

# RESIDENTIAL AND NON-RESIDENTIAL WATER USE FACTORS FOR THE ATLANTA REGION

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**Abstract:** The Atlanta Regional Commission has recently completed a water use study to examine how water is used in the Atlanta Region in both the residential and non-residential sectors. Water use was researched for 300 single family households throughout the Atlanta Region between the years 1993 and 1995 to determine average daily single family household water use in gallons/household/day. Water use in forty apartment complexes, representing approximately 10,640 multi-family households, was analyzed to determine average daily multi-family household water use. Non-residential water use was examined for 1995 water use data for non-residential customers to produce water use factors in gallons/employee/day for eight major standard industrial classification categories. Both the residential and non-residential water use factors were developed to provide a current water use condition for the Atlanta Region. These factors will be used to assist in producing future water demand forecasts for the Atlanta Region.

## INTRODUCTION

The Atlanta Regional Commission (ARC) prepares and maintains the Atlanta Regional Water Supply Plan which is used as a development guide for the 10-county metropolitan Atlanta Region. The plan consists of descriptions of the Region's water suppliers, water supply sources, projected water demands, water allocations, issue areas, research needs, and policy recommendations. ARC is currently in the midst of preparing a major update to the Atlanta Regional Water Supply Plan. New water demand forecasts will be produced for the new plan.

As part of the plan development process, research was conducted to determine water use factors for both the residential sector and the employment sector. Water use factors were developed for four residential income categories as well as for overall households. Factors were also developed for eight different major employment categories that correspond to the Standard Industrial Classification employment categories. Pending final review, these water use factors will be applied to ARC residential and employment data to provide a baseline condition for water demand forecasts.

This paper describes the method used to develop the twelve water use factors. The factors that are presented here are also

compared to other sets of water use factors that have been developed. The results of this research will be used to assist in producing water demand forecasts for the ARC Region.

## RESEARCH METHODS

### Residential Water Use Factors

**Data Collection.** Residential water use factors in gallons/household/day were determined by examining residential use in both single family and multi-family households. Single family water use was determined by examining water bills from 300 single family households located in the City of Atlanta Water Dept., the Fulton County Water & Sewer system, the Cobb County Water System, and the Gwinnett County Dept. of Public Utilities. Monthly water bills were obtained for each household from 1993 to 1995 to give a good overall impression of water use during both dry times and wet times. Water bills for 40 apartment complexes representing approximately 10,662 multi-family housing units were also examined.

In order to obtain a good representative sample of water use, it was desirable to obtain a full years worth of data for each household. However, due to variations in billing systems and the availability of billing records, this was not always possible. Therefore, any household or apartment complex for which seven months of consecutive data were available was included in the study. Seven months of consecutive data was considered adequate to give a true representation of water use for a particular household or apartment complex during the winter and summer months.

After the monthly water bills were collected, a database was developed consisting of household and apartment complex addresses and average daily water consumption history for each month by system area. For the single family households, each address was matched with an income estimate based on Census Block Group Data collected as part of the 1990 Census. This income data yielded a good approximate estimate of each household's income level.

**Data Analysis.** When the data collection was complete, a statistical analysis was performed to estimate the approximate

average daily household water use for single family households for each of four household income levels, all single family households, and all multi-family households, and all households combined. Household water use by income group was estimated according to the following income levels: households whose average yearly income was between \$0-\$19,999, between \$20,000 and \$39,999, between \$40,000 and \$59,999, and greater than \$60,000. These income levels were chosen because the ARC Vision 2020 Baseline Forecast publication produces household forecasts for each one of these income levels. These residential water use factors are expressed in gallons/household/day.

### Non Residential Water Use Factors

Estimating gallons/employee/day factors for eight different major industry employment groups proved to be more challenging due to the varying types of employment that exist in these eight categories and the way each one of these categories consumes water. In order to develop factors for each of these industry groups, a historical water use computer file from the DeKalb County Department of Public Works was obtained listing monthly water consumption in 1995 for each non-residential address in DeKalb County. The addresses that were obtained from DeKalb County were address matched with the ARC employment database that estimates employment by address. Following this match, a database was developed listing each address, the company name, monthly water use, and a standard industrial classification code. Based on the standard industrial classification code, the addresses were sorted into major industry groups. The average daily water use for each address was divided by the number of employees to yield a gallons/employee/day factor for each address. Each address was further researched to guarantee the accuracy of the number of employees and type of employment at that address. After this additional research was performed, the 1,662 addresses that remained in each major industry group were averaged to yield an average gallons/employee/day factor for each major industry group.

## RESULTS

The residential water use study yielded the following residential water use factors (per household):

Single Family Factor	259.11 gal/hh/day
Multi-Family Factor	176.67 gal/hh/day
Overall HH Factor	231.58 gal/hh/day

Overall Factors by Income Level	
\$0-\$19,999	191.40 gal/hh/day
\$20,000-\$39,999	180.57 gal/hh/day
\$40,000-\$59,999	254.40 gal/hh/day
> \$60,000	317.47 gal/hh/day

The four factors that are associated with household income levels will be used to produce water demand forecasts. The other three factors were produced to give an overall estimate of

household use and to compare with residential water use estimates that have been produced for other areas.

The non-residential water use study yielded the following non-residential water use factors for the following employment sectors (per employee):

Construction	20 gal/emp/day
Manufacturing	115 gal/emp/day
Transportation, Communication & Utility (TCU)	50 gal/emp/day
Wholesale	50 gal/emp/day
Retail	90 gal/emp/day
Finance, Insurance & Real Estate (FIRE)	40 gal/emp/day
Services	125 gal/emp/day
Government	125 gal/emp/day

A government employment factor was not calculated due to a lack of data. Therefore, the services factor has been used to estimate water use by government employees. This is because of the similarities in the types of work and employment that are included in the government and services sectors.

Both the residential and non-residential factors have been compared to other sets of water use factors that have been developed. Table 1 gives a comparison between the water use factors that have been generated by the Atlanta Regional Commission and other factors that been produced.

The factors generated by ARC prove to be comparable to residential water use estimates that have been produced for other areas. The notable exception above is Boston, which is most likely due to the predominance of higher density, multi-family type housing units in Boston and weather differences.

The only comparable comprehensive set of factors found for the non-residential sector are those factors that are used in the IWR-MAIN water demand forecasting model produced by

**Table 1. Comparison of Residential Water Use Factors**

Area/Source	SFHH (gal/hh/day)	MFHH (gal/hh/day)	Overall Households (gal/hh/day)
ARC Study	259.1	176.7	231.6
Washington, DC <sub>1</sub>			237.0
Arlington County, VA <sub>1</sub>	205.0	154.0	
Fairfax County, VA <sub>1</sub>	229.0	156.0	
Montgomery Co., MD <sub>1</sub>	249.0	233.0	
Boston, MA <sub>2</sub>			173.8
Chapel Hill, NC <sub>3</sub>			288.0
Fayetteville, NC <sub>3</sub>			231.0
Durham, NC <sub>3</sub>			230.0
Raleigh, NC <sub>3</sub>			235.0

<sup>1</sup> Source: Interstate Commission on the Potomac River Basin, 1995

<sup>2</sup> Source: PMCL, 1994

<sup>3</sup> Source: NC Div. of Water Resources (1992 data)

**Table 2. Comparison of Non-Residential Water Use Factors**

Major Industry Group	IWR-MAIN <sup>1</sup> (gal/emp/day)	ARC <sup>2</sup> (gal/emp/day)
Construction	20.7	20
Manufacturing	132.5	115
TCU	49.3	50
Wholesale	42.8	50
Retail	93.1	90
FIRE	70.8	40
Services	137.5	125
Government	105.7	125

<sup>1</sup> From IWR-MAIN Version 6.1 Users Manual

<sup>2</sup> From ARC Non-Residential Study

Planning and Management Consultants, Ltd., 1995. IWR-MAIN Water Demand Analysis Software Version 6.1 Users Manual, Carbondale, IL.

Planning and Management Consultant, Ltd. Table 2 shows the ARC factors compared to the factors used in IWR-MAIN.

## CONCLUSIONS

The water use factors generated as part of this study will assist in producing water demand forecasts for the metropolitan Atlanta Region. These factors have been initially tested using the ARC water demand forecasting model and checked against historical water use data for local water utilities that are located in the 10-county Atlanta Region. The model runs using these factors have produced water use estimates that are close to actual historical water use. Pending final review outcomes, these factors will be used to produce water demand forecasts for the Atlanta region.

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