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1.1 Background

Greene County is among the fastest growing communities in Virginia. According to the *Greene County Comprehensive Plan 2003*, the County is in a transition period from being a rural, farming area to a residential community. Significant residential and commercial growth has occurred due to pressure from Albemarle County, Charlottesville and the University of Virginia, and the metropolitan Washington, D.C. area. Since 1990, Greene County's population has increased by 72 percent, ranking Greene County among the fastest growing counties in the State of Virginia.

Due to the nature of the topographic, geologic, climatic and soil features, Greene County has a limited surface water and groundwater supply. Approximately 66 percent of residential and commercial water users in Greene County obtain water from private groundwater wells. The Rapidan Service Authority (RSA) supplies the remaining need through its water treatment plant with the Rapidan River serving as the primary source water supply. The watershed for the Rapidan River falls within the northern portion of the County and is part of the Rappahannock River Basin. The State Water Control Board reported the safe yield of the Rapidan River at the water treatment plant withdrawal point as 1.15 MGD based on the 1Q30 value. Reference Appendix A for RSA's water treatment plant Virginia Department of Health Waterworks Permit and fact sheet.

A previous study prepared in August 2000, entitled *Project 2000 Comprehensive Water Supply Plan*, examined the water needs for Greene County and the other localities served by the Rapidan Service Authority (RSA). The objectives and findings of RSA's 2000 report are summarized in Section 3 of this report. The report analyzed the construction of a water storage reservoir. The report concluded that due to the limitations of other water supply sources, the construction of impoundments would be the only method of securing water for the future. Pumped storage sites were identified as the best solution for an impoundment in the County.

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1.2 Purpose

The purpose of this report is to introduce new pumped storage reservoir sites and further examine the alternatives previously identified, taking into account Greene County's stake in the process and tailoring a solution that fits their needs. The sites to be revisited include pumped storage sites previously identified as high-ranking alternatives in RSA's 2000 report. A hydraulic model has been developed as part of this report incorporating the basic rules considered good guidelines by State agencies in assessing the feasibility of constructing a pumped storage in Greene County. Also part of this study is an analysis of the storage and distribution system, and improvements necessary to meet growing water demands.

1.3 Scope

Greene County has contracted with WW Associates to develop this Regional Water Supply Study. The project scope is listed as follows:

- Review the previous study entitled, *Comprehensive Water Supply Plan*, dated August 2000, as it relates to the water supply needs of Greene County.
- Evaluate existing water data, population projections, comprehensive plan, and other sources, to develop future water demand projections.
- Evaluate existing Greene County water treatment plant and determine whether the existing plant and site are viable as a future water treatment facility.
- Evaluate potential pumped storage reservoir sites to supply water to Greene County based on projected future water demands. Evaluations include:
 - Identification of potential reservoir sites.
 - Safe yield determination for most viable reservoir sites.

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- Maximum feasible distance from WTP and existing infrastructure to proposed reservoir.
 - Site visitations for the most viable reservoir sites.
 - Land use restrictions that would preclude the construction of a pumped storage reservoir.
 - Minimizing project costs.
 - Optimizing water supply yield.
 - Minimizing adverse cultural, historical, and environmental impacts.
 - Recreational benefits
 - Land acquisition issues.
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- Evaluate continual exploration into the use of groundwater sources.
 - Identify water utility infrastructure required to serve Greene County based on projected future demands.
 - Preliminary construction cost estimates for recommended improvements.



Greene County is a growing community and has defined the Route 29/33 corridor as the primary development area for the County. This area of Greene County has experienced most of the growth in the past, and it is anticipated that this trend will continue, and in fact, accelerate in the future.

Rapidan Service Authority currently provides water service to the primary service areas within the County utilizing an existing water treatment plant on the Rapidan River. The Rapidan River is the only major river water source in the County. The watershed for the Rapidan River falls within the northern portion of the County and is part of the Rappahannock River Basin.

The Rapidan River has a safe yield of 1.15 million gallons per day (MGD) as defined by the State Water Control Board. The safe yield of a simple intake (free-flowing stream) is defined by 12 VAC-5-590-830A2 as “... *the minimum withdrawal rate available during a day and recurring every 30 years (30 year - one day low flow).*”

The Rapidan Service Authority (RSA) water system has produced water for Greene County since 1970. During this time, water production has grown steadily at an exponential rate. Over the course of the last 30 years, water production has grown at an average annual rate of 4.25 percent. Reference Table E-1 for projected water demands.

In addition to the safe yield of the Rapidan River, the existing RSA water treatment plant located on U.S. Route 29 has a current rated capacity of 1.2 MGD. Based on future growth projections, it is anticipated that the treatment plant will be operating near capacity by year 2009 during periods of peak demand, generally in the summer.



**Table E-1
Greene County Water Demand Projections**

Year	Average Daily Flow (MGD)	Peak Monthly Flow (MGD)	Peak Daily Flow (MGD)
2009	0.7	0.8	1.2
2033	1.8	2.2	3.3
2048	3.4	4.1	6.0

The conclusions derived from Table E-1 include:

- A new pump storage reservoir with a minimum safe yield of 3.5 MGD is needed to ensure adequate reservoir capacity for the next 40 years. The safe yield analysis performed on the reservoir sites indicates that a storage volume of at least 850 MG is required to provide 3.5 MGD.
- A new water treatment plant is needed with a capacity of 3.0 MGD to meet the peak daily demand in year 2030.
- The new water treatment plant should be easily expandable to 6.0 MGD to meet the 40-year peak daily demand.

A previous study entitled “*Comprehensive Water Supply Plan,*” dated August 2000, evaluated the water supply needs of Greene, Orange, and Madison Counties for the Rapidan Service Authority. The purpose of this Greene County Regional Water Supply Study is to re-evaluate the previous study as it relates to Greene County and further evaluate potential pumped storage reservoir sites, and water treatment facilities to ensure an adequate water supply to serve Greene County for a time horizon of 40 years.

Although several conventional water impoundment dam sites are available on the Rapidan River, only sites conducive to adaptation as a pumped storage facility were

analyzed due to current regulatory opinion as it relates to conventional water impoundments.

As part of the evaluation of pumped storage sites, a computer model was developed to determine potential safe yield of the proposed reservoirs. The model is based on historical flows obtained from the United States Geological Survey (USGS) gauging station and determines the safe yield of the river/reservoir system based on a series of conditions. The model was structured and programmed with the ability to simulate different reservoir sizes, varying demands, and diversion pump capacities.

For the generation of the Greene County Pumped Storage Model, rules previously established by the State of Virginia were incorporated. Although every site is unique, conversations with the Department of Environmental Quality and Department of Game and Inland Fisheries indicate that the basic rules used in this report are considered good guidelines to use in assessing the feasibility of constructing a pumped storage reservoir in Greene County.

Previous water models developed for RSA in the “*Comprehensive Water Supply Plan*” were based on the premise of 20 percent flow-by requirements at the Rapidan River intake. The model analysis in this report is based on the 60/40 rule, based on discussions with DEQ, which sets a limit on how much water can be withdrawn during two different seasonal conditions. Under this rule, water may be withdrawn from a river based on its mean annual flow as follows:

- March 1 – June 30: Withdrawal from the river will be allowed if the natural stream flow minus the withdrawal is greater than 60 percent of the mean annual flow.
- July 1 – February 29: Withdrawal from the river will be allowed if the natural stream flow minus the withdrawal is greater than 40 percent of the mean annual flow.



The alternative pumped storage reservoir sites further analyzed in this study include Buckner Run, Henshaw Run, White Run, Upper Welsh Run Run, and Blackberry Lane Property. Several of these sites were among the highest-ranking alternatives previously identified by the RSA “*Comprehensive Water Supply Plan.*” Additional sites were identified as potential reservoir locations but were not further analyzed due to yield and volume restrictions or severe environmental impacts.

An alternative analysis of the sites was performed. The economical aspects of the reservoir alternatives along with other important considerations such as yield, storage volume, environmental impacts, land use and site access and location were some of the factors used in the analysis.

The analysis performed was a weighted average analysis. This type of analysis assigns a weighted factor to each category in order to distinguish each factor’s importance. The eight evaluation criteria listed below were used in this analysis.

- Storage Volume/Potential Yield
- Environmental Impacts
- Infrastructure Impacts
- Project Construction Cost
- Location to Service Area
- Distance from Diversion
- Land Acquisition
- Land Owner Impact

The Upper Welsh Run and White Run alternatives are the highest-ranking options in the analysis based on the above listed evaluation criteria. The safe yield of the Upper Welsh Run Reservoir and White Run Reservoir is 4.5 MGD and 4.0 MGD, respectively.

Water infrastructure improvements in Greene County are needed to provide adequate service such as the construction of a water treatment plant, transmission lines, and storage



and distribution system improvements. All of these elements are important to providing long-term water solutions in Greene County. Some of the improvements are considered immediate, while other described improvements will be developed as needed to meet new water demands. The following is a list of improvements recommended for Greene County. Costs for these improvements are summarized in Table E-2.

- Source Water Intake and Pump Station
- Raw Water Transmission Line
- Pumped Storage Reservoir
- 3.0 MGD Water Treatment Plant
- Finished Water Transmission Line
- Town of Stanardsville Water Distribution and Storage System Improvements

**Table E-2
Estimated Infrastructure Construction Costs**

Projects	Upper Welsh Run Cost	White Run Cost
Source Water Intake and Pump Station	\$2,800,000	\$2,800,000
Raw Water Transmission Line	\$8,400,000	\$5,400,000
Pumped Storage Reservoir	\$15,000,000	\$14,900,000
3.0 MGD Water Treatment Plant	\$10,500,000	\$10,500,000
Finished Water Transmission Line	\$1,500,000	\$2,000,000
Groundwater Resource Development	\$1,000,000	\$1,000,000
Total Cost of Alternative	\$39,200,000	\$36,600,000
Town of Stanardsville Estimated Infrastructure Construction Costs		
750,000 Gallon Storage Tank	\$1,125,000	
12-inch Water Main (outside Stanardsville)	\$3,700,000	
12-inch Water Main (inside Stanardsville)	\$450,000	
Total Cost	\$5,275,000	



The rated capacity of the new Source Water Pump Station is projected to be between 10.5 MGD and 13.5 MGD. The Raw Water Transmission Line will be constructed from the Source Water Pump Station to the selected reservoir location.

Long-term improvements require construction of a new water treatment plant. The new plant will be a water conventional treatment facility. The plant will be designed to provide for easy expansion. The new water treatment plant will be designed for the 20-year peak daily demand of 3.0 MGD, with future expansion available to 6.0 MGD.

Other smaller improvements may be necessary to provide service to developing areas such as water line extensions and looping in the system. When possible, the construction costs for these types of improvements should be provided by the developer in need of additional water service.

Effective November 2, 2005, the Commonwealth of Virginia's State Water Control Board added 9 VAC 25-780-10 through 9 VAC 25-780-190 to the Local and Regional Water Supply Planning Regulations, requiring the submission of local or regional water supply plans for all counties, cities, and towns in the Commonwealth by year 2011. These plans will include the following information:

- Existing water source information
- Existing water user information
- Existing resource information, including geologic, hydrologic, and meteorological conditions, and environmental, natural, and historical resources
- Projected water demand information
- Water demand management information
- Drought response and contingency plans
- Statement of need and alternatives



The water planning, permitting, and approval process can be a lengthy process. We recommend proceeding with the water supply plan in the near future to allow it to become a planning tool in conjunction with the reservoir project. Additionally, we recommend that Greene County move forward with the reservoir project to ensure adequate future supply. The following are steps necessary in moving forward with this project:

- Regulatory review and determination of water withdrawal regulations on the Rapidan River.
- Selection of site.
- Environmental review of the selected site and the raw water intake.
- Acquisition of property.
- Proceed with Preliminary Engineering Report and determine likely transmission line routing, water treatment plant location, and final source water pump station location.
- Subsurface exploration to assist preliminary engineering by exploring the geologic features.
- Evaluate available alternatives in financing the capital costs associated with the proposed improvements.
- Proceed with the design and construction.

WW Associates would like to express appreciation for the assistance given by Greene County and the Rapidan Service Authority in the development of this report. Through the joint effort of these stakeholders, the development of this Greene County Regional Water Supply Study has been possible.