



**WATER CONSERVATION STUDY REPORT  
APRIL 2009  
Revised – November 2009**

**City of Charlottesville Public Works Department and  
Albemarle County Service Authority**

Introduction

As part of the commitment to conservation by the governing boards of the City of Charlottesville (City), Albemarle County, the Albemarle County Service Authority (ACSA), and the Rivanna Water and Sewer Authority (RWSA), a Water Conservation Study was jointly prepared by the City and ACSA.

Quantifying how much water customers use and in what way is difficult. One broad measurement is to look at water use as total water demand. This means dividing the volume of water used for all purposes, commercial, industrial and residential, by population. In the City this value is 109 gallons per capita per day (gpcd). Using this method to compare communities to each other can be misleading as some have very water intensive industries, such as a paper mill, while others do not.

There are national averages that focus on residential usage alone; for instance, the U.S. Environmental Protection Agency (EPA) cites 100 gpcd as the average household use. In the 2008-2009 Utility Rate Report, the average water usage for a City residence is calculated at 204 gallons per household per day, or 64 gallons per capita per day. During that same period, the average water used for an ACSA residential customer was approximately 56 gpcd. For both agencies, this is approximately 40% below the national average residential use. However, when comparing to a national average, it is important to remember that every community is different and usages may vary widely. Reasons include the efficiency of existing fixtures and appliances, household income, occupancy rates, age and lifestyle of residents, lawn watering and outdoor usage, and awareness of a need to conserve. From a statewide perspective, the Virginia Department of Environmental Quality has stated that the Charlottesville-Albemarle area has one of the lowest water demands among communities in the Commonwealth.

This report has been developed to comprehensively look at our community's current and planned programs, nationwide best practices, new opportunities and recommendations.

### Current & Planned Programs

The charts on the following pages summarize all of the current initiatives that the City and ACSA have undertaken as part of our conservation efforts. Some highlights of our success include the free distribution of 14,000 indoor water conservation kits (8,000 from the City and 6,000 from ACSA), the development and dissemination of a listing of Water-Wise landscaping information, and a toilet rebate program which has replaced more than 7,100 higher consumption toilets over the past six years (2,800 in the City and 4,400 from ACSA).

Rehabilitating and replacing water distribution mains and service lines is an important component in water conservation. Aging pipes are often a primary cause of lost water in a system. Since fiscal year 2007, the ACSA has replaced 8.8 miles of aging water mains and the City has been replacing mains at a rate of about 1% of the system per year. In addition, the City has replaced over 2.3 miles of service lines. Service lines are the small diameter pipes connecting individual meters to distribution mains.

<b>Current Water Conservation Activities - City of Charlottesville 2009</b>	
<b>Program Initiatives</b>	<b>Description</b>
Water Conservation Posters Inside City Buses	Free advertising in a location where riders have the time to learn more about conservation and available programs (toilet rebate, conservation kits). Artwork is complete and posters in production.
Low Flow Toilet Rebate Program	Number of rebates issued in 2008 was up 49% from 2007. Plan to increase public awareness and continue to increase number of participants in 2009.
Public Awareness Campaign for Free Indoor Conservation Kits	10 give away events held since January 2008, more planned in 2009. Plan to increase signage, points of availability, and work with office of communications to publicize this program that's been in place since 2002.
Water Conservation Webpage Expansion to Include Local Xeriscaping Efforts	Working with the Parks Department to add signage to City landscaping that exemplifies low water use techniques and refers citizens to the website. Water-Wise landscaping webpage has been developed.
Water-Wise Landscaping Literature Distribution to Plant Nurseries	Distributed brochures and plant lists multiple times to 5 area plant nurseries. Plan to continue on a regular basis.
Online Residential Water Use Calculator	Will help customers pinpoint how personal usage can be reduced. Calculator has been added to website, based on program provided by the water utility in Tampa, FL.
Rain Barrel Program Expansion	Eight workshops currently planned for 2009 with educational programs provided by the Thomas Jefferson Soil and Water Conservation District (TJSWCD).
Rain Barrel Pilot Program	Working with TJSWCD, ACSA and local Master Gardeners. Will record data related to rain barrel usage over two growing seasons to determine conservation effectiveness.
Restaurant Certification	Based on a program in San Antonio, TX, outline simple water conservation requirements for a restaurant to claim certification. Questionnaire for pilot program is written and has been distributed to Downtown restaurants for pilot study.
Restaurant Low Flow Sprayer Retrofit	Estimated savings was 200 gallons per unit per day if used 4 hours. 250 restaurants in Charlottesville x 200 gpd = 18mgpy. May be part of the restaurant certification program.

Carwash Certification	Working with ACSA to use industry guidelines to develop standards for different types of carwashes to claim certification. Program is the first in Virginia.
Educational Presentation to Business Groups Individual Businesses	Make available to download from the website as well as presenting in person. Presentation recently made to the Charlottesville Networking Group and Green Matters Workshop.
Educational Presentation to Neighborhood Groups and Multi-Family Housing	Make available to download, as well as presenting in person. Presentation is complete and coordinating with Neighborhood Development Services (NDS) to contact neighborhoods.
Regular Ad Campaign, Year Round	Keep conservation ideas before community all year long, utilizing different methods. Have advertising quotes from local papers and media groups. Currently scheduled to run radio ad July-September 2009.
Drought Public Notification Plan	Insure that the community is informed of future drought conditions in a timely, thorough and consistent manner by maintaining updated plan.
Low-Income Homes Retrofitted with Low Flow Toilet and Conservation Kit	Working with Spark! (part of the Charlottesville Community Design Center) on possibility of supplying low-flow retrofit equipment for low-income homes.
System Leak Detection	Invitation for Bid (IFB) for annually renewable contract has been written and is pending release. Expect to have work started in late spring 2009.
Aging Infrastructure Replacement	Continue Water Department program to replace aging distribution lines and public side of service laterals, preventing wasteful leaks.
Rainwater Harvesting System Installation on Multiple City Properties	System to supply water for street sweepers, asphalt rollers, etc installed on City Warehouse Reduce City's water bill and set example for other businesses. NDS, Environmental Management and Facilities Management all contributing to effort. Planned systems on the new CTS Maintenance and Operations Facility and Martin Luther King Jr. Performing Arts Center.

### Current Water Conservation Activities - ACSA 2009

Program Initiatives	Comments
Public Awareness Campaign for Free Indoor Conservation Kits	Although this program was well received in 2002 when approximately 4,000 kits were distributed, interest has waned. ACSA is now giving kits to multi-family complexes and will double efforts over 2009.
Water Conservation Webpage Expansion to Include Local Xeriscaping Efforts	ACSA has constructed a xeriscape garden at their office on Pantops as an example of water conserving landscape ideas.
Rain Barrel Program	Offer \$30 rebates to customers, up to two barrels per account.
Low Flow Toilet Rebate Program	Recently expanded to include multi-family housing.
Rain Barrel Pilot Program	Working with TJSWCD, City and local Master Gardeners. Will record data related to rain barrel usage over two growing seasons to determine conservation effectiveness.
Carwash Certification	Working with City to use industry guidelines to develop standards for different types of carwashes to claim certification. Program is the first in Virginia.
Business Outreach	Meetings have been conducted with many trade and business groups and will be continued in 2009.
Educational Presentation to Business Groups / Individual Businesses	In partnership with the City and RWSA, the ACSA has participated in UVA's Energy Day, RCS's Teacher Forum, and the annual meeting of the Virginia Native Plant Society.
Educational Presentation to Neighborhood & Civic Groups and Multi-Family Housing	ACSA has been invited and continues to participate in educational presentations to neighborhood and civic groups.
Water Conservation Results Monitoring	The ACSA has developed a detailed monthly report showing breakdown of water usage by customers.
Regular Ad Campaign, Year Round	Keep conservation ideas before community all year long, utilizing different methods.
Water Restriction Rules and Regulation	Recently updated.
Drought Public Notification Plan	Recently updated to insure that the community is informed of future drought conditions in a timely, thorough and consistent manner.
System Leak Detection	Ongoing program with in-house staff continually monitoring for system leaks.

In addition to our current efforts, both utilities have multiple programs currently in the planning phase:

<b>Planned Water Conservation Activities - City of Charlottesville 2009</b>	
<b>Program Initiatives</b>	<b>Comments</b>
Conservation Leader Program	Modeled on program in Cary, NC where citizens volunteer for annual 1-hour seminars; they then carry those lessons and educational materials to neighbors. Plan to emulate here using established neighborhood groups.
Business Outreach	Meet with local businesses to determine best conservation efforts for each field.
Water Conservation Results Monitoring	Monitor changes to water bills for the accounts receiving toilet rebate in 2008.
Cost Efficiency Study	Develop cost effective, long-term conservation goals using guidelines from the U.S. Environmental Protection Agency.
Gray Water Reuse Report	Research reuse options that may be feasible for this area.
Water Conservation Kit Distribution to Multi-Family Homes	Use systematic distribution to reach as many multi-family households as possible.
City Water Reuse Guideline Development for Homes / Businesses	Joint research by Public Works and NDS resulted in memorandum of guidance on rainwater reuse being released in March 2009. A standard to be written once report is issued by Virginia Department of Health. City has position on the American Water Works Association's Water Reuse Committee.
System Development for Updating all City Departments	Annually circulate drought restriction and water conservation information to City Departments. Help insure that the City continues to lead by example.
Low Flow Toilet Vouchers	Same as toilet rebate except no up-front costs, which may make it more viable for some families.
Rainwater Harvesting Evaluation for Additional City Properties	Build upon experience with recent systems and identify other locations where this strategy can be incorporated.

<b>Planned Water Conservation Activities - ACSA 2009</b>	
<b>Program Initiatives</b>	<b>Comments</b>
Water Conservation Posters	In conjunction with County schools' education on water conservation, hold a poster contest with students (5th grade) displaying their "motto" for conservation. Winners' posters would be displayed in ACSA lobby.
Restaurant Certification	Follow the City's lead in implementing a pilot program for restaurants to be outfitted with a low-flow spray valve and to solicit participation in other water conserving business practices.
Online Residential Water Use Calculator	Evaluate and implement water use calculator.
Rainwater Harvesting System Installation on ACSA Warehouse	Install a 250-gallon storage container to collect water for sewer flushing and maintenance of landscape.

Nationwide Best Practices:

The American Water Works Association (AWWA) created a list of best management practices in water conservation for utilities. The following table presents a summary of the results of a City / ACSA benchmarking exercise against thirteen (13) other municipalities throughout the United States.

<b>AWWA Best Practices</b>	Charlotteville	Albemarle County	James City County	Loudoun County	Cary, NC	Athens, GA	Boston, MA	Austin, TX	San Antonio, TX	Denver, CO	Santa Fe, NM	San Diego, CA	Santa Clara, CA	Seattle, WA	Portland, OR
Regional Integration of water supply and conservation planning	X	X	X	X								X	X	X	X
Accurately monitor consumption and bill metered usage in timely manner	X	X	X									X			
Adopt full cost pricing and conservation rate structure	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Encourage conversion from existing high use fixtures	X	X	X		X		X	X	X	X	X	X	X	X	X
Provide water audits and technical assistance to high use residential, commercial institutional and industrial users				X	X			X	X		X	X	X	X	X
Develop and use educational materials on local water resource issues	X	X	X	X	X	X		X		X			X		X
Develop and use public conservation information for all types of customers	X	X						X	X			X			
Engaging in continued research and dissemination of efficient practices	X	X			X			X			X		X	X	
Investigate and implement appropriate water reuse, including rainwater harvesting	X	X			X	X		X	X	X	X	X	X	X	
Demonstrate leadership by mandating conservation in all public facilities											X				
Participate in development of new efficiency standards in fixtures, appliances and equipment	X	X	X	X	X	X		X	X	X	X	X		X	X
Adopt policy and procedures to reduce waste of all kinds	X	X	X		X	X		X	X	X	X		X		
Encourage Water-Wise landscaping	X	X	X	X	X	X		X	X	X	X	X	X	X	

Although there is certainly room to expand local conservation efforts, it can be seen that our utilities compare favorably to other municipalities. However, in reviewing our area's conservation efforts in relation to other communities throughout the nation, a variety of potential opportunities have been identified for the Charlottesville – Albemarle area. Below are some of the conservation ordinances popular in other areas. Where appropriate, comments regarding potential impacts in our area have been included.

***Residential Water Audits*** – This is a recommended best practice by the AWWA, as in-home audits would be more detailed and more beneficial than the online calculator currently available on the City and ACSA websites. The Local Energy Alliance Program (LEAP) will be implementing home energy and water audits beginning in 2010. These audits will be part of a joint effort with local non-profits. Funding has been supplied by a grant from the Southeast Energy Efficiency Alliance.

***Commercial Water Audits*** – This is also a recommended best practice by the AWWA, as audits for commercial businesses can be very beneficial to conservation. Because different types of businesses vary widely in their water needs, using a general tool such as an online calculator is not beneficial to most companies. Water utility workers with extensive training on business needs in the area, may be able to create significant savings. As in residential audits, this would likely require additional staff or outsourcing, depending on scope and demand of the program.

***Washing Machine Rebate*** - A washing machine rebate is used in many places. As one of the top indoor uses of water, an efficient washing machine can create noticeable savings, in line with having only low flow toilets. In order to be an effective incentive, it would need to be several hundred dollars per washing machine. A negative to this rebate is that it is not uncommon for residents to take a washer when they move, diminishing the long-term benefits of the rebate.

***Alternate Day Watering Schedule*** – This is a very common ordinance in other communities. A study done in Cary, N.C. indicated that it did not reduce water usage, as customers had a tendency to water every assigned day, whether needed or not. However, it did have the benefit of reducing peak usage. A look at current local data indicates that there is not one day of the week that consistently has the highest usage. A more in depth look at the data may be required in order to determine whether this ordinance would provide any benefit in our area.

***Mandatory Drought Tolerant Landscaping*** – This type of ordinance is common in western states, but is also in effect in places like Cary, N.C. For residential accounts, outdoor watering is an area where a good deal of conservation can be achieved. The Charlottesville / Albemarle County area has a 20% spike in summer

water usage over winter, something that can be attributed to irrigating plants during the time of year of minimal rain events but elevated temperatures. Turf is a notoriously high water usage type of landscaping, not only because of the plants physiological needs, but because of the tendency for watering to be done in a wasteful manner, e.g. above ground sprinklers that are left on well past the point of plant need. This type of ordinance may be difficult to police and unpopular with the public.

***Landscape Budgets*** – This type of ordinance is tied to water rates. The utility uses one of various methods to determine how much water a home or business should be able to use outdoors. Water used in excess of that amount is billed at a very high rate. This ordinance can be very fair, as it encourages water-wise landscaping and limited outdoor usage. Some localities base the entire water rate on the idea that all accounts will not exceed their water budget. Should that goal be achieved, rates will not have to be increased because of lower usage. If the goal is not reached, the utility achieves a budgetary surplus that can be put towards increased conservation efforts. This type of program is very time consuming to implement. Some California utilities that utilized the program have moved away from it, as there were constant requests from customers for reevaluations and exemptions.

***Minimum Soil Depth Under Turf*** – The type and depth of soil underneath plants can have a high level of influence on how much precipitation and irrigation can be absorbed. This in turn can reduce losses to evaporation and reduce the amount of water required to maintain turf. Soil that is high in clay content is generally not considered a good base for turf. Since that is a predominant soil type in this area, such an ordinance may be quite expensive for customers to abide. Residents may also consider this too intrusive.

***Prohibit Washing of Exterior Hardscapes*** – The flow rate of power washers and hoses can be quite high, leading to very high water use for minor projects such as cleaning a fence. Additionally, washing hardscapes leads to significant water runoff. This type of limitation already exists in the Drought Warning Stage restrictions of both the City and ACSA. Some communities have this as a permanent restriction. This type of restriction may create hardship with some local businesses such as painters and home improvement contractors.

***Limitations on Washing Vehicles*** – Vehicle washing is a discretionary use that, depending on the method, can be highly wasteful of water. As above, this type of limitation already exists in the Drought Warning Stage restrictions of both the City and ACSA. This type of restriction may create hardship with some local businesses and be considered too intrusive by residents.

***Artificial Turf Rebate*** – In an effort to reduce the water amounts used to irrigate, localities such as San Diego and Las Vegas offer rebates to customers who replace

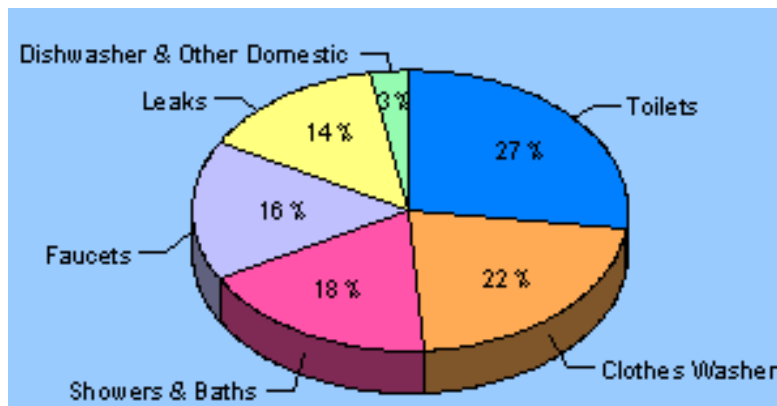
lawn with artificial turf. The amount of the rebate is based on the square footage of lawn that is removed. This may be an unpopular program in our locality, due to aesthetics and the carbon and water footprint of creating artificial turf.

**Water Reuse Distribution System** – Localities on both the east and west coast of the U.S. have built distribution systems for treated effluent. This non-potable water is then piped for use in irrigation and industry. This can have very expensive up front costs, as it requires a new distribution system and new pump stations or mini treatment plants. This is most cost effective in areas where there are concentrations of new development, heavy industry, or large-scale irrigation needs. At this time, it does not appear that the City or ACSA have an area where a reuse system would be cost effective.

### New/Expansion Opportunities & Recommendations

**Current Programs and Ordinances** - It is recommended to continue utilizing all of our current programs and drought ordinances.

**Toilet Rebates and Conservation Kits** - The figure below illustrates the nation's average breakdown of residential water usage. As indicated, toilets, faucets and bathing comprise 61% of indoor usage. The toilet rebates and indoor conservation kits offered by both the City and ACSA are aimed at providing a cost effective means of long-term water reduction for our customers.



**Rainwater Harvesting** – In previous years, City staff have sponsored workshops that provide participants the opportunity to assemble a rain barrel for home or business use. This is an increasingly popular program developed with the Thomas Jefferson Soil & Water Conservation District (TJSWCD) to include a valuable educational component. The number of workshops in 2009 greatly exceeded those held last year, as Pepsi had generously donated a large number of barrels.

Customers of the City and ACSA are also eligible to receive a \$30 rebate per rain barrel, up to two per household, for barrels purchased from any source, including workshops. The City has also compiled a how-to manual on building a rain barrel,



which was posted online, distributed at events and emailed to those on the workshop waiting list. It is hoped that promoting rainwater harvesting will reduce both the use of potable water and the runoff from rooftops, which has the added benefit of protecting local stream health.

At the same time, the City, ACSA and TJSWCD partnership developed a pilot program on rain barrel usage. Over two growing seasons, local volunteers from the Master Gardener program will be recording data on how installed rain barrels affect their potable water use. This may provide a better estimate of actual conservation benefits afforded by barrels.

A rainwater harvesting system has been installed at the City yard's warehouse. The system is capable of capturing over 246,000 gallons per year, which can be used to supply street sweepers and other equipment used by Public Works. The system planned as part of the new CTS Maintenance and Operations Facility is designed to save over 567,000 gallons of potable water per year. A 40,000-gallon harvesting system was installed at the Martin Luther King Jr. Performing Arts Center in the summer of 2009 to supply irrigation to the ball field. These systems will reduce the City's water bill by substituting potable water reliance for a variety of end uses and set an example for other businesses. The 250-gallon harvesting system planned for the ACSA warehouse will save an estimated 30,000 gallons each year.

***Permanent Conservation Ordinances*** – In a number of municipalities, extensive ordinances have been built into their communities during normal 'non-drought' periods. The addition of permanent conservation ordinances is expected to greatly enhance the long-term effectiveness of water conservation in the community. Our proposed regulations include:

*Irrigation Runoff Restriction* – Irrigation in any form shall not be allowed to run-off into the street or storm sewers. This includes run-off from broken or leaking hoses and irrigation systems.

*Time of Day Restrictions* – There shall be no above ground irrigation between the hours of 10am and 9pm on any day of the week.

*Mandated Retrofits* – In collaboration with the free conservation kits and \$100 toilet rebates, non-low flow toilets, aerators and showerheads must be replaced prior to the sale of a home.

***Conservation Cost Efficiency Studies*** – This type of study will detail the most cost effective, long- term conservation strategies for our area. The focus will be on gathering concrete, numerical data on how water is used by our residential and commercial customers. This data can be used to guide future efforts and establish realistic and achievable community goals.

***Rate Structure*** – Increasingly, water utilities are using conservation rates or conservation pricing strategies to promote more efficient water use among residential and non-residential customers. There are four generally accepted

conservation rate structures: Inverted Block Rates, Seasonal Rates, Marginal Cost Rates and Peak Use Charge.

*Inverted Block Rates* – The greater the use the more the customer will pay per gallon of water used, based on blocks, or tiers, of usage. A minimum increase of 50% between tiers is considered necessary to achieve reduction of usage. The ACSA recently modified its inverted block rate structure to include four tiers. The first tier (0-3,000 gallons per month) charges customers based on the RWSA Wholesale Water Rate. The second, third and fourth tiers are charged at 2, 3 and 4 times, respectively, the RWSA Wholesale Water Rate.

*Seasonal Rates* – Rates vary throughout the year and are typically higher during the summer to discourage excessive outdoor water use. The City of Charlottesville uses a seasonal flat rate for assessing volume charges to its customers.

*Marginal Cost Rates* – These rates are based on the cost of providing or acquiring additional water supply or capacity for the water service.

*Peak Use Charge* – These rates use winter water usage as a rate baseline. The extra, discretionary usage during spring and summer months is charged at a much higher rate. At least two Virginia utilities find that this rate structure significantly increases revenue.

To encourage water conservation throughout the year, the implementation of a permanent inverted block rate structure for all customer classes should be evaluated, with a minimum increase of 50% between tiers. The application of seasonal rates to the second and third tiers should also be considered, as this may replicate the revenue advantages of the Peak Use Charge. Seasonal rates may create an even larger reduction in usage.

***Sub-metering*** – Many multi-family dwellings are served by a master meter and not an individual sub-meter for each dwelling unit. Without a sub-meter for each unit, residents will not be immediately impacted by wasteful habits or able to capture the financial benefits of reducing usage. While possible, it is not recommended to pursue sub-metering as the renovation of existing dwellings would be costly. The installation of sub-meters in new dwellings takes up significant space and encroaches into the public right-of-way.

<b>City and ACSA Recommended Implementation Plan</b>		
<b>Recommendation</b>	<b>Timeframe</b>	<b>Estimated Cost</b>
Toilet Rebate Program Expansion	June 2015	\$300,000 City \$125,000 ACSA
Conservation Kit Distribution	June 2012	\$25,000 City \$15,000 ACSA
Rainwater Harvesting Expansion	June 2012	\$75,000 City \$45,000 ACSA
Irrigation Run-off Adoption	July 2010	N/A
Time of Day Watering Adoption	July 2010	N/A
Mandated Retrofits (Equipment costs covered under other programs; costs shown for advertising and community meetings)	June 2010	\$10,000
Conservation Cost Efficiency Studies	June 2010	N/A
Rate Structure Evaluation and Changes	July 2011	N/A

## Conclusion

The area's water supply is of critical importance today and in the future. Preserving this essential resource is not only in keeping with the sustainability goals of the local governing boards, but also demanded by water customers. Efforts to increase efficiency and minimize water waste must stay at the forefront of utility operational management.

As stated within the Introduction to this report, the City and ACSA customers use significantly less than the national average for water consumption. Prior to the Drought of 2002, residents were not as aware as they are today of their impact on the water supply in the area. Since 2002, many customers have continued to maintain water conservation practices in their everyday lives. This recognition of the effects of personal habits on our environment will make it much more difficult to achieve significant reductions in water use through voluntary actions. Mandatory compliance through ordinances, codes and rules will be required to achieve measurable reductions in water use.

Ongoing efforts toward increased local water conservation are consistent with efforts in many other parts of the country. Greater water savings in the region can be achieved with new and reinvigorated programs that are expected to increase the breadth and depth of conservation in the community. Implementing additional ideas relating to ordinances and rates is in keeping with efforts around the nation to make an even greater impact.