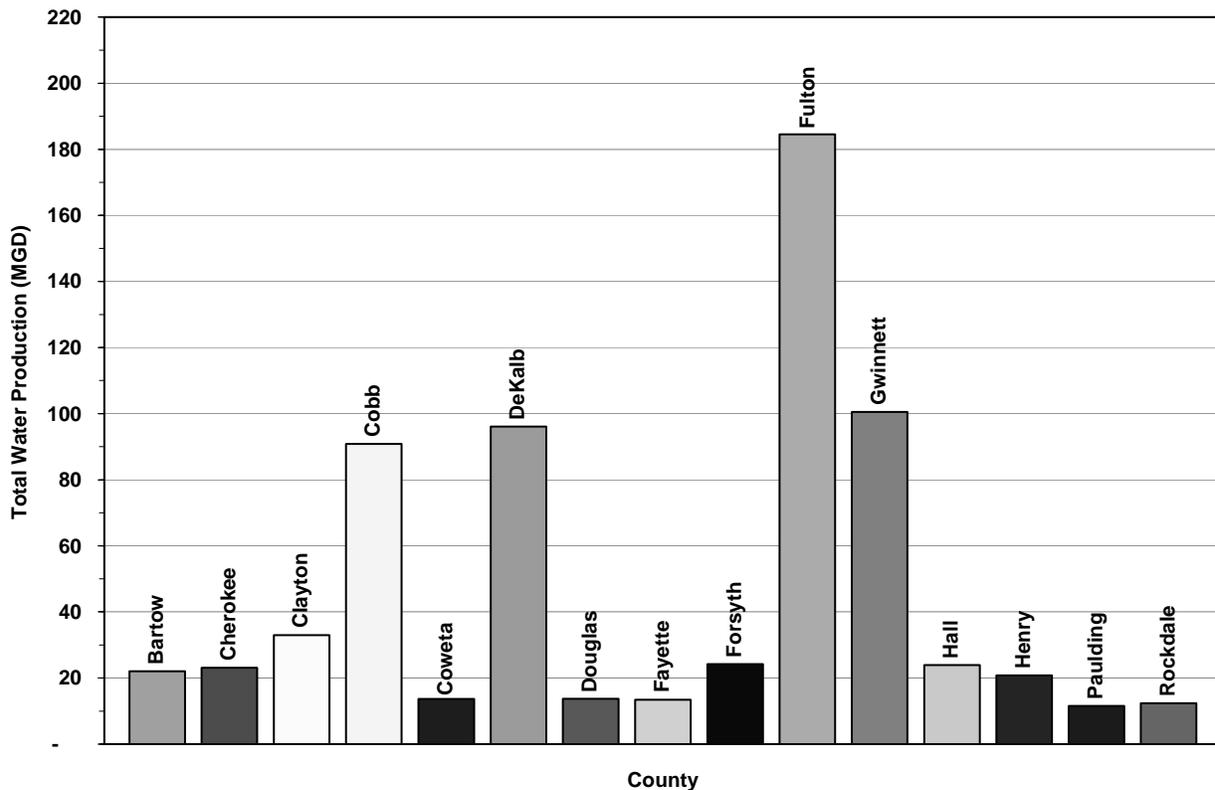
Water usage data was solicited from the local water providers in the Metro Water District. This data included water withdrawal and production data, as well as customer billing data (water use data) by category. Figure 3-1 shows the process by which water is conveyed from the source to the end use, and how the provided billing data was separated into its various components for further analysis.

FIGURE 3-1
Water System Diagram



The current water use data for each county in the Metro Water District is shown in Figure 3-2 in million gallons per day on an annual average day demand (AAD-MGD). For the purposes of forecasting future water demands, the 2006 actual water use data was adjusted as discussed later in this Section to reflect the ongoing drought conditions and suppressed usage due to emergency drought measures in 2006. If water use data was not available, water production data was adjusted to reflect expected water use.

FIGURE 3-2
2006 Adjusted Municipal Water Use by County (AAD-MGD)



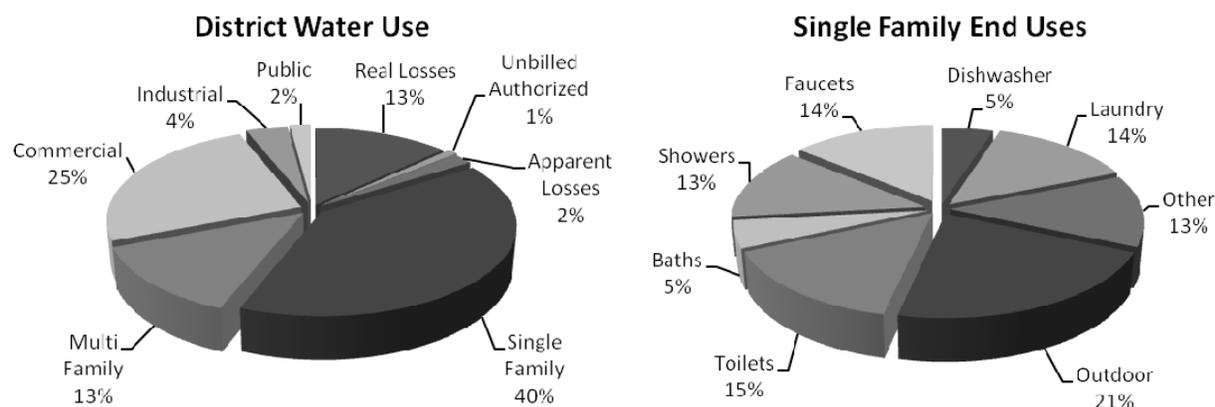
Section 3: WATER DEMAND FORECASTS

Non-revenue water (NRW) and water loss are indicators of the efficiency of the region's water distribution systems. NRW is identified by the International Water Association/American Water Works Association (IWA/AWWA) as the total water in the system (including water produced and imported) minus the total billed consumption, or as water that does not provide revenue to the local water provider. Water loss can be subdivided into a number of categories; unbilled authorized, apparent losses, and real losses. Unbilled authorized uses include fire fighting, hydrant flushing, street cleaning and public fountains. Apparent losses include meter inaccuracies, data errors and unauthorized consumption (theft or illegal connections). Real losses include physical losses from any type of leakage, break, or overflow. NRW and water loss were estimated based on the national information and limited local information, as available. The IWA/AWWA methodology that defines NRW and water loss is a new national standard and as it becomes more widely understood and used by water systems more complete data should be available.

The local water provider production data was broken out by customer category (such as single family residential, commercial, industrial, etc.) and was used along with NRW and water loss data to create the Metro Water District water use profile. The calibration of the top down and bottom up analyses in the model generated the typical single family residential end uses.

Figure 3-3 shows the water use profile for the Metro Water District. Residential water use, including single and multi-family use, accounts for 53 percent of the Metro Water District's total water use.

FIGURE 3-3
Metro Water District Water Use Profile (AAD-MGD)



POPULATION FORECASTS

Population and employment data for each of the 15 counties were obtained from each county's local Regional Development Center (RDC). Where data was not available from the local RDC, data from the Atlanta Regional Commission was used, with the exception of Hall County where the Gainesville-Hall Metropolitan Planning Organization (MPO) data was used. Table 3-1 shows the population forecasts by county.

Section 3: WATER DEMAND FORECASTS

TABLE 3-1
Population and Employment Forecasts by County

County	Population Forecasts (# of people)		
	2015	2025	2035
Bartow ¹	139,600	210,800	304,900
Cherokee	229,900	303,000	410,700
Clayton	288,600	294,000	307,300
Cobb	694,200	737,400	796,900
Coweta ²	124,900	162,500	253,400
DeKalb	747,100	789,800	856,400
Douglas	138,000	182,000	257,000
Fayette	114,700	142,200	181,200
Forsyth ¹	256,700	342,100	412,800
Fulton	943,900	1,065,500	1,233,800
Gwinnett	843,900	945,900	1,044,300
Hall ³	245,300	325,200	405,200
Henry	222,600	309,700	424,100
Paulding ¹	215,700	353,000	445,600
Rockdale	88,600	117,100	159,200
District Total	5,293,700	6,280,200	7,492,800
County	Employment Forecasts (# of employees)		
	2015	2025	2035
Bartow ¹	44,900	56,300	67,900
Cherokee	66,700	99,800	141,500
Clayton	138,900	155,700	181,600
Cobb	361,600	415,200	480,700
Coweta ²	43,300	59,600	82,900
DeKalb	343,600	397,100	459,200
Douglas	53,600	72,900	92,400
Fayette	56,800	76,900	99,100
Forsyth ¹	89,800	120,700	146,600
Fulton	845,600	978,300	1,103,600
Gwinnett	396,100	477,200	546,100
Hall ³	134,300	230,700	327,200
Henry	70,100	103,800	140,900
Paulding ¹	27,000	33,900	40,800
Rockdale	42,200	52,900	65,200
District Total	2,714,500	3,331,000	3,975,700

Source: ARC Population and Employment Forecasts were used for all counties within the ARC Region; sources for counties outside the ARC Region are as follows:

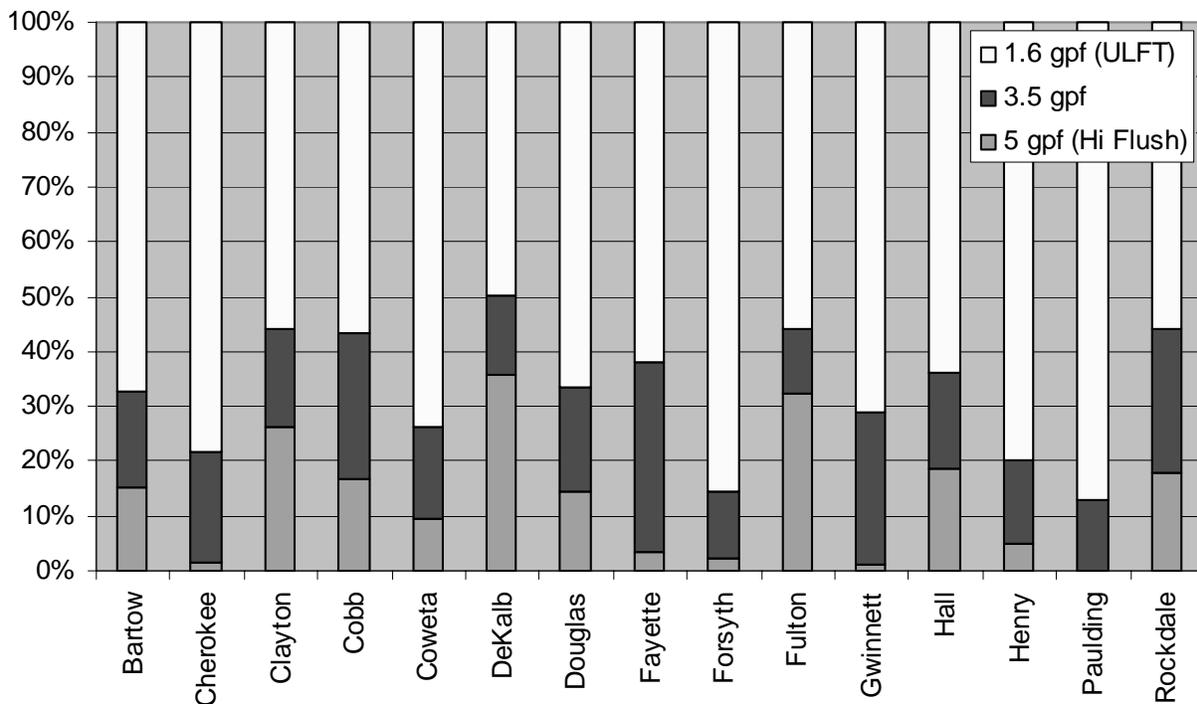
1. RDC Population and Employment Forecasts (Bartow, Forsyth and Paulding)
2. ARC Population and Employment Forecasts (Coweta)
3. Gainesville-Hall County 2030 MPO Population and Employment Forecasts (Hall)

PLUMBING FIXTURE STOCK

Plumbing fixture stock was inferred from housing data provided by the Metro Water District and the 2000 US Census. The Metro Water District provided estimates of housing age from the 2000 Census and the 2006 American Community Survey that were adjusted based on a projected replacement rate to more efficient fixtures.

The types of plumbing fixtures installed in houses and other buildings play a large role in current internal use as well as forecasted use in the future. Counties with recent development, such as Forsyth and Paulding have very low estimates of inefficient toilets. Alternatively, counties which developed more heavily in past decades, such as Fulton and DeKalb, have a higher percentage of inefficient toilets. Toilets are the largest water users inside the home; therefore, counties with large percentages of high flush toilets have a higher water savings potential in the future from the natural replacement of fixtures due to plumbing code. Estimates for existing types of toilet fixtures by county are provided in Figure 3-4.

FIGURE 3-4
Toilet Fixture Estimates by County, Year 2006



ASSUMPTIONS

Certain assumptions and adjustments were made to the billing data collected from local water providers in order to account for non-typical weather patterns and for certain data that was not available. General assumptions in the model include the following:

- The base year for the water use forecasts is 2006. However, drought management restrictions in effect during 2006 depressed the normal water use rates. In order to create a representative base year for water demands forecasts, 2006 demands were adjusted to take into account drought management restrictions. The adjustment was based on the last 10 years of weather data looking at water use during both wet and dry years of record, long-term permanent changes in water use behavior as the result of drought, and the benefits of natural conservation and the Metro Water District's aggressive water conservation program in reducing historical demand. The difference in per capita demand between the 2006 actual and the 2006 adjusted demand essentially reflects demand suppression resulting from emergency drought response actions, including outdoor watering restrictions, which are not reflective of normal water use patterns.
- Once the per-account unit-based demands for each customer category were established, the number of accounts was used to estimate the total demand for each county. In cases where complete billing data was available, the numbers of accounts were taken directly from the data.
- In cases where part or all of the billing data was not available, accounts were either increased from the 2003 Plan model relative to either the increase in population and employment, or the increase in housing units over the 5-year period.
- When both production and billing data were available, non-revenue water was estimated as a percentage of production. When this value was not available, non-revenue water was based on percentages in the 2003 Plan.

Table 3-2 shows the resulting adjusted base year per capita and per employee uses for residential single- and multi-family, as well as other non-residential uses, including indoor and outdoor use.

ADJUSTED BASE YEAR PROFILE

As 2006 water use was unnaturally depressed as a result of the ongoing drought, the water use data was adjusted to create an adjusted base year profile that would reflect normal water use conditions. For long-term regional planning, normal water conditions provide a more reasonable estimate of future needs than the drought-impacted actual water usage. The 2006 data shown in Figure 3-2 was adjusted to develop the 2006 adjusted base year profile, which represents water use under normal conditions. Following the adjustment, the total system per capita use adjusted is approximately 10% lower than the 2003 Plan despite regional growth as residual demand suppression from drought restrictions will remain. Table 3-2 shows the adjusted base year per capita and per employee uses for residential single and multi family, as well as all other non-residential uses, including indoor and outdoor use.

Section 3: WATER DEMAND FORECASTS

TABLE 3-2
Adjusted Base Year Water Use Profile by County

County	Total System Use (Note 1)	Overall (gpcd) (Note 2)				Single Family Residential (gpcd) (Note 3)				Multi Family Residential (gpcd) (Note 3)				Non-Residential (gpd/employee) (Note 3)			
		Total Consumption	Indoor	Outdoor (Note 5)	% Outdoor	Total	Indoor	Outdoor (Note 5)	% Outdoor	Total	Indoor	Outdoor (Note 5)	% Outdoor	Total	Indoor	Outdoor (Note 5)	% Outdoor
Bartow	241	186	152	34	18%	88	68	20	23%	75	66	9	12%	266	225	41	15%
Cherokee	126	106	84	22	21%	79	61	18	23%	69	59	10	15%	117	94	22	19%
Clayton	124	108	91	17	16%	81	68	14	17%	78	66	12	15%	61	52	9	15%
Cobb	140	127	100	27	22%	82	63	19	23%	67	60	7	10%	98	73	25	25%
Coweta	127	101	84	17	17%	83	66	17	20%	67	60	7	10%	78	70	8	10%
DeKalb	143	120	98	22	18%	85	68	17	20%	69	61	8	12%	89	76	13	15%
Douglas	115	88	73	15	18%	78	65	13	17%	60	57	3	5%	62	47	16	25%
Fayette	130	116	92	23	20%	87	69	18	21%	63	57	6	10%	85	70	15	18%
Forsyth (Note 4)	160	130	88	42	32%	99	70	30	30%	N/A	N/A	N/A	N/A	83	50	32	39%
Fulton	202	168	135	33	19%	106	79	28	26%	83	73	10	12%	94	77	17	18%
Gwinnett	142	116	90	27	23%	91	71	20	22%	67	60	7	10%	58	38	20	34%
Hall	138	123	97	26	21%	79	63	16	20%	61	55	6	10%	132	102	30	23%
Henry	121	102	77	24	24%	78	63	16	20%	69	59	10	15%	103	65	39	37%
Paulding	95	85	71	14	17%	80	66	14	17%	72	64	7	10%	44	37	7	15%
Rockdale	154	105	84	21	20%	83	68	15	18%	71	64	7	10%	53	39	15	27%
Weighted Average (Note 6)	151	127	101	26	20%	89	69	20	22%	69	61	8	11%	89	70	19	22%

Notes:

1. Total adjusted per capita use (total adjusted demand including non-revenue water divided by total population) includes self-supplied water demands, shown in gpcd
 2. Includes self-supplied, does not include non-revenue water
 3. Publicly supplied water and population only
 4. Billing data includes multi-family in single family category
 5. Outdoor use is defined as all use above the winter minimum level
 6. Weighted average based on population
- gpcd = gallons per capita (person) per day
gpd = gallons per day

METHODOLOGY

TOP-DOWN ANALYSIS

The total adjusted demand for each county was estimated based on the per-account unit-based demands for each customer category and the number of customer accounts. In cases where complete billing data was available, the numbers of accounts were taken directly from the data. In cases where part or all of the billing data was not available, accounts were either increased from the 2003 Plan model relative to either the increase in population and employment, or the increase in housing units over the 5-year period. Since there is not a standard billing category system in place in the Metro Water District, common categories were used across the Metro Water District for comparative purposes. The main categories were as follows:

- Single Family Residential
- Multi Family Residential
- Commercial
- Industrial
- Institutional

Other categories vary as defined based on the billing data submitted by the utilities. These include separate irrigation metering, wholesale customers, individual industries (i.e., food processing), etc. A “self-supplied” category was added to counties with a significant population on private wells. Based on these account categories and data supplied by water providers, the number of accounts per customer category was determined.

The top-down analysis also looked at housing stock information to estimate the percentage of water use by plumbing fixtures. The makeup of plumbing fixtures in the Metro Water District was based on housing age (derived from the 2000 census and 2006 American Community Survey) and adjusted with a modest natural replacement rate, shown in Table 3-4.

The natural replacement converts existing less efficient plumbing fixtures with more efficient fixtures as they are damaged or due to changes in style. The Georgia plumbing standards ensure that older fixtures are replaced with more efficient fixtures. Over time, the plumbing code will gradually reduce indoor per capita demands, as the percentage of efficient fixtures in homes and buildings increases. This demand, which includes water savings due to efficient fixtures, is referred to as the ‘baseline’ demand.

BOTTOM-UP ANALYSIS

The American Water Works Association Research Foundation (AWWARF) study, “Residential End Uses of Water” provided the initial bottom-up estimates for fixture use frequencies and quantities. Table 3-3 shows the average water end uses and frequency of use factors for a single-family account, based on the AWWARF study. These initial end use estimates were compared in each model to the existing stock of plumbing fixtures in each of the counties, based on the top-down analysis. For instance, counties with a larger percentage of older homes have a larger portion of indoor use attributed to toilet flushing than counties with a higher percentage of new

Section 3: WATER DEMAND FORECASTS

development. The top-down and bottom-up were adjusted until they matched to assure calibration of the model, with preference provided to the more accurate top-down generated numbers.

TABLE 3-3
Single Family Water End Uses (AWWARF)

End Use	Share	Gallons Per Person Per Day	Average Uses per Person Per Day
Toilets	26.7%	18.5	5.05 flushes
Clothes Washers	21.7%	15.0	0.37 loads
Shower	16.8%	11.6	0.75 showers and baths
Faucet	15.7%	10.9	8.1 minutes
Leaks	13.7%	9.5	
Other Domestic	2.2%	1.5	
Bath	1.7%	1.2	
Dishwasher	1.4%	1.0	0.1 loads
Indoor Total	100%	69.3	

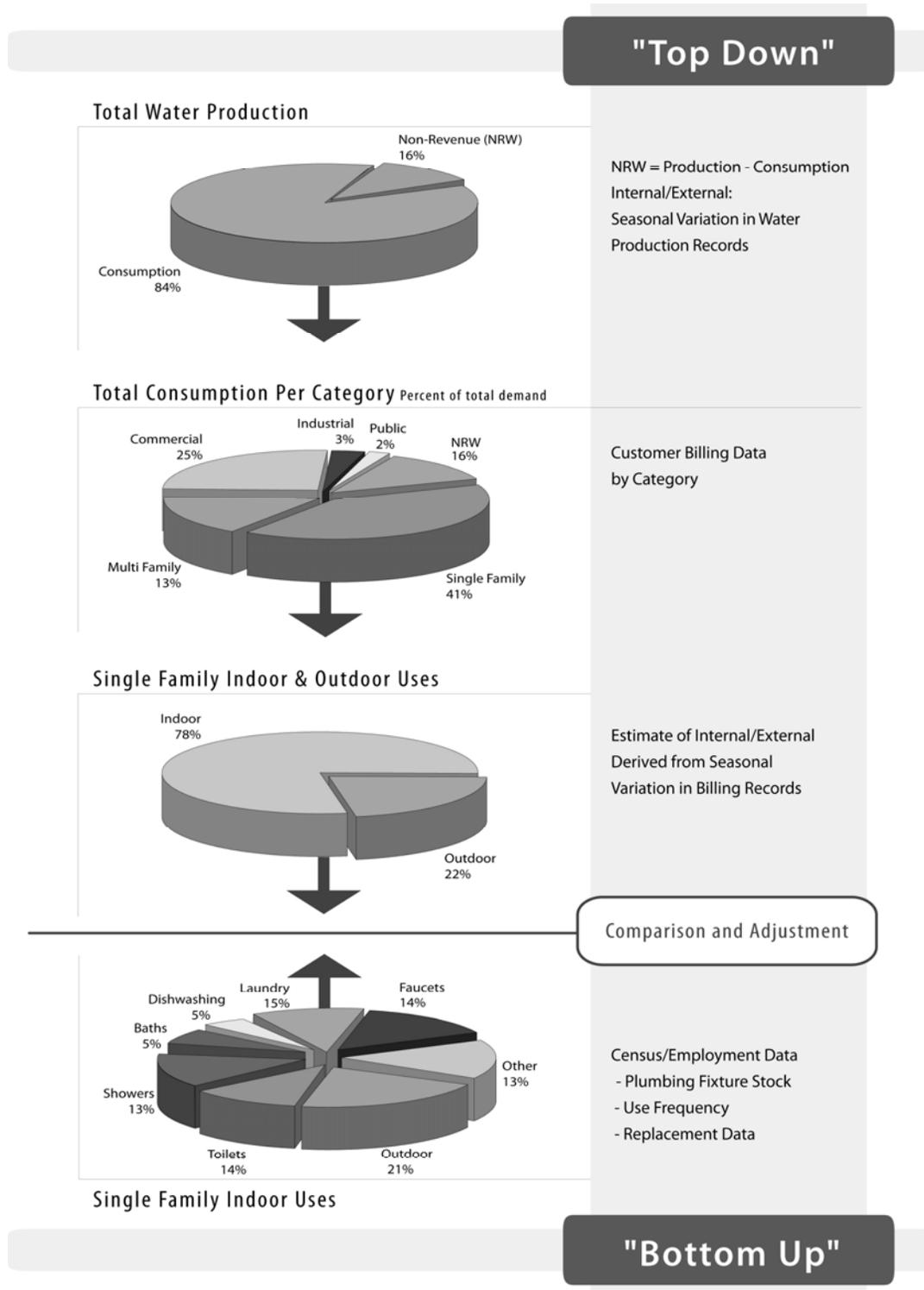
Source: "Residential End Uses of Water," Mayer, AWWARF, 1999.

TABLE 3-4
Natural Plumbing Fixture Conversion

End Use	Current Plumbing Code	Natural Replacement Rate
Toilets	1.6 gallons/flush	2% per year
Urinals	1.0 gallons/flush	2% per year
Showerheads	2.5 gallons/minute	4% per year
Washing Machine	19 gallons/load or less	6.7% per year Up to 2007, 30% will be efficient From 2007 to 2010, 50% will be efficient Beyond 2010, all replacements will be efficient

Specific water savings resulting from the plumbing code vary by county depending upon the demographics of each county and its current share of low, medium, and high flow fixtures in existing dwellings and businesses.

FIGURE 3-5
Water Use Model Methodology



BASELINE WATER DEMAND FORECASTS

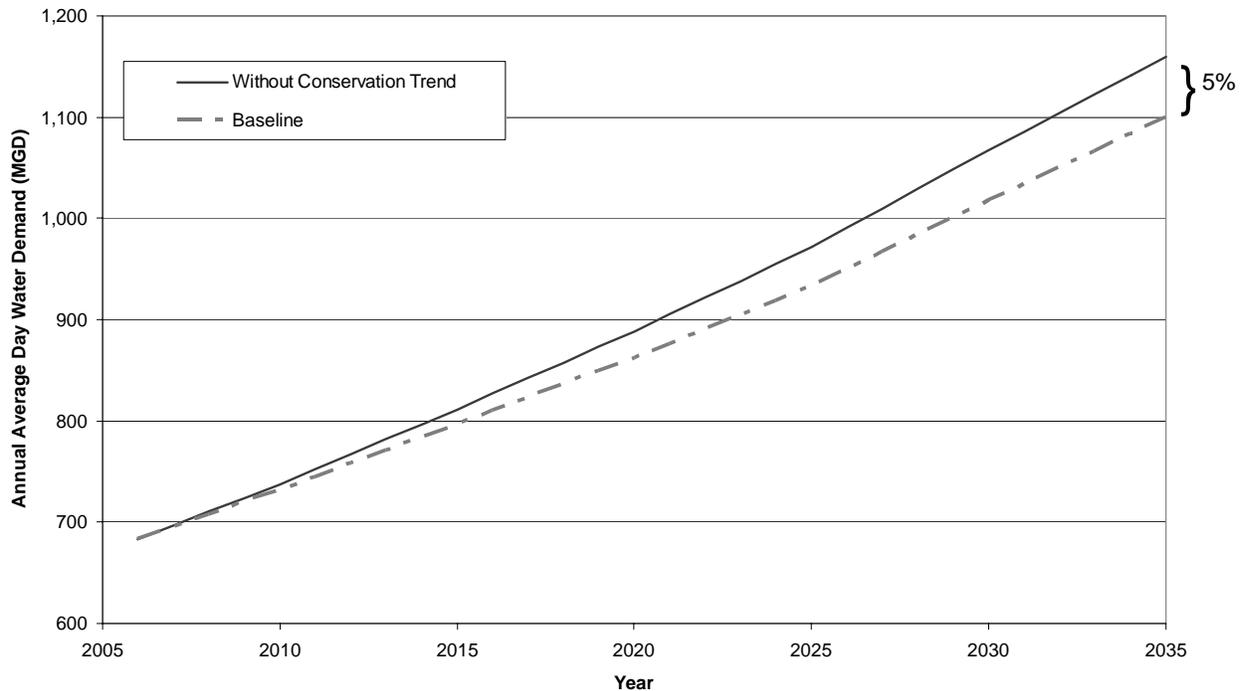
The without conservation trend forecasts water demands without water savings due to the existing plumbing code; while the baseline water demand forecast incorporates future reductions in indoor use as a result of the continued implementation of the existing plumbing code. The natural replacement of less efficient plumbing fixtures is expected to reduce future water demand by 5% in 2035. Figure 3-6 provides a comparison of the demands considered “baseline” and those demands based on trends without conservation.

The baseline savings in the 2003 Water Supply and Water Conservation Management Plan was estimated to be 9%. While a reduced savings is anticipated from progress since 2004 in implementing the conservation plan and plumbing code, the difference between 9% and 5% is worth noting.

The 2003 Water Supply and Water Conservation Management Plan used a base year of 2001 for the water supply and water conservation models. The models used the best available information at that time, and relied heavily on the typical residential water use, as published in the AWWA Research Foundation (AWWARF) Residential End Uses report that shows average residential water uses from 12 American cities in the mid 1990s.

For this Plan update, the Metro Water District relied more heavily on fixture stock (inferred from housing age) than the outdated residential end uses presented in the AWWARF Residential End Uses report due to the availability of more accurate local data on housing age and toilet replacement rates. The typical end uses in this report no longer reflect conditions in the Metro Water District; including the relatively new housing stock compared to other cities, the high level of bathroom remodels in the past decade, and the impact of the federal and state plumbing code requirements. For the Plan update, housing stock information provided by the Metro Water District was not adjusted to match the AWWARF study. The makeup of residential toilets in the Metro Water District was based on housing age (derived from the 2000 census and 2006 American Community Survey) and adjusted with a modest natural replacement rate of 1% to 1.5% per year. The current residential water usage profile for the Metro Water District, shown on page 3-3, does not match the AWWARF Report for 12 cities from the mid 1990s. The Plan update water use profile is more reflective of existing conditions in the Metro Water District.

FIGURE 3-6
Forecast of Baseline and Without Conservation Demands



FINAL WATER DEMAND FORECASTS WITH METRO WATER DISTRICT CONSERVATION PROGRAM

The baseline water demands were reduced through the application of the chosen Metro Water District Water Conservation Program. The analysis and selection of the recommended water conservation program is further described in Section 4. The recommended water conservation program, discussed in Section 4, is projected to reduce the baseline water demands by 8 percent from a baseline demand of 1,099 AAD-MGD to 1,011 AAD-MGD. Table 3-5 shows the baseline and projected water demands with the conservation program by county.

TABLE 3-5
2035 Water Demand Forecasts by County

County	2035 Forecasts		
	Without Conservation AAD-MGD	Baseline AAD-MGD	Recommended Conservation Program AAD-MGD
Bartow	55.4	52.8	46.4
Cherokee	50.5	47.8	44.6
Clayton	45.0	42.7	40.0
Cobb	121.0	115.3	108.7
Coweta	33.5	31.9	29.3
DeKalb	123.4	116.0	106.4
Douglas	29.7	27.5	24.5
Fayette	26.0	24.3	23.1
Forsyth	69.5	66.9	59.7
Fulton	263.2	250.0	228.2
Gwinnett	161.5	153.6	140.4
Hall	57.3	54.3	52.0
Henry	49.2	46.9	43.4
Paulding	52.0	49.2	47.2
Rockdale	22.0	20.2	16.9
District Total	1,159.2	1,099.4	1,010.8

Comparing the water demand forecasts by county to the 2003 Water Supply and Water Conservation Management Plan, the increase in demands correlate to the population and employment forecasts. These forecasts are also impacted by the current water use patterns for each county as well as the potential for water conservation associated with the housing stock and the blend of water users specific to each county.

BEYOND 2035

The 2050 demand forecasts are provided to initiate consideration of supplies needed outside of the planning horizon. With the cost and time needed to develop new water sources, communities may wish to consider demand beyond the 2035 planning horizon. Population information for 2050 was obtained, where available, from long range planning by the local Regional Development Centers (RDC), Counties, and the City of Atlanta. Where this information was not available, the 2035 population forecasts were linearly projected out to 2050. Water demands for 2050 were estimated by multiplying the 2050 population by each county’s future gallons per capita daily estimates with conservation. The results of the forecasts are shown in Table 3-6. As population and employment forecasts for 2050 are not available in any degree of precision, the forecasts of demands followed the same straight line analysis. The population and employment forecasts for 2050 as part of the Comprehensive State-wide Water Management Plan will be used, when available, for the next Plan update.

TABLE 3-6
2050 Population and Demand Forecasts

County	2050 Population	2050 Demand (AAD-MGD)
Bartow (Note 1)	486,254	74
Cherokee	499,639	54
Clayton	388,064	44
Cobb	869,974	119
Coweta	287,444	33
DeKalb	923,885	120
Douglas (Note 2)	310,000	31
Fayette	208,278	27
Forsyth (Note 2)	538,606	78
Fulton (Note 3)	1,692,114	284
Gwinnett (Note 2)	1,158,000	156
Hall (Note 1)	442,800	57
Henry	531,098	54
Paulding (Note 1)	479,393	51
Rockdale	185,543	20
District Total	9,001,092	1,202

Notes:

1. Population projection provided by local RDC.
2. Population projection provided by county water system.
3. Population projection provided by county water system and City of Atlanta.