

## MEMORANDUM

**TO: RIVANNA WATER & SEWER AUTHORITY  
BOARD OF DIRECTORS**

**FROM: THOMAS L. FREDERICK, EXECUTIVE DIRECTOR**

**SUBJECT: REVIEW OF THE 2004 WATER DEMAND ANALYSIS**

**DATE: AUGUST 24, 2010**

At the April 2010 Board meeting, the Board of Directors asked that the staff retain an engineering consultant to review the 2004 Water Demand Analysis prepared by Gannett Fleming. The Board limited the funding for this consultant review to a maximum of \$25,000, for a review (not a complete new demand analysis) of the 2004 analysis, with the further review of updated information within three areas: (1) updated historical data (2002-2010); (2) updated water conservation information; and (3) updated development decisions and information. Swartz Engineering Economics was retained for this review based on the low overhead rate of a small firm combined with the broad-based long-term experience of Mr. Swartz covering the engineering, financial, and economic aspects of the water utility business.

Mr. Swartz' report is attached, and Mr. Swartz is scheduled to be at the August 24 Board meeting to summarize his report and discuss its content with the Board. In summary, he has concluded from his review that Gannett Fleming used sound methods to project future water demand within the context of what was known in 2004 and what were standard utility practices of the time. He has also concluded that recent historical data not available in 2004 confirms a one-time step-down in water demand within the last eight years attributable to a number of both permanent and temporary factors, but in his opinion the new historical data currently available is not sufficient to establish a new long-term trend of water use. He recommends the Authority use a target of 18.45 mgd in the year 2060 for planning purposes.

### **Board Action Requested**

No specific Board action on this review is requested, but it is anticipated this review will be considered along with other studies in the Board's deliberations regarding the status of the Community Water Supply Plan.

Attachment

**Review of the 2004 Water Demand Analysis  
for the Urban Service Areas  
of the  
Rivanna Water and Sewer Authority**

**August 2010**

Prepared by

**Swartz**  
Engineering Economics  
*Stuart, Virginia*

# Review of the 2004 Water Demand Analysis for the Urban Service Areas

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### APPENDICES:

A: Data and Graphs

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By reference:

- *Demand Analysis for the Urban Service Area*, Gannett Fleming, May 2004
- *Raw Water Supply Facility Permitting, Demand Analysis*, Vanasse Hangen Brustlin, Inc, October 1997

# **Review of the 2004 Water Demand Analysis for the Urban Service Areas of the Rivanna Water & Sewer Authority**

## **EXECUTIVE SUMMARY**

The Rivanna Water and Sewer Authority (Rivanna) engaged Swartz Engineering Economics, Inc. (Swartz) in June 2010 to review the 2004 Gannett Fleming, Inc. (GF) Water Demand Study, and review more recent information available on water use, conservation practices, and potential development. Based on this review, Swartz was charged with providing a professional assessment of the reasonableness of the 2004 study.

Rivanna did not request a detailed new water demand analysis. Instead, Rivanna sought an updated opinion concerning the likely range of water demand in its Urban Service at the end of the next 50 years.

Swartz was asked to address four questions:

1. In the context of what was known at the time, was the methodology and forecasting of the 2004 Water Demand Study reasonable and sound?
2. What major trends developed between 2004 and 2010 that have significantly influenced wholesale water demands?
3. What major trends can be reasonably anticipated over the next 50 years that could influence water demand or water supply planning to include
  - development?
  - water conservation?
  - climate change?
4. What is the likely range of potential future wholesale water demands for the Urban Service Area that Rivanna should plan for 2060?

It is our opinion that the GF 2004 study used sound methods to project water demand for Rivanna within the context of standard utility practices of the time.

We conclude that Rivanna water production data since Fiscal Year 1995 show that a water demand reduction occurred around 2002 in an amount of approximately 1.4 mgd. We believe

the data to date suggest this is a one-time reduction in demand rather than a new trend in water demands beginning after 1995.

This reduction in demand is probably due to a variety of factors including temporary factors such as the imposition of water use restrictions and the economic recession of the past several years as well as permanent changes in water use due to water conservation initiatives of the City of Charlottesville (City) and the Albemarle County Service Authority (Service Authority) and Rivanna. For the purpose of this report, Swartz attributes this step-down in use as being due entirely the result of permanent water conservation initiatives. We see no basis in the data for concluding that the likely long-term rate of growth in demand as projected by the GF 2004 study has changed.

From our interviews with organizations and individuals involved in water use and interested in planning for water demand in the Rivanna Urban Service Area we also see potential for several one-time steps up in water demand due to planned development. However, because of the limited nature of this review, we have not attempted to quantify or account for these changes. We believe that these are properly accounted for in the long-term growth trend.

On this basis, we project the 2060 water demand of the Rivanna Urban Service Area to be 18.45 mgd for planning purposes.

## 1. BACKGROUND

### Previous Water Demand Studies

The Rivanna Water and Sewer Authority (Rivanna) was created through an agreement among the City of Charlottesville (City), Albemarle County Virginia (County) and the Albemarle County Service Authority (Service Authority) dated June 12, 1973. Under the agreement, Rivanna is required to “produce and deliver potable water to the City and the Service Authority ...in accordance with their needs...” This agreement prohibits both the City and the Service Authority from producing potable water and requires them to purchase it from Rivanna.

Over the years, Rivanna periodically has projected the future water demands within the areas it serves. Doing so allows Rivanna to plan for new or updated facilities that may be necessary to assure an adequate water supply in accordance with regulations promulgated by the Commonwealth of Virginia. Rivanna's current water supply facilities include 1) raw water storage reservoirs, 2) raw water river withdrawal facilities, 3) potable water treatment facilities, and 4) interconnecting pipelines. In its guidance to water utilities, the VA Department of Environmental Quality states its preference is to use a 50-year water supply planning horizon <sup>[1]</sup>.

Rivanna engaged Vanasse Hangen Brustlin, Inc. (VHB) in 1996 to project the water demand of its customers for the next 50 years. VHB published the results of its study in 1997. VHB used multiple projection techniques and concluded that the demand for potable water by both the City (including UVA) and the Service Authority would be between 18 and 21 million gallons per day (mgd) in the year 2050.

In 2003, Gannett Fleming, Inc. (GF) was engaged by Rivanna to review, update and evaluate the 1997 VHB study. GF published the report of its water demand analysis in May 2004,

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<sup>[1]</sup> *Commonwealth of Virginia Guidance for Conducting a Comprehensive Public Drinking Water Supply Needs Assessment, May 2000*, page 5.

which built on the earlier VHB study. It incorporated water use data from the intervening years and took into account the major drought being experienced in the area about the same time. It also attempted to factor in water conservation programs being initiated by the City and the Service Authority.

GF considered that these programs would have a likely long-term effect of reducing demand by about 5%. Based on this assumption and using the four different projection techniques used by VHB, GF estimated that water demand in the Urban Service Area would be approximately 18.7 MGD in 2055.

### **Subsequent Events**

Drought and mandatory water restrictions: Because of the drought being experienced in the area, both the City and the Service Authority (together, the Retail Utilities) called for voluntary water restrictions in August and September 1999 and again in November and December 2000. The drought continued, and these water utilities placed mandatory water restrictions on the use of water by its customers. Governor Mark Warner declared a drought state of emergency on August 30, 2002; on September 4<sup>th</sup>, Albemarle County declared a violation of the Governor's executive order to be a Class III misdemeanor.

The drought eased somewhat and:

- Retail Utilities relaxed restrictions to voluntary status in November 2002 through February 2003
- Retail Utilities called for voluntary restrictions for 10 days in June 2006
- Retail Utilities again called for voluntary restrictions mid-July through mid-August 2007
- The Retail Utilities imposed mandatory restrictions from mid-August 2007 through early January 2008
- From early January through mid-May 2008, the drought restrictions were reduced to voluntary

The water use restrictions appear to be responsible, in part, for lower water use in the Urban Service Area in 2003 and several other subsequent years. Typically, such mandated reductions in demand are dramatic but always temporary.

Water Conservation Initiatives: Beginning in 2002, the Retail Utilities undertook aggressive water conservation initiatives. Some of these initiatives were highlighted in a jointly issued *Water Conservation Study Report*, April 2009:

- Free distribution of 14,000 indoor water conservation kits

- Dissemination of a “Water-Wise” landscaping information
- Toilet rebate program which replaced over 7,000 high-consumption toilets

Another significant water conservation program was undertaken by UVA. Recent interviews with university representatives indicate that concerns induced by the severe drought caused the university to re-think how it uses water. In the drought period, UVA significantly revised the ways it uses water for cooling purposes. It also installed low-flow shower heads and toilets in most housing facilities, among other initiatives. These actions have probably resulted in a one-time, permanent step down in UVA's water use from prior practices.

Rivanna Water and Sewer Authority itself switched from potable water to treated wastewater effluent for in-plant use at its wastewater treatment plant reducing demand a significant amount of potable water. Such uses include equipment and work area wash-down, irrigation, and other equipment- and treatment-related uses.

There are also reports indicating that both Retail Utilities began system leak reduction efforts in this time period. To the extent these efforts are successful, these would classify as one time drops in apparent customer demand.

Economic Recession: In the years since the GF study, the United States has experienced the most significant economic downturn since the Great Depression. Commercial and industrial operations that had been relatively large users of water have, for now, cut back on their use. Historically, economy-based reductions in water use have proven to be temporary, with water use recovering rapidly with renewed economic activity.

### **Possible Increases in Water Demand**

While the foregoing factors will tend to reduce future water demand from the amount GF projected at the time of its study, a number of other planned or proposed activities within the Urban Service Area have the potential to increase future water demand.

- First, UVA is considering increasing its student enrollment and the combination of student classifications. This could mean that more (perhaps, most) of the new students will be graduate students. As graduate students tend to be older and (many) married with children, their expectations for housing and use of water will be different than typical for undergraduate students.
- Second, the National Ground Intelligence Center (NGUC) is expanding its efforts.

- Third, the Martha Jefferson Hospital (MJH) is moving its operations to a new campus east of Charlottesville. It is now constructing that facility. The MJH Master Plan for this new site calls for more than doubling the footprint of buildings now under construction. The move from its current location also will free up that property for residential and commercial development in Charlottesville.
- Fourth, the U. S. Defense Intelligence Agency has stated its interest in moving some of its operations to the Albemarle County in a joint-use facility with NGIC.

### **Purpose of this Review**

In light of these occurrences, Rivanna engaged Swartz Engineering Economics, Inc. (Swartz) in June 2010 to review the 2004 GF Water Demand Study, and review more recent information available on water use, conservation practices, and potential development. Based on this review, Swartz was charged with providing a professional assessment of the reasonableness of the 2004 study at the time it was conducted.

Although Rivanna did not want a detailed new water demand analysis conducted, Rivanna sought an updated opinion concerning the likely range of water demand in its Urban Service at the end of the next 50 years in 2060.

Specifically, Swartz was asked to address four questions:

1. In the context of what was known at the time, was the methodology and forecasting of the 2004 Water Demand Study reasonable and sound?
2. What major trends have developed between 2004 and 2010 that have significantly influenced wholesale water demands?
3. What major trends can be reasonably anticipated over the next 50 years that could influence water demand or water supply planning to include
  - development?
  - water conservation?
  - climate change?
4. What is the likely range of potential future wholesale water demands for the Urban Service Area that Rivanna Water and Sewer Authority should plan for 2060?

## **2. THE GANNETT FLEMING WATER DEMAND STUDY OF 2004**

We have reviewed the Gannett Fleming Water Demand Study of 2004. We find its methodologies and the techniques used to project water demand to have been properly performed and to be reasonable and sound. Given the available data at the time of the study, we find it to be consistent with the standards of practice contained in the American Water Works Association (AWWA) *Manual of Water Supply Practices M50 – Water Resources Planning* in publication at that time.

## **3. MAJOR TRENDS BETWEEN 2004 AND 2010**

The data show clearly that there has been a generally lower demand for water by Rivanna's two customers – the Albemarle County Service Authority and the City of Charlottesville – since Fiscal Year 1998-99. The combined demand is measured by Rivanna as the *Rivanna Water and Sewer Authority Urban Area Water Wholesale and Retail Flows* and is shown on pages A-1 and A-2 of Appendix A. These data show the volume of water treated and delivered into the wholesale distribution system; which volume includes unmetered (*unaccounted for*) flows in the customer's retail distribution systems.

Examination of the data shows that a drop in water use occurred from FY 1999 to FY 2003 (the year of the Governor's state of emergency declaration). Following that, demand increased sharply in FY 2004 through FY 2006. Since then, water use dropped again.

These fluctuations in customer demand do not appear to indicate a long-term trend. If the recent data are simply added to the data in the GF 2004 report and purely statistical analysis is performed, it would show the City ceasing to use water after the year 2060 (see also page A-3.a). This is clearly not plausible. Such a conclusion is also in direct contradiction to the implications of the City population data shown on Page A-5 and to discussions with City planners.

Because treating the recent data as the start of a long-term trend plainly produces impossible results, Swartz believes that they indicate a combination of factors such as 1) permanent reductions to water use resulting from conservation initiatives, 2) temporary customer responses to water use restrictions during the drought, 3) commercial and industrial customer

water use cut-backs induced by the recession, and 4) one-time institutional revisions to water use practices.

The latter is consistent with UVA reports that its goal is to achieve zero growth in water use per unit. Data indicate that on-grounds per capita use has held almost constant at 39 gallons per day for the past 3 years. This suggests that its water use practices may have achieved this zero unit demand growth and future water use will keep pace with increased on-grounds population.

Billed use data over 2002-2010 for the City and the Service Authority are equally inconclusive of a trend. Of particular note is the linear regression analysis shown in Appendix A for the City, excluding and including UVA (pages A-3.a and A-3.b).

It is our considered opinion that data from the past 16 years do not indicate any change to long-term trends, except for a one-time and partially-permanent reduction in overall water use in reaction to extraordinary occurrences and water conservation measures. Our examination of the data indicates two distinct, 8-year periods of corresponding water demand activity at Rivanna – 1995 -2002, and 2003-2010. These periods of demand show rising, peaking, and falling demands in almost twin-like fashion. In our opinion, the best explanation for these data appears to be a one—time reduction in demand.

Average demand in the first period is 11.2 mgd; the average demand in the second period is 9.8 mgd. We believe this indicates an aggregate 1.4 mgd step-down in Urban Service Area water use for all causes previously discussed (some temporary) with long-term trends likely to resume over time. Conservatively, we attribute this reduction entirely to water conservation initiatives even though it contains other, temporary elements.

We see no data to suggest that the slope of a post-adjustment growth line will be different than that of the GF Study.

#### 4. POTENTIAL MAJOR TRENDS OVER THE NEXT 50 YEARS

Looking for information, insight, opinion, and planning efforts that might allow an analysis of the possibility of a change in the development trends indicated in the GF study, we interviewed 22 organizations and individuals with interests in water supply planning for the area. A list of the organizations and individuals interviewed is presented in Appendix B.

As discussed previously, we were advised of several potentially significant development plans and potential plans. These are listed again here:

- ✓ UVA is considering increasing its student enrollment and possibly the classifications of students i.e., more graduate than undergraduate students.
- ✓ The National Ground Intelligence Center is apparently expanding its efforts. In fact, we were advised by several senior planners not to underestimate the potential for growth by this operation.
- ✓ The Martha Jefferson Hospital (MJH) is moving its operations to a new campus east of Charlottesville with master plans to more than double the footprint currently under construction.
- ✓ The move of MJH from its current location will free up that space for residential and commercial growth in Charlottesville.
- ✓ Current thinking is that the US Defense Intelligence Agency is very interested in moving some of its operations to the county. This has been given some definition with the August 8, 2010 news release announcing a joint-use Intelligence Analysis Facility in Albemarle County which is expected to bring 1,500 jobs to the County<sup>[2]</sup>.

Rather than these possibilities indicating a new trend, we believe that this indicates a continuation of growth in the Urban Service Area as projected by the linear regression analysis of the 2004 GF study with potential one-time, permanent increases in water demand by certain specific institutions. The permanent upward shifts in the demand curve caused by these could likely be offset by additional permanent downward shifts in the demand curve due to continued conservation efforts.

One possible new trend in water use may come through the effects of global climate change, which projects changes in rainfall patterns. Most analysts believe that total annual rainfall will

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<sup>[2]</sup> As reported by NBC29, WVIR TV and posted August 8, 2010.

<http://www.nbc29.com/global/story.asp?s=12944992> Accessed 8/9/2010.

likely not change significantly in the Rivanna service area but will be distributed differently across the year. This anticipated redistribution appears to manifest itself in longer periods of heavier rainfall and longer periods of drought. This represents a risk that water storage requirements may be currently understated.

## **5. LIKELY RANGE OF WATER DEMAND IN 2060**

We believe that the best way to estimate water demand for the Rivanna Urban Service Area in 2060 is to 1) account for the change in water demand over the two recent time periods as a one-time permanent adjustment in water demand due to increased conservation in the Urban Service Area and 2) continue the slope of the linear regression analysis resulting from the long-term 2004 GF study to project future growth.

This approach is shown in Appendix A, page A-7. Under this approach and for planning purposes, the 2060 estimated water demand in the Urban Service Area is 18.45 mgd.

## **6. SUMMARY AND CONCLUSIONS**

It is our opinion that the Gannett Fleming 2004 *[Water] Demand Analysis for the Urban Service Area* study used sound methods within the context of standard utility practice of the time to project water demand for Rivanna.

We believe that Rivanna water production data since Fiscal Year 1995 show that a water demand reduction occurred around 2002 in an amount of approximately 1.4 mgd which is not a trend in water demands. Conservatively, we attribute this step-down in use entirely to water conservation initiatives.

We see no indication in the data that the rate of growth in demand as projected by the GF 2004 study has changed. However, from our interviews with organizations and individuals interested in planning for water demand in the Rivanna Urban Service Area, we see potential for several one-time steps up in water demand due to planned development.

Based on our study, we estimate the 2060 water demand of the Rivanna Urban Service Area to be 18.45 mgd for planning purposes.

## **APPENDICES**

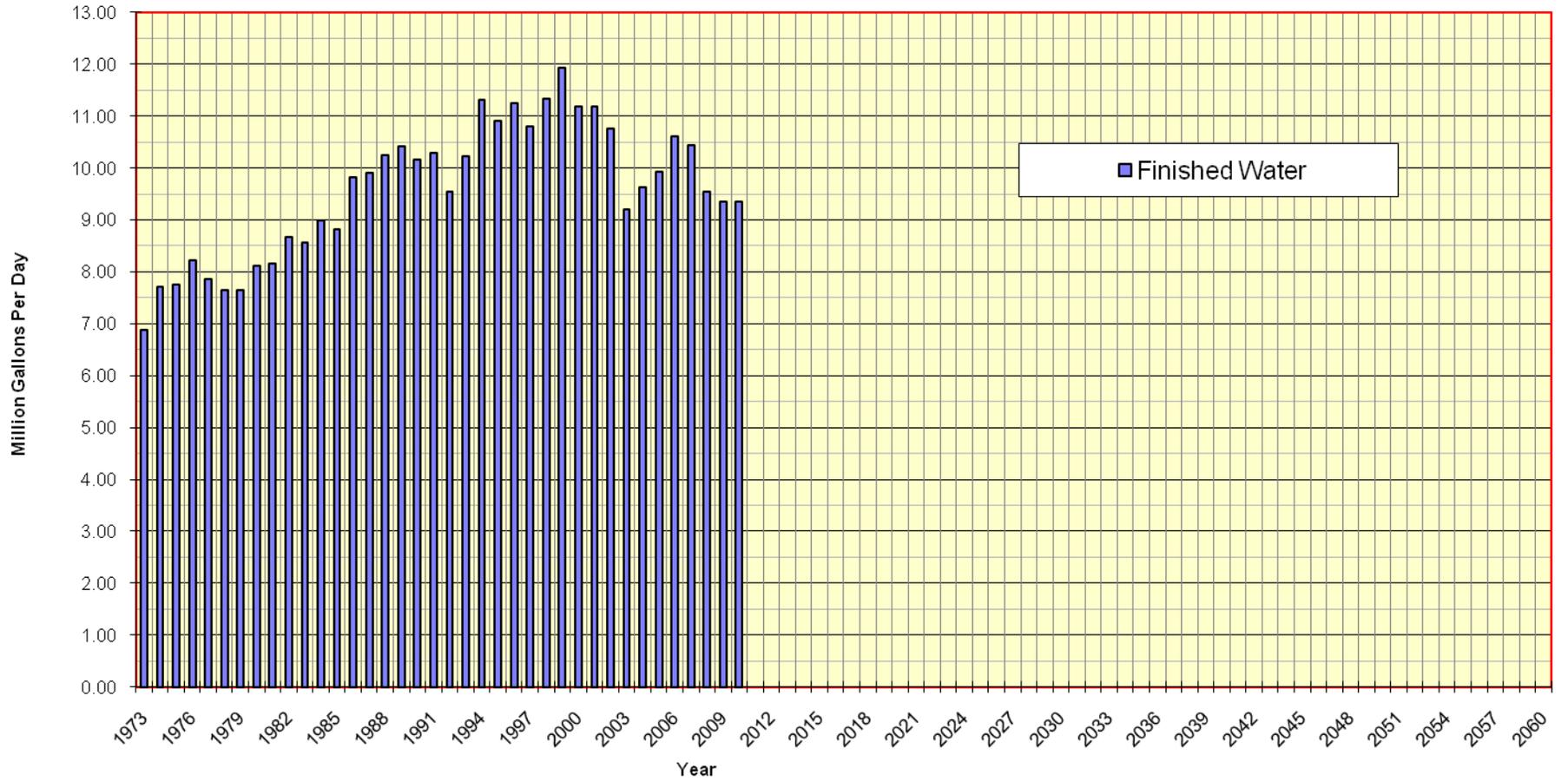


## RIVANNA WATER & SEWER AUTHORITY URBAN WATER WHOLESALE AND RETAIL FLOWS: 1983 - 2010

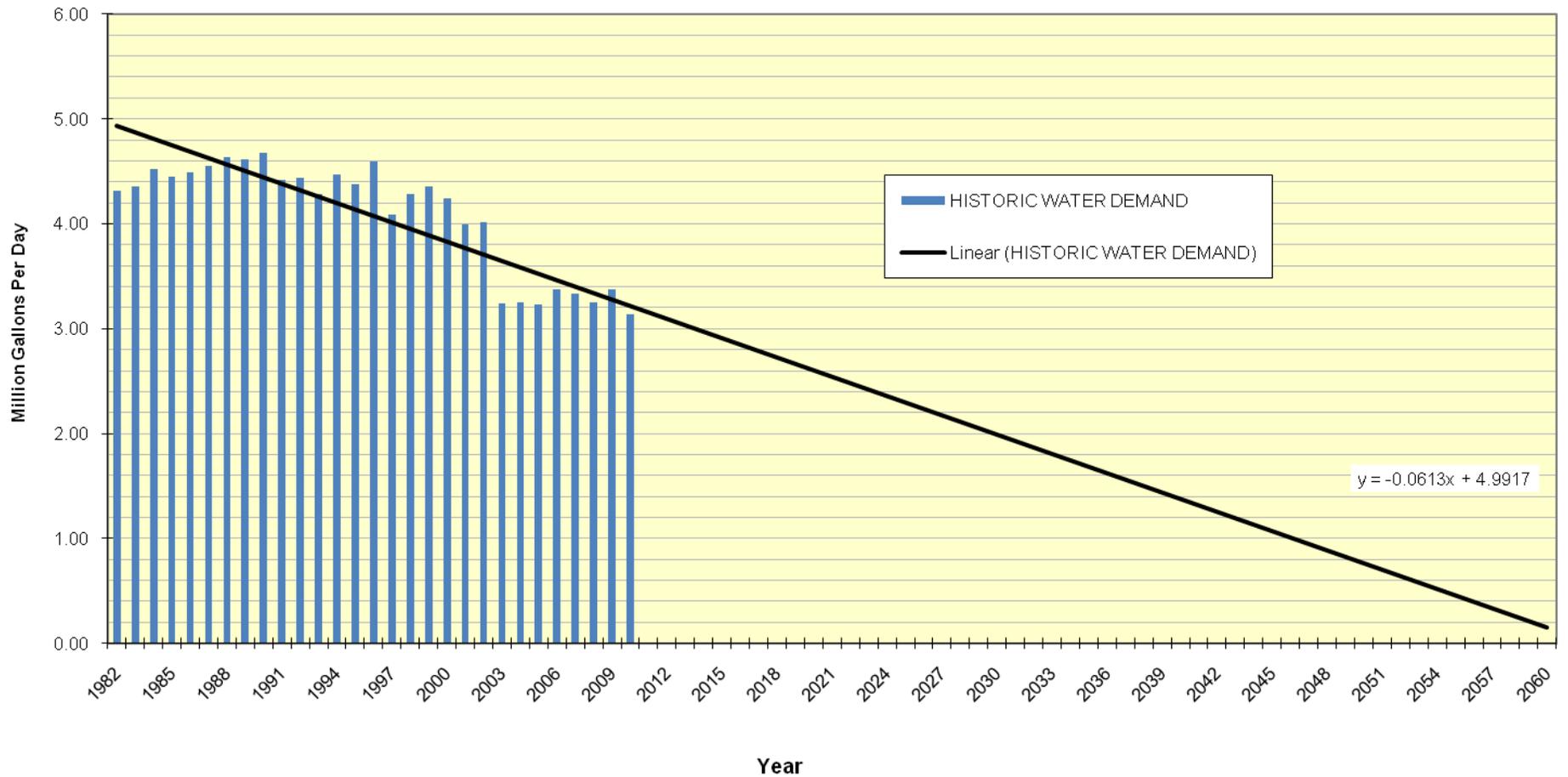
Note: All flows are in gallons except where noted.

FISCAL YEAR	RWSA Urban MGD	RWSA Urban Water Flow	City Only Retail Flow	ACSA Retail Flow	Total Retail Flow	Unmetered	Unmetered as % of Total	UVA Flow	
1983	8.57	3,127,101,000	1,588,125,620	766,095,250	2,737,712,470	389,388,530	12.45%	383,491,600	
1984	9.01	3,290,135,000	1,653,776,695	832,585,195	2,892,436,130	397,698,870	12.09%	406,074,240	
1985	8.82	3,220,246,000	1,623,980,713	877,875,703	2,946,033,776	274,212,224	8.52%	444,177,360	
1986	9.83	3,587,977,000	1,638,368,664	916,163,975	2,987,901,879	600,075,121	16.72%	433,369,240	
1987	9.91	3,618,836,000	1,661,658,993	959,356,150	3,072,921,939	545,914,061	15.09%	451,906,796	
1988	10.27	3,749,320,000	1,588,125,620	1,041,041,715	3,097,832,961	543,561,012	14.50%	468,665,626	
1989	10.42	3,801,653,000	1,684,103,880	1,062,829,924	3,247,470,528	554,182,472	14.58%	500,536,724	
1990	10.17	3,710,324,000	1,706,413,805	1,044,212,081	3,303,318,318	407,005,682	10.97%	552,692,432	
1991	10.28	3,753,690,000	1,611,852,315	1,090,205,760	3,351,985,700	401,704,300	10.70%	649,927,625	
1992	9.56	3,489,773,000	1,625,971,403	1,062,559,100	3,248,659,077	241,113,923	6.91%	560,128,574	
1993	10.22	3,731,740,000	1,564,701,163	1,086,516,960	3,213,871,352	517,868,648	13.88%	562,653,229	
1994	11.32	4,133,212,000	1,632,369,224	1,240,470,915	3,440,211,806	693,000,194	16.77%	567,371,667	
1995	10.92	3,984,228,000	1,599,206,841	1,255,499,854	3,421,315,746	562,912,254	14.13%	566,609,051	
1996	11.27	4,114,643,000	1,681,764,222	1,293,814,365	3,551,010,380	563,632,620	13.70%	575,431,793	
1997	10.79	3,940,126,000	1,491,716,122	1,295,793,162	3,399,161,742	540,964,258	13.73%	611,652,458	
1998	11.33	4,135,098,000	1,562,260,095	1,420,341,706	3,607,716,207	527,381,793	12.75%	625,114,406	
1999	11.93	4,354,131,000	1,588,992,513	1,543,066,746	3,772,258,867	581,872,133	13.36%	640,199,608	
2000	11.22	4,094,568,000	1,553,143,790	1,490,022,645	3,612,210,688	482,357,312	11.78%	569,044,254	
2001	11.18	4,079,510,000	1,457,110,418	1,513,272,546	3,487,493,263	592,016,737	14.51%	517,110,300	
2002	10.76	3,926,016,000	1,464,244,834	1,571,993,800	3,609,283,873	316,732,127	8.07%	573,045,238	
2003	9.20	3,358,086,000	1,182,291,972	1,328,494,675	2,993,595,035	364,490,965	10.85%	482,808,388	
2004	9.65	3,521,515,000	1,188,829,768	1,352,757,875	3,011,440,395	510,074,605	14.48%	469,852,752	
2005	9.93	3,625,474,000	1,178,985,527	1,413,604,086	3,028,543,566	596,930,434	16.46%	435,953,953	
2006	10.61	3,871,649,000	1,232,816,634	1,497,808,526	3,202,926,886	668,722,114	17.27%	472,301,726	
2007	10.44	3,808,843,000	1,217,444,852	1,551,230,474	3,217,273,314	591,569,686	15.53%	448,597,988	
2008	9.57	3,493,740,000	1,190,296,222	1,393,234,182	2,974,655,782	519,084,218	14.86%	391,125,378	
2009	9.34	3,410,615,000	1,233,068,725	1,395,758,394	3,087,300,554	323,314,446	9.48%	458,473,435	
2010	9.35	3,413,337,000	1,144,955,709	1,364,855,300	3,003,202,864	410,134,136	12.02%	493,391,855	
		8-YEAR AVERAGES				average =		13.08%	
		<u>1995-2002</u>	<u>2003-2010</u>	1.41	< difference				
		11.17	9.76						

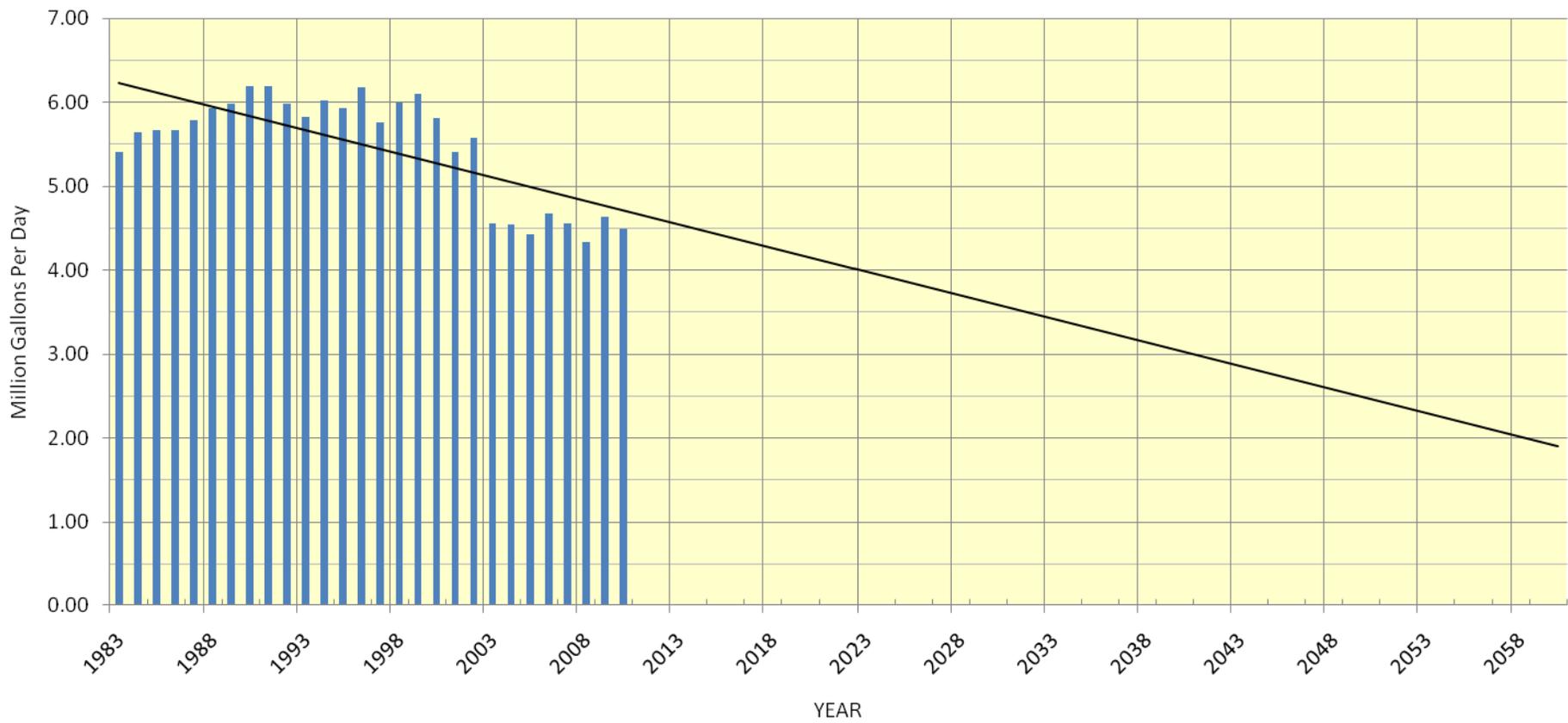
### RWSA URBAN AREA WATER PRODUCED



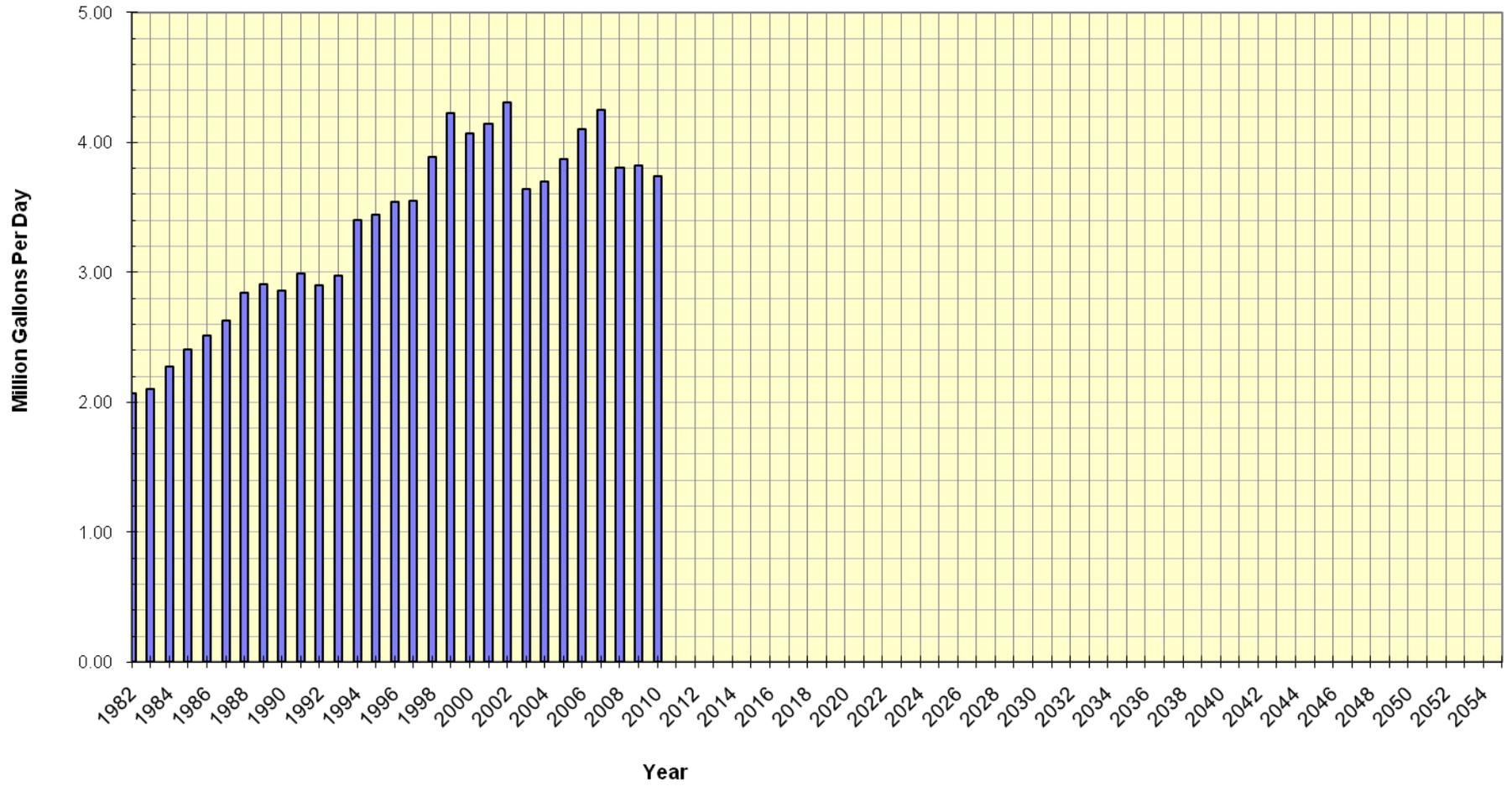
City of Charlottesville Water Demand (exclusive of UVA)



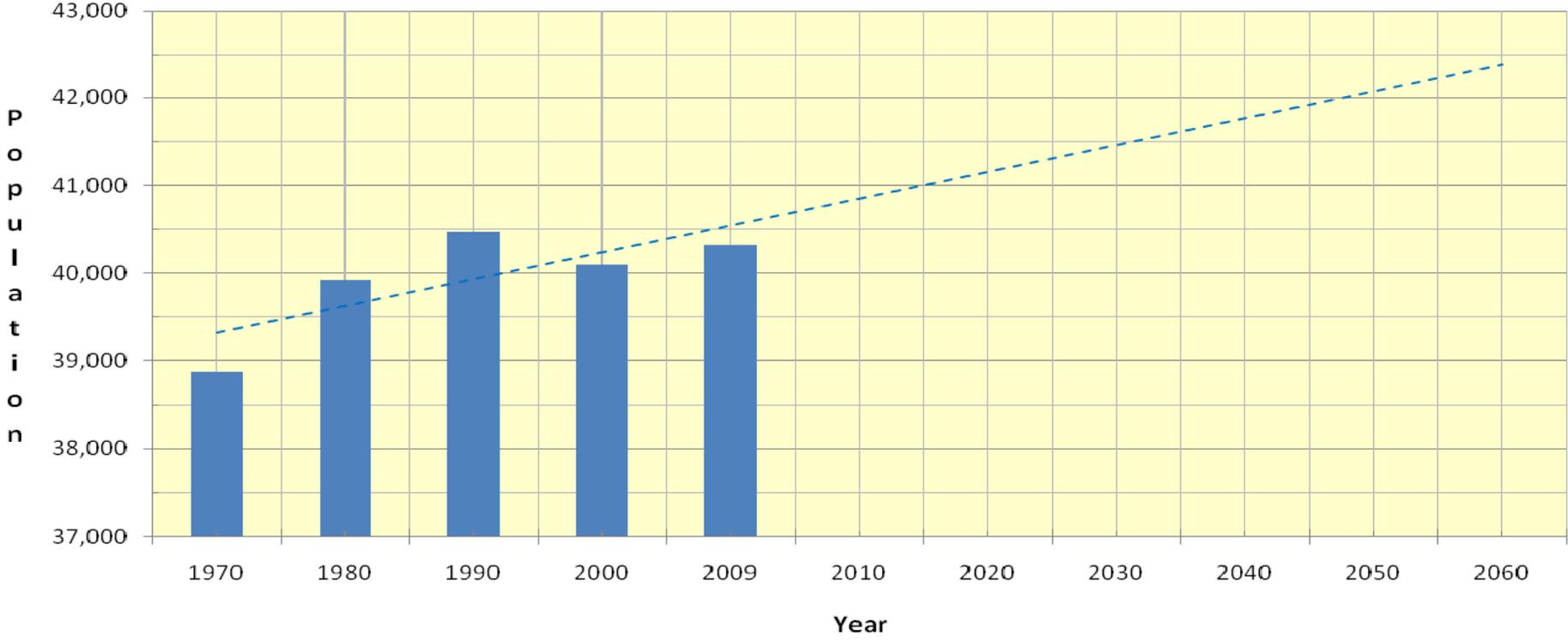
### City of Charlottesville Water Demand (including UVA)



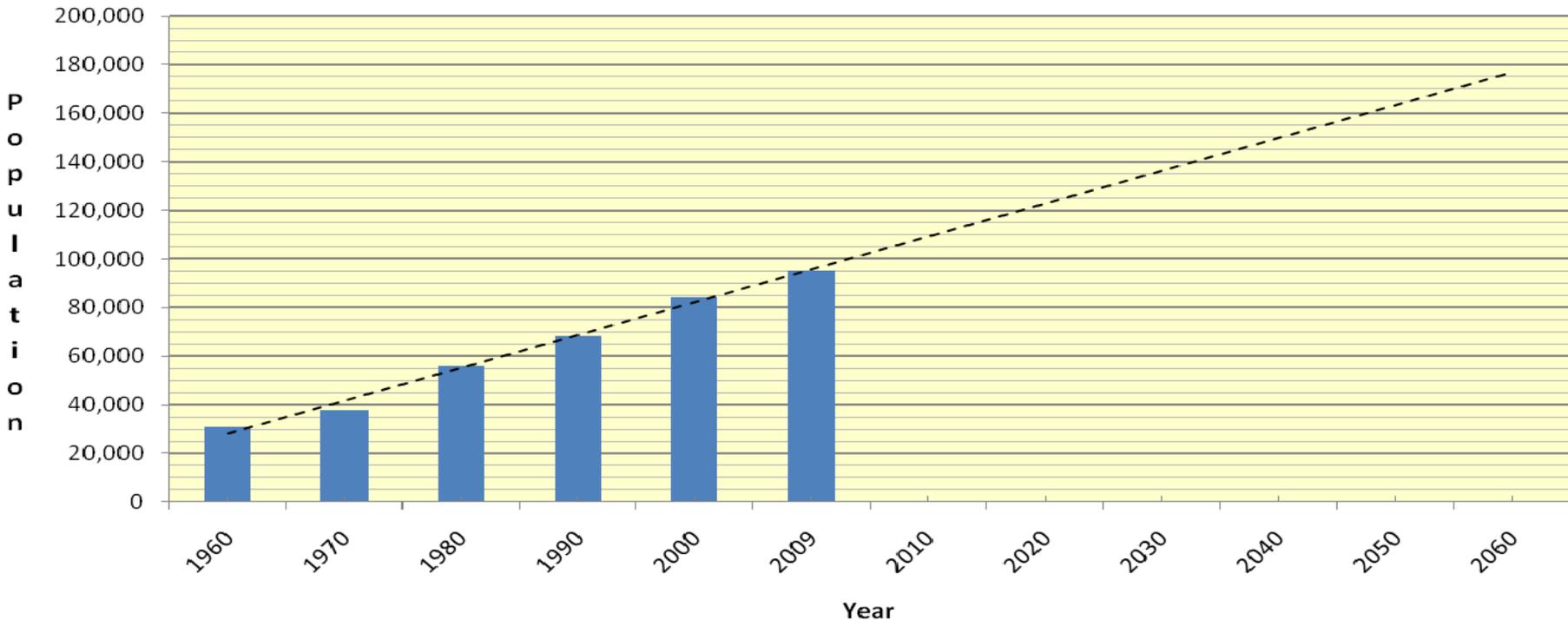
ACSA Historic Urban Water Demand



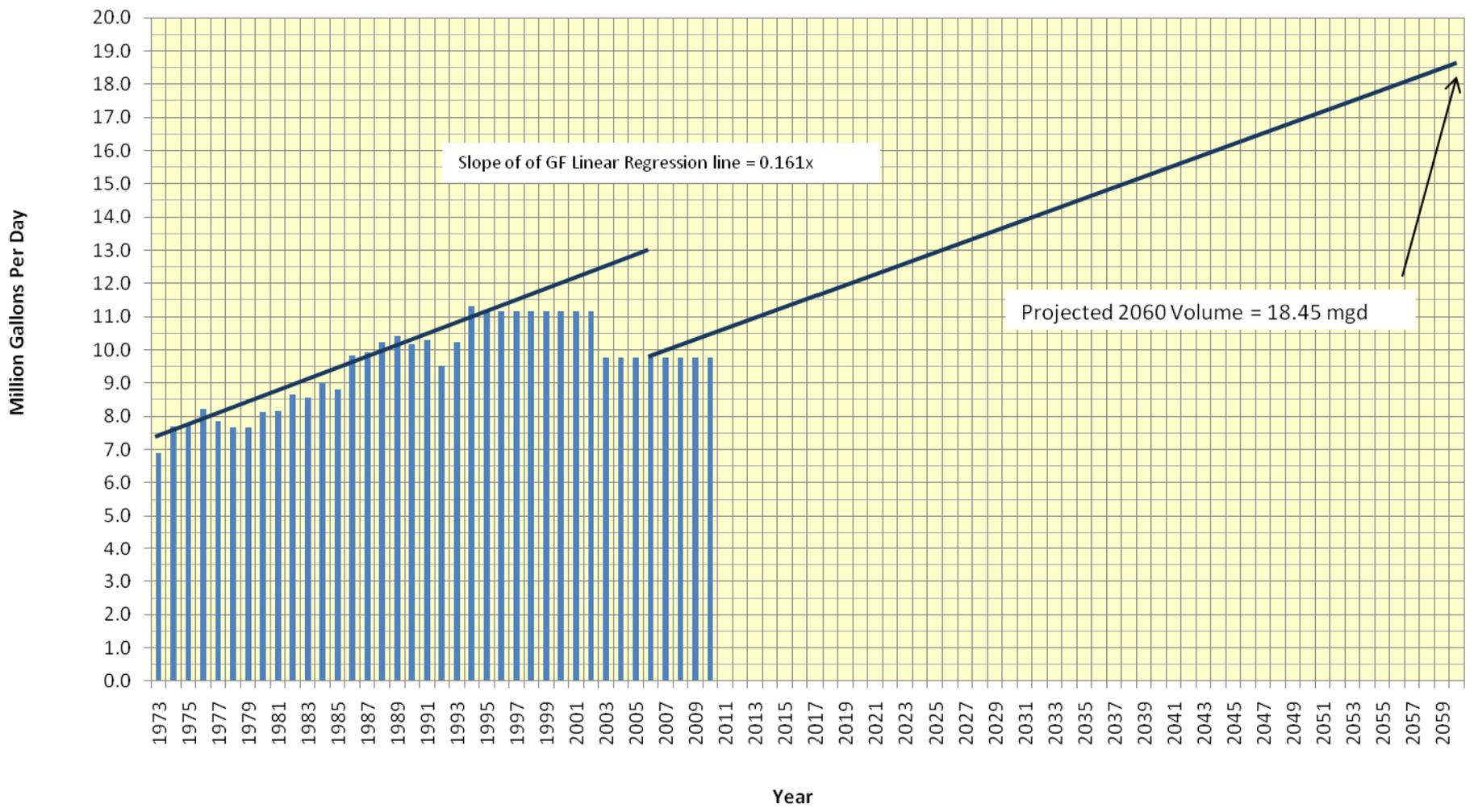
# City of Charlottesville Population



# Albemarle County Population



# RWSA URBAN AREA NORMALIZED WATER PRODUCED



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***Appendix B***

***Organizations and Individuals Interviewed***

**The Following Organizations and Individuals Provided Insights, Perceptions, Opinions, and/or Data in the Research for this Study:**

- Albemarle County Department of Community Development
- Albemarle County Service Authority
- Blue Ridge Home Builders Association
- Camp Holiday Trails
- Citizens for a Sustainable Water Plan
- Charlottesville Area Association of Realtors
- Charlottesville Regional Chamber of Commerce
- City of Charlottesville Finance Department
- City of Charlottesville Public Works Department
- Charlottesville Neighborhood Development Services
- Ednam Forest Community Association
- Free Enterprise Forum
- Friends of the Moormans
- League of Women Voters
- Martha Jefferson Hospital
- Rivanna Conservation Society
- Sierra Club
- Southern Environmental Law Center
- The Nature Conservancy
- University of Virginia
- UVA Foundation
- Mr. Blake Hurt