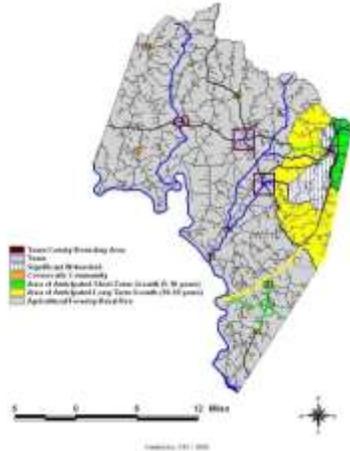




Figure 4-1
Charlotte County Future Land Use



REGIONAL WATER SUPPLY PLAN



Charlotte County, Virginia

Final: July 2011

TABLE OF CONTENTS

1.0	<i>INTRODUCTION</i>	<i>1</i>
1.1	<i>Purpose of the Study</i>	1
1.2	<i>Charlotte County – General Location and Description</i>	2
1.3	<i>Abbreviations Used in this Plan</i>	2
2.0	<i>EXISTING WATER SOURCE INFORMATION - GROUND WATER</i>	<i>5</i>
2.1	<i>The Town of Charlotte Court House Water System</i>	5
2.1.1	<i>Tanyard Spring</i>	5
2.1.2	<i>Well No. 1</i>	6
2.1.3	<i>Well No. 3</i>	6
2.1.4	<i>Well No. 4</i>	6
2.1.5	<i>Well No. 5</i>	6
2.1.6	<i>Well No. 6</i>	7
2.1.7	<i>Screens</i>	7
2.1.8	<i>Ground Water Withdrawal Permits:</i>	7
2.1.9	<i>Storage</i>	8
2.1.10	<i>System Source Capacity</i>	8
2.1.11	<i>Storage Capacity</i>	8
2.1.12	<i>Operation Permit</i>	9
2.1.13	<i>VDH Engineering Description Sheets and Permit Information</i>	9
2.1.14	<i>Map of the System</i>	9
2.2	<i>The Town of Drakes Branch Water System</i>	11
2.2.1	<i>Well No. 2</i>	11
2.2.2	<i>Well No. 4</i>	11
2.2.3	<i>Well No. 5</i>	11
2.2.4	<i>Well No. 6</i>	12
2.2.5	<i>Well No. 7 – WestPoint Stevens Well</i>	12
2.2.6	<i>System Source Capacity</i>	12
2.2.7	<i>Screens</i>	13
2.2.8	<i>Ground Water Withdrawal Permits</i>	13
2.2.9	<i>Storage Capacity</i>	13
2.2.10	<i>Operation Permit</i>	13
2.2.11	<i>VDH Engineering Description Sheets and Permit Information</i>	14
2.2.12	<i>Map of the System</i>	14
2.3	<i>The Town of Phenix Water System</i>	16
2.3.1	<i>Well No. 1</i>	16
2.3.2	<i>Well No. 2</i>	16
2.3.3	<i>Screens</i>	16
2.3.4	<i>Ground Water Withdrawal Permits</i>	16
2.3.5	<i>Storage</i>	16
2.3.6	<i>System Source Capacity</i>	17
2.3.7	<i>Storage Capacity</i>	17
2.3.8	<i>Permitted Capacity</i>	17
2.3.9	<i>VDH Engineering Description Sheets and Permit Information</i>	17
2.3.10	<i>General System Map</i>	17
3.0	<i>EXISTING WATER SOURCE INFORMATION – SURFACE WATER</i>	<i>19</i>
3.1	<i>Keysville Reservoir</i>	19
3.2	<i>Water Treatment Facility</i>	19
3.2.1	<i>Raw Water Quality</i>	20
3.2.2	<i>Preaeration</i>	21

3.2.3	Flash Mixing.....	21
3.2.4	Flocculation	21
3.2.5	Sedimentation	21
3.2.6	Chemical Feed Systems	21
3.2.7	Sand Filters	22
3.2.8	Clearwell.....	22
3.2.9	Pumping Equipment	22
3.2.10	Chlorination Facilities	22
3.2.11	Fluoridation Facilities	22
3.2.12	Storage and Booster Pump Station	22
3.2.13	Industrial Park Elevated Tank.....	23
3.2.14	Limitations on Withdrawal	23
3.2.15	Capacity of the Water Treatment Plant.....	23
3.2.16	Keyville Water System Map	23
3.3	<i>Community Water Systems Using Stream Intakes.....</i>	27
3.4	<i>Self-Supplied Users of More than 300,000 gallons per Month of Surface Water for Non-Agricultural Uses.....</i>	27
3.5	<i>Self-supplied Non-agricultural Users of More than 300,000 Gallons per Month of Ground Water ...</i>	27
3.5.1	Cardinal Homes Inc.	27
3.5.2	Well	27
3.5.3	Treatment.....	28
3.5.4	Storage	28
3.5.5	Ground Water Withdrawal Permit	28
3.5.6	Permitted Capacity.....	28
3.5.7	VDH Engineering Description Sheets and Permit Information	28
3.5.8	Limitations Established by VDEQ.....	28
3.6	<i>Water Purchased from Systems Outside of Charlotte County.....</i>	28
3.7	<i>Water Available for Purchase Outside of Charlotte County.....</i>	28
3.8	<i>Agricultural Use – Using More Than 300,000 Gallons Per Month.....</i>	29
3.8.1	Estimated Water Use –Agricultural Sector	29
3.9	<i>Estimate of the Number of Residences and Businesses that are Self-Supplied by Individual Wells Withdrawing Less Than 300,000 Gallons of Water per Month.....</i>	31
3.9.1	Sampling of Individual Well Permits	31
3.9.2	Estimated Population and Usage	31
3.10	<i>Noncommunity Users – Using Groundwater</i>	31
3.10.1	Nontransient Noncommunity Users.....	31
3.10.2	J.M. Jeffress Elementary School.....	32
3.10.3	Eureka Elementary School.....	32
3.10.4	Bacon District Elementary School.....	32
3.11	<i>Transient Noncommunity Waterworks Using Groundwater</i>	33
3.12	<i>cc Assessment Plans or Wellhead Protection Programs.....</i>	33
4.0	<i>EXISTING WATER USE INFORMATION</i>	36
4.1	<i>Population within the Planning Area Served by Each Community Water System</i>	36
4.2	<i>Number of Connections for Each Community Water System.....</i>	36
4.3	<i>Average and Maximum Daily Withdrawal for Each Community Water System</i>	36
4.4	<i>Summary of Existing Water Use</i>	38
4.5	<i>Peak Day Water Use.....</i>	38
4.6	<i>Estimated Average Annual Usage by Self-Supplied Non-Agricultural Users of more than 300,000 Gallons per Month of Surface and Ground Water Within the Service Area of Each Community Water Supply.....</i>	39

4.7	<i>Estimated Average Annual Usage by Self-Supplied Agricultural Users of more than 300,000 Gallons per Month of Surface and Ground Water Within the Service Area of Each Community Water Supply</i>	39
4.8	<i>Self-Supplied Users of Less than 300,000 Gallons per Month of Ground Water Within the Service Areas of the Community Water Systems</i>	39
4.8.1	Town of Charlotte Court House	39
4.8.2	Town of Drakes Branch	40
	Town of Phenix	40
4.8.4	Town of Keysville	40
4.8.5	Summary of Estimated Usage by Self Supplied Users within the Service Area of Community Systems	40
4.9	<i>Disaggregated Estimated Water Demand for Each Community Water System</i>	41
4.10	<i>In-Stream Beneficial Uses Affected by Point of Stream Withdrawal</i>	42
4.11	<i>Self-Supplied Nonagricultural Users of More than 300,000 Gallons per Month Outside of the Service Areas of the Community Systems</i>	42
4.12	<i>Use by Self-Supplied Agricultural Users of more than 300,000 Gallons per Month Outside of the Service Areas of the Community Water Systems</i>	42
4.12.1	Estimated Water Use – Agricultural Sector	42
4.13	<i>Estimated Self-Supplied Users of less than 300,000 Gallons per Month, Outside the Service Areas of the Community Water Systems</i>	43
4.13.1	Estimated Usage of Self-Supplied Homes	44
4.13.2	Usage of Non-Residential Self-Supplied Users	44
4.14	<i>Summary of All Withdrawals in Charlotte County</i>	44
5.0	<i>EXISTING RESOURCE INFORMATION</i>	45
5.1	<i>Geologic, Hydrologic and Meteorological Conditions</i>	45
5.1.1	Geologic Conditions	45
5.2	<i>Hydrologic Conditions</i>	49
5.2.1	Ground Water Hydrology	49
5.2.2	Surface Hydrology	50
5.2.3	Watersheds	50
5.3	<i>Ground Water</i>	53
5.3.1	Ground Recharge Potential	53
5.4	<i>Licensed Dams</i>	54
5.1	<i>Meteorological Conditions</i>	55
5.2	<i>Existing Environmental Conditions that Pertain to or May Affect In-Stream Flow, In-Stream Uses, and Sources that Provide the Current Supply</i>	56
5.2.1	State or Federal Listed Threatened or Endangered Species or Habitats of Concern	56
5.2.2	Anadromous, Trout and other Significant Fisheries	57
5.2.3	River Segments that have Recreational Significance including Scenic River Status	58
5.3	<i>Sites of Historic Significance</i>	59
5.4	<i>Sites of Archaeological Significance</i>	61
5.5	<i>Unusual Geologic Formations or Special Soil Types</i>	61
5.6	<i>Wetlands</i>	63
5.7	<i>Riparian Buffers</i>	63
5.8	<i>Conservation Easements</i>	66
5.9	<i>Land Use and Land Coverage</i>	66
5.10	<i>Land Use and Zoning</i>	69
5.11	<i>Soil, Farmland, and Forest</i>	69
5.12	<i>Drakes Branch Reservoir</i>	70

5.13	<i>Mineral Resources</i>	70
5.14	<i>Flood Zones</i>	71
5.15	<i>Presence of Impaired Streams and Type of Impairment,</i>	71
5.16	<i>Location of Point Source Discharges</i>	72
5.17	<i>Other Potential Threats to the Existing Water Quantity and Quality</i>	73
6.0	<i>PROJECTED WATER DEMAND INFORMATION BASED ON POPULATION</i>	80
6.1	<i>Historical Population</i>	80
6.2	<i>Population in 2000 by “Growth Area”</i>	81
6.3	<i>Historical Population Trends in the Towns</i>	84
6.4	<i>Projected Population - “Lower Level” Population Growth Estimates</i>	84
6.5	<i>Projected Population - “Upper Level” Population Growth Estimates</i>	85
6.6	<i>Projected Water Demands – “Lower Level”</i>	86
6.7	<i>Projected Water Demands – “Upper Level”</i>	87
6.8	<i>Projected Population within the Planning Area Served by the Community Water Systems</i>	90
6.9	<i>Projected Population within the Planning Area Served by the Community Water Systems</i>	90
6.10	<i>Estimated Disaggregated Demands for Community Systems</i>	94
6.11	<i>Projected Water Demand for Self-Supplied Nonagricultural Users of More than 300,000 Gallons per Month Estimated Disaggregated Demands for Community Systems</i>	98
6.12	<i>Projection of Self-Supplied Agricultural Users</i>	98
6.13	<i>Projected Number of Self-Supplied Users of Less Than 300,000 Gallons per Month Located outside of the Service Areas of the Community Water Systems</i>	98
7.0	<i>PROJECTED WATER DEMAND – BASED ON LAND USE</i>	101
7.1	<i>Projected Demands Using Comprehensive Plan</i>	101
7.2	<i>Comparison of Demand Projections (Land-Use Projections to vs. Population-based Projections)</i> ..	102
7.3	<i>Summary of Projected Demands</i>	104
7.4	<i>Cumulative Demand, Use Conflict, In-Stream Flow Information</i>	104
8.0	<i>WATER DEMAND MANAGEMENT</i>	107
8.1	<i>Practices for Efficient Use of Water in the County</i>	107
8.2	<i>Educational Programs that Encourage Conservation</i>	107
8.3	<i>Water Rates as a Conservation Tool</i>	108
8.4	<i>Practices to Reduce Unaccounted for Water</i>	108
9.0	<i>DROUGHT RESPONSE AND CONTINGENCY PLANS</i>	110
10.0	<i>STATEMENT OF NEED AND ALTERNATIVES</i>	111
10.1	<i>Town of Keysville</i>	112
10.2	<i>Town of Drakes Branch</i>	112
10.3	<i>Town of Charlotte Court House</i>	113
10.4	<i>Town of Phenix</i>	114
10.5	<i>Groundwater Resource Recommendations</i>	114
10.6	<i>Potential Water Savings from Water Demand Management Actions</i>	115
10.7	<i>Potential Sources for New Supply</i>	116
10.8	<i>Potential Resource Issues or Impacts</i>	117
10.9	<i>Water Reuse</i>	117
11.0	<i>SUMMARY</i>	118

TABLES

Table 1-1 - Abbreviations Used.....	2
Table 2-1 – Town of Charlotte Court House – Summary of Well Data	7
Table 2-2 – Town of Charlotte Court House – Source Capacity	8
Table 2-3 – Town of Charlotte Court House – Storage Capacity	9
Table 2-4 – Town of Drakes Branch – Summary of Well Data.....	12
Table 2-5 – Town of Drakes Branch – Source Capacity	13
Table 2-6 – Town of Drakes Branch – Storage Capacity	13
Table 2-7 – Town of Phenix – Summary of Well Data	16
Table 2-8 – Town of Phenix – Source Capacity	17
Table 3-1 – Livestock Information	30
Table 3-2 –Crop Information	30
Table 3-3 – Transient Noncommunity Waterworks.....	33
Table 3-4 – Current Estimated Ground Water Usage	35
Table 4-1 –Estimated Population Served.....	36
Table 4-2 –Number of Connections.....	36
Table 4-3 –Average and Maximum Daily Withdrawals – Town of Charlotte Court House - 2006.....	37
Table 4-4 –Average and Maximum Daily Withdrawals – Town of Drakes Branch - 2006	37
Table 4-5 –Average and Maximum Daily Withdrawals – Town of Phenix - 2006.....	37
Table 4-6 –Average and Maximum Daily Withdrawals – Town of Keysville - 2006.....	37
Table 4-7 –Average and Maximum Daily Withdrawals – Planning Area - 2006.....	38
Table 4-8 –Summary of Water Use – Community Systems	38
Table 4-9 – Estimate of Number of Self-Supplied Users and Estimated Annual Consumption within the Community Systems	41
Table 4-10 –Estimated Disaggregated Use – Community Systems.....	42
Table 4-11 – Livestock Information	43
Table 4-12 –Crop Information	43
Table 4-13 – Average Usage Based on VDH Inspection.....	44
Table 4-14 –Summary of Water Withdrawal.....	44
Table 5-1 –Charlotte County Geologic Regions and Rock Types	46
Table 5-2 – River and Stream Flow Rates 1990 - 2003.....	50
Table 5-3 – Hydrologic Watersheds in Charlotte County.....	51
Table 5-4 – Ground Water Recharge Potential	54
Table 5-5 – State Licensed Dams	55

Table 5-6 – Climate	56
Table 5-7 –Endangered or Threatened Species.....	56
Table 5-8 – Sites of Historic Significance	59
Table 5-9 – Land Conservation Easements in Charlotte County	66
Table 5-10 - Land Cover Type.....	69
Table 5-11 –Impaired Waters of Charlotte County.....	72
Table 6-1 –Historical and Projected Population	80
Table 6-2 –2000 – 2006 Population.....	81
Table 6-3 –2000 Population by Growth Area.....	84
Table 6-4 –Population in the Towns	84
Table 6-5 –Projected “Lower Level” Population – Charlotte County	85
Table 6-6 –Population Growth Rates – 2010 – 2060 – Upper Level Projections	85
Table 6-7 –Projected “Upper Level” Population – Charlotte County.....	86
Table 6-8 –Water Demand Projections – Based on “Lower Level” Population Projections	88
Table 6-9 –Water Demand Projections – Based on “Upper Level” Population Projections	89
Table 6-10 –Projected Population in the “Growth Areas” of the Existing Community Water Systems	90
Table 6-11 –Peak Month Demands – Community Water Systems – Based on 2006 Records.....	91
Table 6-12—Projected Community Water System Demands – Annual Average and Peak Monthly Demands – “Lower Level”	92
Table 6-13—Projected Community Water System Demands – Annual Average and Peak Monthly Demands – “Upper Level”	93
Table 6-14 –Estimated Disaggregated Use – Community Systems.....	95
Table 6-15 –Estimated Disaggregated Use – Community Systems – Lower Level Projections	96
Table 6-16 –Estimated Disaggregated Use – Community Systems – Upper Level Projections.....	97
Table 6-17 –Projected Self-Supplied Users – Using “Lower Level” Projections.....	99
Table 6-18 –Projected Self-Supplied Users – Using “Upper Level” Projections	100
Table 7-1 – Summary of Demand Projections - 2060– Community Systems	105
Table 8-1 – Comparison of Existing Water Rates to Average Rate in Virginia	108
Table 10-1 - Possible Sources for Future Water Supply.....	112
Table 10-2 – Average Residential Consumption	116

FIGURES

Figure 1-1 - Charlotte County and Surrounding Counties	3
Figure 1-2 - Charlotte County Topographic Map	4
Figure 2-1 –Existing Water System – Town of Charlotte Court House	10
Figure 2-2 – Existing Water System – Town of Drakes Branch.....	15
Figure 2-3 – Existing Well and Tank Location - Town of Phenix.....	18
Figure 3-1 - Keysville Reservoir.....	24
Figure 3-2 – General Schematic, Water Treatment Plant, Keysville	
Figure 3-3 – Existing Water System - Town of Keysville	25
Figure 3-4 –Summary of Well Data.....	34
Figure 5-1 – Geological Conditions, Charlotte County	48
Figure 5-2 – Watersheds, Charlotte County.....	52
Figure 5-3 – Historic Sites	60
Figure 5-4 –Archaeological Sites located in Charlotte County	62
Figure 5-5 – Wetlands, Charlotte County	64
Figure 5-6 – Riparian Buffers, Charlotte County.....	65
Figure 5-7 – Charlotte County Zoning Map	68
Figure 5-8 – U.S. Army Corps of Engineers Land in Charlotte County	74
Figure 5-9- Important Farmlands	75
Figure 5-10 – Charlotte County Rivers, Major Creeks, and State Licensed Watershed Dams.....	76
Figure 5-11 – Drakes Branch Reservoir and Watershed.....	77
Figure 5-12 – Non-Fuel Mineral Mines in Charlotte County	78
Figure 5-13 – Charlotte County Flood Plain Map	79
Figure 6-1 – Population by Census Block Group	82
Figure 6-2 –Charlotte County Future Land Use	83
Figure 7-1 – Charlotte Courthouse.....	102
Figure 7-2 – Drakes Branch.....	103
Figure 7-3 – Keysville	103
Figure 7-4 – Phenix.....	104
Figure 7-5 – Comparison of Results of Population and Land Use Demand Projections	106

APPENDIX

APPENDIX I. VDH Engineering Descriptions of Water Systems

Community Water Systems

- ◆ Town of Charlotte Courthouse
- ◆ Town of Drakes Branch
- ◆ Town of Phenix
- ◆ Town of Keysville (includes excerpt from Wiley and Wilson 2010 report)

Nontransient Noncommunity Water Systems

- ◆ Cardinal Homes, Inc.
- ◆ J.M. Jeffress Elementary School
- ◆ Eureka Elementary School
- ◆ Bacon District Elementary School

Transient Noncommunity Water Systems

- ◆ Keysville Save-U-Time
- ◆ Wylliesburg Diner
- ◆ Tastee Freeze
- ◆ Sheldon's Motel and Restaurant
- ◆ Staunton River Battlefield State Park
- ◆ Paradise Grill

APPENDIX II. Photographs of the Reservoirs and Keysville Water Plant

APPENDIX III. Ground Water Survey Data Summary (Private Wells)

APPENDIX IV. Public Meeting Information

APPENDIX V. VDEQ Withdrawal Records

APPENDIX VI. VDEQ Safe Yield Report

1.0 INTRODUCTION

1.1 Purpose of the Study

Charlotte County and the Towns of Charlotte Court House, Drakes Branch, Keysville and Phenix have developed this Water Supply Plan to evaluate the current and future water supply needs in Charlotte County to ensure that the water supply needs of the people living in the County will be met now and in the future. This Water Supply Plan was developed to comply with the State Water Control Board's Local and Regional Water Supply Planning Regulation (9 VAC 25-780-10 through 9 VAC 25-780-190, hereinafter, the "Regulation") which establishes a comprehensive water supply planning process for the development of local, regional and state water supply plans.

The water supply planning process is designed to:

- ◆ Ensure that adequate and safe drinking water is available;
- ◆ Encourage, promote, and protect all other beneficial uses of water resources; and
- ◆ Encourage, promote, and develop incentives for alternative water sources.

This report represents Charlotte County's Water Supply Plan and addresses the items required by the State Water Control Board's Local and Regional Water Supply Planning Regulations.

The Water Supply Regulation establishes a schedule for submittal of the local and regional Water Supply Plans. The due dates are based on the locality's latest population as published by the U.S. Bureau of the Census. Based on the Census Bureau's 2000 population count, Charlotte County has a population of 12,472, including the population of the towns. The Water Supply regulation requires that a county of this size needs to submit the completed Water Supply Plan by November 2010. However, the regulation allows a November 2011 submittal date for regional plans and this plan qualifies as a regional plan.

1.2 Charlotte County – General Location and Description

Charlotte County is located in the Central-Southside Region of Virginia, approximately 80 miles southwest of the state capitol, Richmond (see **Figure 1-1**). The County is predominately rural; the population in 2006 is estimated to be 12,762.¹

The County is 475 square miles in area; the greatest east to west distance is approximately 24 miles, and the greatest north to south distance is approximately 38 miles. There are four incorporated towns in the county; Charlotte Court House, the county seat; Drakes Branch, Keysville and Phenix. The terrain ranges from gently rolling to hilly, steep, and broken. General elevations are 350 to 450 feet, and no elevation is greater than 750 feet above sea level (see **Figure 1-2**).

1.3 Abbreviations Used in this Plan

Throughout this Water Supply Plan, numerous abbreviations are used. The following table provides definitions for each of the abbreviations used throughout the Plan.

Table 1-1 - Abbreviations Used

Abbreviation	Definition
cfs	cubic feet per second
ERC ²	equivalent residential connection
gpd	gallons per day
gph	gallons per hour
gpm	gallons per minute
HP	Horsepower
lbs	Pounds
MGD or mgd	million gallons per day
psi	pounds per square inch
rpm	rotations per minute
TDH	total dynamic head
VDEQ	Virginia Department of Environmental Quality
VDH	Virginia Department of Health
VOF	Virginia Outdoor Fund
VDCR	Virginia Department of Conservation and Recreation
VDHR	Virginia Department of Historic Resources

¹ Demographics and Workforce Section, Weldon Cooper Center for Public Service, University of Virginia.

² “ERC” means “equivalent residential connection” or 400 gpd, in accordance with the 1995 Waterworks Regulations.

Figure 1-1 - Charlotte County and Surrounding Counties

Figure 1-2 - Charlotte County Topographic Map

2.0 EXISTING WATER SOURCE INFORMATION - GROUND WATER

As required by the Regulation³, this section of the Water Supply Plan provides information on existing water sources.

Existing water sources in Charlotte County include the public water systems owned and operated by the Town of Charlotte Court House, the Town of Drakes Branch, the Town of Keysville and the Town of Phenix. The municipal systems operated by the four towns supply treated water to customers within town limits, and to some areas immediately outside of town limits. Except for Keysville, which obtains its water from a reservoir, the towns rely on wells for water supply.

In addition, there are numerous wells serving individual homes, businesses and agricultural uses. Each is discussed in the following sections of this report.

The following information is from the VDH descriptions sheets, except in cases where more current information is available, that information is footnoted and the source is cited.

2.1 The Town of Charlotte Court House Water System

The Town of Charlotte Court House community waterworks consists of one spring with 24,000 gallons of reservoir storage, five drilled wells⁴ and two elevated steel storage tanks with capacities of 30,000 and 100,000 gallons. There is corrosion control at all sources and disinfection at the Tanyard Spring source. The design capacity for the system is 224 equivalent residential connections or 89,600 gpd. The permit number for the Charlotte Courthouse waterworks is 5037150; the permit was last amended on June 20, 2003.

2.1.1 Tanyard Spring

Tanyard Spring is located in the north side of Route 40 at the end of Tanyard Road, which is approximately 600 feet west of the Courthouse. This facility consists of two 10-foot deep collection reservoirs with effective volumes of 10,000 and 14,000 gallons, constructed of concrete with reservoir diameters of 17 feet and 20 feet, respectively. The screened 3-inch diameter overflow pipe allows

³ 9 VAC 25-780-70.

⁴ One of the drilled wells, Well No. 1, is not operational and is disconnected from the system.

a water depth of 6 feet. The lowest observed overflow rate was determined to be 12 gpm, based on a February 25, 1982 inspection. The spring has a hypochlorinator with a 30-gallon solution tank and a metering pump. Corrosion control consists of a soda ash (Na_2CO_3) feed system. The spring is not currently used as a source.

2.1.2 *Well No. 1*

Well No. 1 is not currently in use and is physically disconnected from the system. The well sits in a concrete block structure on Route 40 east of the high school.

2.1.3 *Well No. 3*

This well is located approximately 300 feet west of Route 645 and approximately 0.15 miles southwest of the intersection of Route 645 and Route 40. The well was drilled in 1959 to a depth of 200 feet and is cased with a 6-inch steel casing pipe to a depth of 103.5 feet and is not grouted. A 30-hour yield and drawdown test performed in May 1992 indicated a stabilized yield of 12 gpm at a drawdown depth of 159 feet from the surface. The well is housed in an enclosure with a concrete floor. Corrosion control treatment similar to that installed at Tanyard Spring is present at Well No. 3.

2.1.4 *Well No. 4*

This well is located on the east side of Route 645, approximately 0.3 miles south of the intersection of Route 40 and Route 645. The well was drilled in 1966, has a depth of 400 feet and is cased with a 6-inch steel casing and grouted to a depth of 50 feet. A 48-hour yield and drawdown test was performed in July 1992 and indicated a stabilized yield of 10 gpm at a drawdown depth of 298 feet from the surface. Corrosion control treatment similar to that installed at Tanyard Spring is present at Well No. 4.

2.1.5 *Well No. 5*

This well is located on the south side of Route 40 approximately 0.6 miles east of the intersection of Route 40 and Route 47 east of town. The well was drilled in 1980, has a depth of 165 feet and is cased with a 10-inch diameter steel casing to

depth of 40 feet and with a 6-inch steel casing to a depth of 46 feet. The well is grouted to a depth of 46 feet. A 48-hour yield and drawdown test was performed in September 1992 and indicated a stabilized yield of 90 gpm at a drawdown depth of 49.6 feet from the surface. The well is housed in a concrete block structure. Corrosion control treatment similar to that installed at Tanyard Spring is present at Well No. 5.

2.1.6 *Well No. 6*

Well No. 6 is located west of Route 47 and north of the corporate limits of the town. The well was drilled in 1996 to a depth of 305 feet. Six-inch diameter galvanized steel casing was installed to a depth of 57 feet. A 48-hour pump test was performed in July 1996 with a yield of 17 gpm at a drawdown depth of 145.7 feet. The well has a submersible pump rated at 35 gpm and 365 TDH. The well sits in a prefabricated well enclosure. Corrosion control treatment consists of orthophosphate feed. This well is not currently in use.

Table 2-1 – Town of Charlotte Court House – Summary of Well Data⁵

Name	Well No. 3	Well No. 4	Well No. 5	Well No. 6⁶	Tanyard Spring
Well Depth	200 ft.	400 ft.	165 ft.	305 ft.	N/A
Casing Depth	103.5 ft.	50 ft.	46 ft.	57 ft.	N/A
Well Diameter	6-inch	6-inch	10-inch; 6-inch	6-inch	N/A

2.1.7 *Screens*

The wells in the Town of Charlotte Court House are Piedmont Rock wells and do not require screens.

2.1.8 *Ground Water Withdrawal Permits:*

Ground water withdrawal permits are not required in Charlotte County.

⁵ During 2006, the Town of Charlotte Court House sited 11 wells and is prepared to develop three of those wells.

⁶ Well #6 is not in use.

2.1.9 *Storage*

System storage consists of a 30,000-gallon elevated storage tank located just east of the Courthouse with an overflow elevation of 767.3 feet, and a 100,000 gallon elevated tank located approximately 300 feet northwest of the intersection of Route 1110 and Route 47. The capacity of the Tanyard Spring reservoir is 24,000 gallons.

2.1.10 *System Source Capacity*

As shown in **Table 2-2**, the total effective source capacity for the Town of Charlotte Court House system is 89,600 gallons per day.

Table 2-2 – Town of Charlotte Court House – Source Capacity

Source (Yield Rate)	Yield (gpd⁷)	Pump Capacity (gpd⁸)	Effective Capacity (gpd)	Effective Capacity (gallons per month)	Effective Capacity (gallons per year)
Spring (10 gpm)	8,000	89,280	Not in Use	-	-
Well No. 3 (12 gpm)	9,600	25,920	9,600	292,000	3.50 million
Well No. 4 (10 gpm)	8,000	21,600	8,000	243,333	2.92 million
Well No. 5 (90 gpm)	72,000	72,000	72,000	2,190,000	26.28 million
Well No. 6 (17 gpm)	13,600	50,400	Not in Use	-	-
Total Effective Capacity			89,600	2,725,333	32.7 million
Effective Capacity is equivalent to VDH permitted capacity.					

2.1.11 *Storage Capacity*

The storage capacity for the Charlotte Court House system is 154,000 gallons as shown below.

⁷ (gpm/(0.5 gpm per ERC) X 400 gpd per ERC = Well Yield (gpd)

⁸ gpm X 1440 min./day

Table 2-3 – Town of Charlotte Court House – Storage Capacity

	Gross Volume (gals)	Effective Volume (gals)
Spring Reservoir	24,000	24,000
Elevated Tank	30,000	30,000
Elevated Tank	<u>100,000</u>	<u>100,000</u>
Total	154,000	154,000

2.1.12 *Operation Permit*

The Town of Charlotte Court House waterworks has been issued an amended Operation Permit with a design capacity of 224 ERCs or 89,600 gpd.⁹

2.1.13 *VDH Engineering Description Sheets and Permit Information*

Detailed VDH engineering descriptions and permit information pertaining to the Town of Charlotte Court House waterworks can be found in **Appendix I**.

2.1.14 *Map of the System*

A general overview of the Charlotte Court House water system with source locations shown is provided as **Figure 2-1**.

⁹ See page 4 of the VDH Engineering Description Sheet for this system.

2.2 The Town of Drakes Branch Water System

The Town of Drakes Branch community waterworks consists of five drilled wells and a 100,000-gallon elevated atmospheric-type storage tank and water distribution system. The design capacity for the system is 112,800 gpd.

The Town's permit number is 5037200; the permit was last amended on February 24, 1999.

2.2.1 Well No. 2

Well No. 2 is located on Route 1205, 0.2 miles east of the intersection with Route 47. The well is estimated to be 435 feet deep and cased with 8-inch diameter steel casing. A 48-hour yield and drawdown test was performed in April 1995, resulting in 13 gpm at a drawdown level of 188 feet below the top of the casing pipe. Data provided by the Town in 2011 indicates that Well #2 pumps 10 gpm for a maximum period of 2 hours.

The well is housed in a concrete block building.

2.2.2 Well No. 4

Well No. 4 is located at the intersection of Routes 637 and 619. The well was drilled in 1975 to a depth of 370 feet and cased with 6-inch diameter steel casing to 73 feet and grouted to 73 feet. The pump was tested in April 1995, and yielded 22 gpm at a drawdown level of 80 feet. The well is housed in a concrete block building.

2.2.3 Well No. 5

The well is located on Route 47 behind Canada's Supermarket. The well was drilled in 1978 to a depth of 505 feet and cased with 6-inch diameter steel casing and grouted to a depth of 65 feet. The well yielded 31 gpm over a 48-hour period at drawdown level of 222 feet below surface in 1978. The well has a 3-HP submersible pump with a rated capacity of 33 gpm based on a 5 hour test performed in 1998. The well is housed in a concrete block building.

2.2.4 *Well No. 6*

This well is located on the west side of Highway 47, approximately one mile south of Twitty’s Creek. The well was drilled to a depth of 405 feet and cased with 6-inch diameter steel casing to a depth of 89 feet and grouted to a depth of 50 feet in 1986. The well yield is 27 gpm with a drawdown depth of 258 feet based on a 48-hour yield and drawdown test. The well is housed in a building similar to Wells 2, 3, and 5.

2.2.5 *Well No. 7 – WestPoint Stevens Well*

This well is located off State Route 623 on the WestPoint Stevens property approximately 1,500 feet east of the elevated tank at WestPoint Stevens. The well is owned by the Town of Drakes Branch.¹⁰ The well was drilled in 1966 and renovated in 1972. The well is 235 feet deep and cased with 6-inch diameter steel casing and grouted to a depth of 83 feet. A 48-hour yield and drawdown test performed in 1995 indicated the well yield to be 50 gpm with a drawdown depth of 75 feet. The well is housed in a concrete block building.

Table 2-4 – Town of Drakes Branch – Summary of Well Data

Name and ID Number	Well No. 2	Well No. 4	Well No. 5	Well No. 6	Well No. 7
Well Depth	435 ft.	370 ft.	505 ft.	405 ft.	235 ft.
Casing Depth	Not Known	73 ft.	65 ft.	89 ft.	83 ft.
Well Diameter	8 inches	6 inches	6 inches	6 inches	6 inches

2.2.6 *System Source Capacity*

The total effective source capacity for the Town of Drakes Branch system is 282 equivalent residential connections or 112,800 gpd as shown below.

¹⁰ The EDS indicates that the well is leased by the Town.

Table 2-5 – Town of Drakes Branch – Source Capacity

Source (Yield Rate)	Yield (gpd)	Pump Capacity (gpd)	Effective Capacity (gpd)	Effective Capacity (gallons per month)	Effective Capacity (gallons per year)
Well No. 2 (13 gpm)	10,400	19,400	10,400	316,333	3.8 million
Well No. 4 (20 gpm)	16,000	31,680	16,000	486,667	5.84 million
Well No. 5 (31 gpm)	24,800	47,520	24,800	754,333	9.05 million
Well No. 6 (27 gpm)	21,600	44,640	21,600	657,000	7.88 million
Well No. 7 (50 gpm)	40,000	54,720	<u>40,000</u>	<u>1,216,667</u>	<u>14.6 million</u>
Total Effective Capacity			112,800	3,431,000	41.17 million
Effective Capacity is equivalent to VDH permitted capacity.					

2.2.7 *Screens*

The wells in the Town of Drakes Branch are Piedmont Rock wells and do not require screens.

2.2.8 *Ground Water Withdrawal Permits*

Ground water withdrawal permits are not required in Charlotte County.

2.2.9 *Storage Capacity*

The storage capacity for the Town of Drakes Branch system is 100,000 gallons as shown below.

Table 2-6 – Town of Drakes Branch – Storage Capacity

	Gross Volume (gals)	Effective Volume (gals)
Elevated Tank	<u>100,000</u>	<u>100,000</u>
	100,000	100,000

2.2.10 *Operation Permit*

The Town of Drakes Branch waterworks has been issued an amended Operation Permit with a design capacity of 258 ERCs or 112,800 gpd.

2.2.11 *VDH Engineering Description Sheets and Permit Information*

Detailed VDH engineering descriptions and permit information pertaining to the Town of Drakes Branch waterworks can be found in **Appendix I**.

2.2.12 *Map of the System*

A general overview of the Drakes Branch water system is provided in the following figure. The water mains range in size from 2” to 8”.

2.3 The Town of Phenix Water System

The Town of Phenix waterworks consists of two drilled wells, each with hypochlorination, an 114,000-gallon standpipe and distribution system. The waterworks permit number is 5037550; the permit was last amended on December 19, 2003.

2.3.1 *Well No. 1*

Well No. 1 is located near the intersection of Charlotte and Halifax Streets, east of the standpipe. The well was drilled in 1957. The depth of the well is 201 feet and it is cased with 6-inch diameter steel casing to a depth of 70 feet and grouted. The well is housed in an enclosure with a concrete floor.

2.3.2 *Well No. 2*

Well No. 2 is located near the intersection of Charlotte and Halifax Streets, west of the standpipe. The well was drilled in 1968. The depth of the well is 405 feet and it is cased with 6-inch diameter steel casing to a depth of 114 feet and not grouted. The well is housed in an enclosure with a concrete floor.

Table 2-7 – Town of Phenix – Summary of Well Data

Name and ID Number	Well No. 1	Well No. 2
Well Depth	201 ft.	405 ft.
Casing Depth	70 ft.	114 ft.
Well Diameter	6 inch	6 inch
Observed Well Pump Capacity	10 gpm	30 gpm

2.3.3 *Screens*

The wells in the Town of Phenix are Piedmont Rock wells and do not require screens.

2.3.4 *Ground Water Withdrawal Permits*

Ground water withdrawal permits are not required in Charlotte County.

2.3.5 *Storage*

System storage consists of an 114,000-gallon standpipe.

2.3.6 *System Source Capacity*

As shown below, the total effective source capacity for the Town of Phenix system is 24,400 gpd.

Table 2-8 – Town of Phenix – Source Capacity

Source (Yield Rate)	Yield (gpd)	Observed Well Pump Capacity	Effective Capacity (gpd)	Effective Capacity (gallons per month)	Effective Capacity (gallons per year)
Well No. 1	Unknown	10 gpm	N/A	N/A	N/A
Well No. 2	Unknown	30 gpm	N/A	N/A	N/A
Total Effective Capacity			24,400	742,166	8,906,000

2.3.7 *Storage Capacity*

The storage capacity for the Town of Phenix system is calculated as follows:

$$\text{Effective Capacity} = 113,269 \text{ gallons} \div 200 \text{ gpd} / \text{ERC} = 566 \text{ ERCs}$$

2.3.8 *Permitted Capacity*

The permitted capacity of the waterworks is limited to 24,400 gpd because the yield capacity of the wells is unknown.

2.3.9 *VDH Engineering Description Sheets and Permit Information*

Detailed VDH engineering descriptions and permit information pertaining to the Town of Phenix waterworks can be found in **Appendix I**.

2.3.10 *General System Map*

The general location of the Phenix wells and storage tank are shown on **Figure 2-3**.

3.0 EXISTING WATER SOURCE INFORMATION – SURFACE WATER

In Charlotte County, only the Town of Keysville uses a reservoir for its water source. The following summarizes key information describing the Town of Keysville’s water system.

3.1 Keysville Reservoir

The Town’s reservoir (also referred to as the Spring Creek Impoundment), is a 42.5 acre raw water impoundment located one mile west of the Town, just north of Route 40. The impoundment has a volume of 281 acre-feet (or 91.6 million gallons), of which 207.9 acre-feet¹¹ (or approximately 67.74 million gallons) is the water supply storage volume. Water is pumped about 5,000 feet by two 1-mgd (150’ TDH) raw water pumps.¹²

The reservoir is in the Lower Roanoke River sub-basin. The drainage area of the reservoir is 2.6 square miles;¹³¹⁴ VDEQ calculated the safe yield of the reservoir as 0.59 MGD.¹⁵ VDEQ notes that the “Town of Keysville contends that the safe yield for the Keysville Reservoir is 1.0 mgd based on a 1963 report by Burn C. Thompson, Consulting Engineer. The report states ‘a study of rainfall and runoff data for the area over the past 45 years indicates that the watershed will produce adequate water for a usage of one million gallons per day’ Exactly what was entailed in the referenced study of rainfall and runoff is not known....”

The Keysville Reservoir is fed by Spring Creek. The height of the dam is 36 feet; the surface area of the reservoir is approximately 42 acres.

Figure 3-1 shows the location of the reservoir and the watershed boundaries.

3.2 Water Treatment Facility

The Town of Keysville’s water treatment plant is located on the north side of US Route 40 west of the intersection of US Route 40 and Virginia Route 59. The Town’s water

¹¹ Reservoir Analysis completed by Wiley and Wilson indicates the water supply storage is 207.9 acre-feet; 67.74 million gallons. Report is dated April 2010. See excerpt from report in **Appendix I**.

¹² Source: VDH Engineering Description Sheet which is included in **Appendix I**.

¹³ Source: DEQ analysis of safe yield. See **Appendix I**.

¹⁴ The VDH Engineering Description sheet lists the drainage as 2.73 square miles.

¹⁵ See **Appendix I** for DEQ Analysis.

treatment facility consists of coagulation, flocculation, sedimentation, filtration, disinfection, and fluoridation.

A report prepared in 2010 by Wiley and Wilson states: ¹⁶

Based on the latest Virginia Department of Health Office of Drinking Water Inspection Report, the average production at the water treatment plant for the last three months was 311,000 gpd when the plant is in operation, which is approximately every other day. The actual water pumping rate at the plant is 174,300 gpd during the period if all days of the month are utilized. The water treatment plant capacity is 1 MGD. The water supply storage is 2079 acre-feet, or 67.74 million gallons. Assuming no additional surface water flow into the reservoir, the water supply storage volume is sufficient to provide 67 days of water supply at the water treatment capacity, or 253 days of water supply at the current water treatment plant average production. This is a conservative calculation, since there is typically a continuous base flow into the reservoir....”

A general schematic of the water plant layout is shown as **Figure 3-2**. The plant was modified and updated in 2002 and is described below:

3.2.1 *Raw Water Quality*

Overall, the Keysville reservoir has good water quality to be used as a drinking water supply. According to the past two years of water plant reports, influent turbidity levels typically range between 6 and 15 NTU's and alkalinity levels are normally between 27 and 35 mg/L. There are two metals in the reservoir that exceed the secondary drinking water standards and can lead to taste and odor problems, if not properly treated. These metals are iron and manganese. The influent concentrations typically range between 0.4 and 1.0 mg/L for iron (secondary standard is 0.3 mg/L) and between 0.14 and 0.62 mg/L for manganese (secondary standard is 0.05 mg/L). These metals can both be removed by oxidation and chemical addition. In fact, diffused aerators have been installed in

¹⁶ See excerpt from page 2-2 of the report, found in **Appendix I**.

the reservoir near the water intake station, which help to reduce the amount of chemical that needs to be added to the treatment process.

3.2.2 *Preaeration*

The preaeration basin includes twin surface aerators, each driven with a 3-HP motor. The concrete basin has a volume of approximately 110,000 gallons and is rectangular with sloped sides. The purpose of this basin is to allow additional mixing and reaction time to form iron and manganese precipitate and also to begin removal of turbidity.

3.2.3 *Flash Mixing*

The flash mix basin has a working volume of approximately 500 gallons and contains a 3-HP propeller mixer. Several chemicals are added into this basin in order to provide quick and consistent mixing prior to the treatment process.

3.2.4 *Flocculation*

There are two flocculation basins; each is 15' X 13' X 13'. The total combined volume of the two flocculation basins is approximately 38,000 gallons. The detention time is about 42 minutes. Each basin is equipped with a vertical shaft flocculator powered by a 0.5-HP motor.

3.2.5 *Sedimentation*

The two sedimentation basins are 13' X 65' X 15'. The basins have a combined volume of 190,000 gallons. The basins provide a detention time of approximately 4 hours.

3.2.6 *Chemical Feed Systems*

The chemical feed equipment consists of four volumetric feeders to feed alum, carbon, and soda ash to the raw water and lime to the filtered water. There is a secondary alternate chlorine diffuser at the outlet end of the flocculators. Primary chlorine injectors are located between the sedimentation basins and filters. Lime, soda ash, and fluoride injectors are located on a common discharge line from the filters to the clearwell. The dry chemical carbon feeder is in a room equipped with

explosion proof features and ventilation. A liquid containment dam surrounds the sodium fluoride and potassium permanganate solution tanks.

3.2.7 *Sand Filters*

The plant is equipped with two filters: one sand and one carbon. As of July of 2011, the Town is planning to install a carbon filter to replace the sand filter.

3.2.8 *Clearwell*

The concrete clearwell is located beneath the plant and has a volume of 131, 500 gallons. The finished water meter has a range of 0.13 to 1.3 MGD.

3.2.9 *Pumping Equipment*

The pumping equipment consists of two vertical turbine finished water pumps (535 gpm and 250' TDH), each with 50-HP motors. The backwash pump is a 4,000 gpm (31' TDH) vertical turbine unit with a 40-HP motor.

3.2.10 *Chlorination Facilities*

Chlorination facilities consist of two chlorinators with 50 lb./day capabilities for pre- and post-chlorination with a two-in/two-out manifold.

3.2.11 *Fluoridation Facilities*

Fluoride is added through a metering pump with a range of 8.1 gpd to 14.19 gpd with a 10 to 1 feed range. This metering pump feeds hydrofluosilicic acid to the raw water line.

3.2.12 *Storage and Booster Pump Station*

Storage for the Keysville system consists of a 600,000-gallon steel standpipe which receives finished water from the water plant and a 60,000-gallon elevated tank which receives water from the standpipe via a booster pump station. The booster pump station consists of two 250-gpm pumps with 15-HP motors. The storage facilities and pump station are located near Front Street adjacent to Virginia Crafts.

3.2.13 *Industrial Park Elevated Tank*

The industrial park elevated storage tank was constructed in 1996 and has 300,000 gallons of storage capacity.

3.2.14 *Limitations on Withdrawal*

There are no limitations on withdrawal established by permits issued by VDEQ.

3.2.15 *Capacity of the Water Treatment Plant*

The VDH Engineering Description Sheet¹⁷ states that the design capacity of the water treatment plant is 1.0 MGD at 2 gpm/ft². However, the system capacity is limited by the safe yield, which has been determined to be .59 mgd by VDEQ.

3.2.16 *Keysville Water System Map*

A general layout of the Town's water system is shown on **Figure 3-3**.

¹⁷ See **Appendix I**.

3.3 Community Water Systems Using Stream Intakes

Based on review of VDEQ stream intake records, there are no community water systems using stream intakes in Charlotte County.

3.4 Self-Supplied Users of More than 300,000 gallons per Month of Surface Water for Non-Agricultural Uses

In the Charlotte County study area; there are no known self-supplied users of more than 300,000 gallons per month of surface water for non-agricultural uses. VDEQ records do not list any self-supplied non-agricultural users of surface water.

3.5 Self-supplied Non-agricultural Users of More than 300,000 Gallons per Month of Ground Water

3.5.1 Cardinal Homes Inc.

There is only one self-supplied non-agricultural user in Charlotte County that uses more than 300,000 gallons of ground water per month. Cardinal Homes, Inc., a facility that manufactures modular homes, is located in Wylliesburg, owns and operates a waterworks located on U.S. Route 15 approximately one mile south of its location with U.S. Route 360. The permit number for the waterworks is 5037100. The water works consists of a well, treatment and storage. Each is described below.

3.5.2 Well

The Cardinal Homes well is located on the southern side of the plant in a room enclosure incorporated into the plant. The well consists of a 6 1/4 –inch diameter steel casing to 80 feet terminating approximately 12 inches above the concrete floor. The well was drilled in July 1970 to a depth of 160 feet and grouted to a depth of 75 feet. A 4-hour yield and drawdown test indicated a well yield of 25 gpm. The well pump has an observed pump 13.5 gpm. The well casing is fitted with a sample tap/blow off, check valve, water meter, pressure switch, pressure gauge and hypochlorite injector.

The Cardinal Homes well is a Piedmont Rock well and does not require a screen.

3.5.3 *Treatment*

A 10-gpd peristaltic pump fed from a 15-gallon polyethylene solution tank with cover is located adjacent to the well. The metering pump operates with the well pump and is with a calibration chamber. Hypochlorite solution is injected into the well pump discharge upstream of the hydropneumatic tank in the well room.

3.5.4 *Storage*

Two 119-gallon hydropneumatic tanks are located above the ceiling near the office portion of the building. One 119-gallon hydropneumatic tank is located in the well room.

3.5.5 *Ground Water Withdrawal Permit*

Ground water withdrawal permits are not required in Charlotte County.

3.5.6 *Permitted Capacity*

The waterworks is permitted for a design capacity of 19,584 gpd.

3.5.7 *VDH Engineering Description Sheets and Permit Information*

Detailed VDH engineering descriptions and detailed permit information for the Cardinal Homes water system can be found in **Appendix I**.

3.5.8 *Limitations Established by VDEQ*

There are no limitations on withdrawal established by permits issued by VDEQ.

3.6 Water Purchased from Systems Outside of Charlotte County¹⁸

At this time, the existing systems do not purchase water from any systems located outside of the County.

3.7 Water Available for Purchase Outside of Charlotte County¹⁹

It is not anticipated that the community systems in Charlotte County will purchase water from suppliers outside of the County in the near future. There is no available source in close proximity to the County.

¹⁸ 9 VAC 25-780-70 G.

¹⁹ 9 VAC 25-780-70 H.

3.8 Agricultural Use – Using More Than 300,000 Gallons Per Month²⁰

Based on research of DEQ's records and conversations with the Virginia Cooperative Extension, there are no known agricultural users in the study area who use more than 300,000 gallons of water per month. VDEQ withdrawal records list Ridgeway Farm LLC and Turkey Creek Farm, but no withdrawals are recorded for 2002 – 2006. VDEQ records list the following sources for Ridgeway Farm: Cub Creek; a farm pond; Staunton River below Cub Run; Staunton River above Cub Run; and Staunton River, bottom of Horseshoe. Turkey Creek Farm has only one source, a farm pond. VDEQ records indicate that both farms use these surface waters for irrigation purposes. VDEQ records do not include any agricultural ground water users.

Discussions with the Natural Resources Conservation Service²¹ in April 2006 revealed the following:

- ◆ Agricultural wells in Charlotte County tend to be seasonal in nature,
- ◆ 27 wells for agricultural use have been installed since 1998, 7 more wells to be installed in the near future,
- ◆ Agricultural well depths in Charlotte County range from 125 feet to 320 feet,
- ◆ The deepest wells are in the southern part of the County;
- ◆ Yields for the agricultural wells range from 6 gallons per minute to 25-30 gallons per minute; and
- ◆ The deeper wells typically have lower yields.

Discussions with the Virginia Cooperative Extension²² revealed:

- ◆ Farmers in the area often use farm ponds to provide water for livestock and/or raising tobacco,
- ◆ Wells are sometimes used for watering livestock or for tobacco irrigation,
- ◆ The Extension office does not maintain information regarding use of farm ponds or ground water for agricultural purposes.

3.8.1 *Estimated Water Use –Agricultural Sector*

Information concerning the agricultural sector in Charlotte County was obtained from the 2002 Census of Agriculture. The following tables show the estimated water use by farmers to provide water for livestock and crops.

²⁰ 9 VAC 25-780-70 I.

²¹ As per Natural Resources Conservation Service, April 12, 2006.

²² As per Unit Coordinator, Virginia Cooperative Extension, May 8, 2006.

Table 3-1 – Livestock Information²³

Type of Livestock	# in 2002	Number of Farms	Gallons of Water Needed per Day per Animal ²⁴	Estimated Monthly Usage (gallons)	Estimated Annual Usage (gallons)
Beef Cattle and Calves	8,585	260	12	3,133,525	37,602,300
Milk Cows	1,303	33	35	1,387,152	16,645,825
Hogs and Pigs	8,801	9	5	1,338,485	16,061,825
Sheep and Lamb	240	13	2	14,600	175,200
Poultry Layers	- ²⁵	23	.06	-	
Poultry Broilers	-	-	.06	-	
Horses	-	-	12	-	
Total					70,485,150

Table 3-2 –Crop Information²⁶

Type of Crop	Acres in 2002	Number of Farms	Acres Irrigated	Approximate Irrigation Required (in/acre/year) ²⁷	Total Annual Irrigation (Gallons)
Corn for Grain	1,142	32	0	10-15	0
Corn for Silage	1,189	26	0	10-15	0
Wheat for Grain	1,271	56	0	0	0
Oats for Grain	132	15	0	0	0
Barley for Grain	119	5	0	0	0
Soybean	1,410	18	0	0	0
Tobacco	1,511	131	997	25	676,989,951
Forage	19,727	315	0	0	0
Vegetables	33	6	33	15	13,441,231
Potatoes	10	3	10	15	4,073,100
Total					694,504,281

²³ 2002 Census of Agriculture.

²⁴ Source: USGS

²⁵ Data withheld to avoid disclosing data about individual farms.

²⁶ 2002 Census of Agriculture.

²⁷ Handbook for Agriculture and Home Economics Workers, Agricultural Extension Services; NC State University; 1982.

3.9 Estimate of the Number of Residences and Businesses that are Self-Supplied by Individual Wells Withdrawing Less Than 300,000 Gallons of Water per Month²⁸

3.9.1 Sampling of Individual Well Permits

Draper Aden Associates reviewed individual well permits filed at the local VDH office in Charlotte Court House. Due to a cumbersome filing system and small staff, it would have required two to three weeks to review all well permits to collect pertinent data. Since this would have been a difficult undertaking, an alternate procedure was used to *estimate* the water consumption in the County from the shallow aquifer (shallow bored wells) and the deeper aquifer (drilled wells). The procedure used is outlined below.

- ◆ The local Virginia Department of Health divides the County into 24 districts in a grid pattern. The grids are shown on the following map.
- ◆ A representative sample of the wells was analyzed based on review of approximately ten well logs per district.
- ◆ Each well was identified as bored or drilled.
- ◆ The population of each grid that relies on wells was estimated using the total County population less those households served by the public water systems.
- ◆ The population that relies on bored vs. shallow wells was estimated based on the ratio of bored to shallow wells in the representative sample.
- ◆ The current usage was calculated using 100 gallons per day per person.

3.9.2 Estimated Population and Usage

As shown on the following table, it is estimated that 10,544 people, or 85% of the Charlotte County population, are self-supplied by individual wells.

Approximately 74% of those wells are drilled, the balance are bored wells. The estimated residential ground water usage is 1,054,000 gallons per day (see **Table 3-4**).

3.10 Noncommunity Users – Using Groundwater

3.10.1 Nontransient Noncommunity Users

According to the Danville Virginia Department of Health office, there are three nontransient noncommunity wells in Charlotte County. All are elementary

²⁸ 9 VAC 25-780-70 J.

schools. Engineering description sheets for the three are found in **Appendix I**. A brief summary of each follows.

3.10.2 *J.M. Jeffress Elementary School*

The source is one drilled well with a 6-inch diameter steel well casing. The casing has a sanitary seal and screened vent; there is a submersible pump. There is no information available on the well yield or the well pump capacity.

Treatment consists of disinfection and storage consists of six 80-gallon bladder-type hydropneumatic tanks. The effective storage is 160 gallons.

The waterworks has an operation permit with a design capacity of 300 persons.

3.10.3 *Eureka Elementary School*

The source is a drilled well with a depth of 300 feet and cased with a 6-inch diameter steel casing to a depth of 65 feet and grouted to a depth of 65 feet. The well casing extends 12-inches above grade and is equipped with a sanitary seal and screened vent. There is a submersible pump with a capacity of 29 gpm at 352 feet THD and driven by a 5-HP motor.

Treatment for pH adjustment is provided by the addition of soda ash. A 60 gpd chemical feed pump and 100-gallon solution tank with mixer are in the well enclosure.

Storage is provided through a ground level steel tank with an effective volume of 8,000 gallons.

The Eureka Elementary School waterworks has on operation permit for a design capacity of 16,000 gpd.

3.10.4 *Bacon District Elementary School*

The depth of this well is not known, but it is believed to be 220 feet deep. There is a 6-inch diameter steel casing.

Storage is a 1,500 gallon hydropneumatic tank. Treatment to adjust pH is provided by the addition of soda ash. The waterworks has an operation permit for the design capacity of 300 persons.

3.11 Transient Noncommunity Waterworks Using Groundwater

There are six (6) transient noncommunity waterworks in Charlotte County.²⁹

Table 3-3 – Transient Noncommunity Waterworks

	Keysville Save-U-Time	Wylliesburg Diner	Tastee Freeze	Sheldon's Motel and Restaurant	Staunton River Battlefield State Park-Depot	Paradise Grill
Source	Drilled Well	Drilled Well with submersible pump.	Drilled Well with submersible pump	2 Drilled Wells, both with a submersible pump	Drilled Well with 2 HP submersible pump	Drilled Well with jet pump
Design Capacity	44 restaurant seats	32 restaurant seats	24 restaurant seats	40 motel rooms, 200 restaurant seats, and one residence	7 gpm or 5,600 gpd	Limited to one drive-in restaurant
Well Yield	N/A	N/A	N/A	N/A	10 gpm	N/A
Well Pump Capacity	N/A	N/A	N/A	N/A	7 gpm	N/A
Effective Storage Capacity	27 Gallons	6 gallons	6 gallons	158 gallons	39.7 gallons	6 gallons
Operation Permit	44 restaurant seats	32 restaurant seats	24 restaurant seats	40 motel rooms, 200 restaurant seats, and one residence	7 gpm or 5,600 gpd	Limited to one drive-in restaurant

3.12 Source Water Assessment Plans or Wellhead Protection Programs³⁰

Charlotte County is working with Virginia Rural Water to develop a Source Water Protection Plan.³¹

²⁹ These systems are permitted by VDH. Engineering Description sheets are included in the appendix.

³⁰ 9 VAC 25-780-70 K.

³¹ As of June 2011.

4.0 **EXISTING WATER USE INFORMATION**³²

4.1 **Population within the Planning Area Served by Each Community Water System**³³

The following table shows the estimated population served by each of the four community water systems:

Table 4-1 –Estimated Population Served

System	Number of Residential Connections	Average Persons per Household ³⁴	Estimated Population Served
Town of Charlotte Court House	199	2.39	475
Town of Drakes Branch	232	2.18	506
Town of Keysville	385	2.03	781
Town of Phenix	122	2.56	312
Total Estimated Population Served	938		2074

4.2 **Number of Connections for Each Community Water System**³⁵

The following table provides the number of connections for each community water system:

Table 4-2 –Number of Connections

System	Number of Connections
Town of Charlotte Court House	254
Town of Drakes Branch	265
Town of Keysville	435
Town of Phenix	143
Total Connections Served	1097

4.3 **Average and Maximum Daily Withdrawal for Each Community Water System**³⁶

The following tables depict average and maximum daily withdrawals for the four community water systems in Charlotte County.

³² 9 VAC 25-780-80.

³³ 9 VAC 25-780-80 B. 1.

³⁴ Source: Weldon Cooper Center, Table DP-1, Profile of General Demographic Characteristics, 2000.

³⁵ 9 VAC 25-780-80 B. 2.

³⁶ As of the date of this report, the following 2006 withdrawal data from the VDEQ records is the most recent year for which complete data is available.

Table 4-3 –Average and Maximum Daily Withdrawals – Town of Charlotte Court House - 2006³⁷

Source	Annual Withdrawal (mgd)	Average Daily Withdrawal (mgd)	Maximum Day (mgd)	Maximum Month
Spring	2.333	.0064	.048	June
Well #3	3.415	.0094	.014	June
Well#4	3.825	.0105	.015	June
Well#5	17.260	.0473	.081	May
Well #6	.310	.0008	.054	June
Total	27.143	0.0744		

Table 4-4 –Average and Maximum Daily Withdrawals – Town of Drakes Branch - 2006³⁸

Source	Annual Withdrawal (mgd)	Average Daily Withdrawal (mgd)	Maximum Day (mgd)	Maximum Month
Total – All Five Wells	19.049	.0522	.250	November

Table 4-5 –Average and Maximum Daily Withdrawals – Town of Phenix - 2006³⁹

Source	Annual Withdrawal (mgd)	Average Daily Withdrawal (mgd)	Maximum Day (mgd)	Maximum Month
Well #1	1.695	.0046	.0066	August
Well #2	4.299	.0118	.0169	May
Total	5.994	0.0164		

Table 4-6 –Average and Maximum Daily Withdrawals – Town of Keysville - 2006⁴⁰

Source	Annual Withdrawal (mgd)	Average Daily Withdrawal (mgd)	Maximum Day (mgd)	Maximum Month
Keysville Reservoir	46.557	.1276	.94	January

³⁷ Source: DEQ Withdrawal Records.

³⁸ Source: DEQ Withdrawal Records.

³⁹ Source: DEQ Withdrawal Records.

⁴⁰ Source: DEQ Withdrawal Records.

Table 4-7 –Average and Maximum Daily Withdrawals – Planning Area - 2006⁴¹

Community System	Annual Withdrawal (mg)	Average Daily Withdrawal (mgd)
Town of Charlotte Court House	27.143	.0744
Town of Drakes Branch	19.049	.0522
Town of Phenix	5.994	.0164
Town of Keysville	<u>46.557</u>	<u>.1276</u>
Total	98.743	0.2706

4.4 Summary of Existing Water Use⁴²

The previous section summarizes the present water withdrawal of the community systems in Charlotte County. The following summarizes the total water use (or water consumption) of the four community water systems. The following is based on 2005 water withdrawal records and 2005 billing (or consumption) records.

Table 4-8 –Summary of Water Use – Community Systems

Community System	Annual Withdrawal (mg) 2005	Annual Consumption (mg) 2005	Average Monthly Consumption (mg) 2005	Average Daily Consumption (mgd) 2005
Town of Charlotte Court House	23.424	15.145	1.262	.0415
Town of Drakes Branch	19.317	11.730	.978	.0321
Town of Phenix	6.381	6.255	.521	.0171
Town of Keysville	<u>56.131</u>	<u>26.349</u>	<u>2.196</u>	<u>.0722</u>
Total	105.253	59.479	4.957	0.1629

4.5 Peak Day Water Use⁴³

The Regulation requires a reporting of peak day usage for each of the community water systems in the planning area. Review of VDH and DEQ records reveal that none of the four community systems provides records of peak day water use to either VDH or DEQ

⁴¹ Source: VDEQ Withdrawal Records.

⁴² 9 VAC 25-780-80 B4.

⁴³ 9 VAC 25-780-80 B5.

4.6 Estimated Average Annual Usage by Self-Supplied Non-Agricultural Users of more than 300,000 Gallons per Month of Surface and Ground Water Within the Service Area of Each Community Water Supply⁴⁴

Based on review of VDEQ records, there are no self-supplied non-agricultural users of surface or groundwater located within the service areas of the four community water systems in Charlotte County. The Towns confirm that there are no known self-supplied non-agricultural users of this type within the municipal service areas.

4.7 Estimated Average Annual Usage by Self-Supplied Agricultural Users of more than 300,000 Gallons per Month of Surface and Ground Water Within the Service Area of Each Community Water Supply⁴⁵

Based on review of VDEQ records, there are no self-supplied agricultural users of surface or groundwater located within the service areas of the four community water systems in Charlotte County that use more than 300,000 gallons of water per month. The Towns confirm that there are no known self-supplied non-agricultural users of this type within the municipal service areas.

4.8 Self-Supplied Users of Less than 300,000 Gallons per Month of Ground Water Within the Service Areas of the Community Water Systems⁴⁶

Each of the Towns report limited number of homes and businesses within their service area rely on private wells for water supply. While the consumption of water from these wells is generally not measured, it assumed that each of these users withdraws less than 300,000 gallons per month of ground water. The number of users in each town service area is discussed below.

4.8.1 *Town of Charlotte Court House⁴⁷*

There are approximately six existing homes within the Town's service area that rely on a private well. The majority of these homes are not occupied on a full-time basis, but are used only occasionally. There are no businesses using private wells. New homes and businesses are required to connect to the public water system.

⁴⁴ 9 VAC 25-780-80 B6.

⁴⁵ 9 VAC 25-780-80 B7.

⁴⁶ 9 VAC 25-780-80 B8.

⁴⁷ Based on conversation with Town employee, June 2008.

4.8.2 *Town of Drakes Branch*⁴⁸

There are approximately ten houses in Drakes Branch that are self-supplied with private wells. There are no businesses that rely on private wells for their water source. New homes and businesses are required to apply for water service and the town provides water if it is feasible to do so.

4.8.3 *Town of Phenix*⁴⁹

All the homes and businesses in the Town of Phenix are provided water from the town's community water system. There are no homes or businesses using a private well for their water source.

4.8.4 *Town of Keysville*⁵⁰

There is only one home in Keysville that is self-supplied from a private well. There is one business, Sheldon's Restaurant (and related business operations) which relies on two private wells for its water source. The Town provides wastewater treatment services to Sheldon's, so the water that is used by the business is metered and the Town records the usage in order to bill for wastewater treatment services. The water consumption for 2005 is provided below.

4.8.5 *Summary of Estimated Usage by Self Supplied Users within the Service Area of Community Systems*

The following table summarizes the estimated annual water consumption of self-supplied users within the service areas of the community water systems.

⁴⁸ Based on conversation with town employee, June 2008.

⁴⁹ Based on conversation with town employee, June 2008.

⁵⁰ Based on conversation with town employee, June 2008.

Table 4-9 – Estimate of Number of Self-Supplied Users and Estimated Annual Consumption within the Community Systems⁵¹

Community System	Number of Self-Supplied Residential Users	Estimated Annual Consumption (gallons)
Town of Charlotte Court House	6	130,853 ⁵²
Town of Drakes Branch	10	795,700 ⁵³
Town of Phenix	0	0
Town of Keysville	<u>1</u>	<u>74,095⁵⁴</u>
Total	17	1,000,648
Community System	Number of Self-Supplied Non-Residential Users	Estimated Annual Consumption (gallons)
Town of Charlotte Court House	0	0
Town of Drakes Branch	0	0
Town of Phenix	0	0
Town of Keysville	<u>1</u>	<u>1,700,000⁵⁵</u>
Total	1	1,700,000
Total	18	2,700,648

4.9 Disaggregated Estimated Water Demand for Each Community Water System⁵⁶

The following tables include estimated disaggregated amounts of water used in each of the community water systems.

⁵¹ VAC 25-780-80 B.8.

⁵² The homes on wells are used only occasionally, therefore the water usage is estimated to be only 25% of typical residential usage. Usage is calculated as follows: ((100 gpd per person x 2.39 persons x 365 days) x 25%) x 6 = 109,500 gallons per year.

⁵³ (100 gpd per person x 2.18 persons x 365 days) x 10 wells = 795,700 gallons per year.

⁵⁴ (100 gpd per person x 2.03 persons x 365 days) x 1 well = 74,095 gallons per year.

⁵⁵ Annual consumption based on actual meter readings from the Sheldon's wells during 2005.

⁵⁶ VAC 25-780-80 B.9.

Table 4-10 –Estimated Disaggregated Use – Community Systems⁵⁷

	Residential		Non-Residential ⁵⁸		Estimated “Unaccounted” ⁵⁹		Total	
	(MG)	%	(MG)	%	(MG)	%	(MG)	%
Town of Charlotte Court House	8.464	36.1%	6.682	28.5%	8.278	35.3%	23.424	100%
Town of Drakes Branch	10.181	53.4%	1.549	8.1%	7.318	38.4%	19.049	100%
Town of Phenix	4.857	77.7%	1.398	22.3%	.076	1.2%	6.331	100%
Town of Keysville	11.528	20.5%	13.122	23.4%	31.481	56.1%	56.131	100%
Totals	35.03	33.4%	22.751	21.7%	47.153	44.9%	104.935	100%

4.10 In-Stream Beneficial Uses Affected by Point of Stream Withdrawal⁶⁰

There are no water systems included in this water plan that use stream intakes.

4.11 Self-Supplied Nonagricultural Users of More than 300,000 Gallons per Month Outside of the Service Areas of the Community Systems⁶¹

Cardinal Homes is the only “self-supplied nonagricultural” user in the County that uses more than 300,000 gallons of water per month. The average monthly consumption of Cardinal Homes is 320,000 gallons; or approximately 3,840,000 gallons per year.

4.12 Use by Self-Supplied Agricultural Users of more than 300,000 Gallons per Month Outside of the Service Areas of the Community Water Systems⁶²

There are no known self-supplied agricultural users who use more than 300,000 gallons of water per month in Charlotte County. This has been established by reviewing VDEQ withdrawal records and by talking to county planners, extension agents and SWCD personnel.

4.12.1 *Estimated Water Use – Agricultural Sector*

As outlined in an earlier section of this report, information concerning the agricultural sector in Charlotte County was obtained from the 2002 Census of

⁵⁷ Based on 2005 Billing Records. “Unaccounted for” water is an **estimate**, based on billing records compared to production records.

⁵⁸ Includes commercial, light industrial and some public uses. There is no heavy industrial usage and no military water use.

⁵⁹ Water used in water production processes and water used at the Keysville wastewater treatment facility is not included in unaccounted for losses. These “Unaccounted Losses” **are estimates only and require further study of billing and production records.**

⁶⁰ VAC 25-780-80 B. 10.

⁶¹ VAC 25-780-80 C.

⁶² VAC 25-780-80 D.

Agriculture. The following tables show the estimated water use by farmers to provide water for livestock and crops.

Table 4-11 – Livestock Information⁶³

Type of Livestock	# in 2002	Number of Farms	Gallons of Water Needed per Day per Animal ⁶⁴	Estimated Monthly Usage (gallons)	Estimated Annual Usage (gallons)
Beef Cattle and Calves	8,585	260	12	3,133,525	37,602,300
Milk Cows	1,303	33	35	1,387,152	16,645,825
Hogs and Pigs	8,801	9	5	1,338,485	16,061,825
Sheep and Lamb	240	13	2	14,600	175,200
Poultry Layers	- ⁶⁵	23	.06	-	
Poultry Broilers	-	-	.06	-	
Horses	-	-	12	-	
Total					70,485,150

Table 4-12 –Crop Information⁶⁶

Type of Crop	Acres in 2002	Number of Farms	Acres Irrigated	Approximate Irrigation Required (in/acre/year) ⁶⁷	Total Annual Irrigation (Gallons)
Corn for Grain	1,142	32	0	10-15	0
Corn for Silage	1,189	26	0	10-15	0
Wheat for Grain	1,271	56	0	0	0
Oats for Grain	132	15	0	0	0
Barley for Grain	119	5	0	0	0
Soybean	1,410	18	0	0	0
Tobacco	1,511	131	997	25	676,989,951
Forage	19,727	315	0	0	0
Vegetables	33	6	33	15	13,441,231
Potatoes	10	3	10	15	4,073,100
Total					694,504,281

4.13 Estimated Self-Supplied Users of less than 300,000 Gallons per Month, Outside the Service Areas of the Community Water Systems

The ground water used by self-supplied users consuming less than 300,000 gallons per month includes self-supplied homes as well as several schools. Both are summarized below.

⁶³ 2002 Census of Agriculture.

⁶⁴ Source: USGS.

⁶⁵ Data withheld to avoid disclosing data about individual farms.

⁶⁶ 2002 Census of Agriculture.

⁶⁷ Handbook for Agriculture and Home Economics Workers, Agricultural Extension Services; NC State University; 1982.

4.13.1 *Estimated Usage of Self-Supplied Homes*

Table 4-1 shows the estimated number of people served by community water systems (2,074). In 2006, the estimated County population was 12,764; the estimated number of persons who are self-supplied is estimated to be 10,698 people with total estimated usage of 1,069,800 gallons per day.

4.13.2 *Usage of Non-Residential Self-Supplied Users*

The following table summarizes the known consumption of the smaller non-residential self-supplied users.

Table 4-13 – Average Usage Based on VDH Inspection

Waterworks	Average Consumption
Bacon School District	2,600 gpd
Eureka Elementary School	4,000 gpd
J.M. Jeffries Elementary School	<u>2,350 gpd</u>
Total	8,950 gpd

4.14 Summary of All Withdrawals in Charlotte County

The following table summarizes estimated ground water and surface water withdrawals of the various categories of systems and users in Charlotte County.

Table 4-14 –Summary of Water Withdrawal

System / Type of User	Daily (GPD)	Annual (MG)
Town of Drakes Branch	52,189	19.05
Town of Keysville	127,553	46.56
Town of Charlotte Court House	74,364	27.14
Town of Phenix	16,422	5.99
Individual Self-Supplied Users (inside the service areas of the community systems)	9,173	3.35
Individual Self-Supplied Users (outside of the service areas of the community systems)	1,069,800	390.48
Cardinal Homes	10,521	3.84
Schools	8,950	3.27
Agriculture – Crops	1,902,751	694.50
Agriculture – Livestock	193,110	70.49
Transient Non-Community Systems	<u>N/A</u>	<u>N/A</u>
Total	3,464,833	1,264.67

5.0 *EXISTING RESOURCE INFORMATION*

5.1 **Geologic, Hydrologic and Meteorological Conditions**⁶⁸

5.1.1 *Geologic Conditions*

Charlotte County is an irregularly shaped, well-dissected, moderately high plateau that lies wholly within the Piedmont physiographic province. In Virginia, this province lies between the Blue Ridge province on the west and the Coastal Plain province on the east. A map of the geological conditions in Charlotte County is provided in **Figure 5-1**.

The Piedmont Physiographic province is a rolling to hilly area that extends from the Fall Line on the east to the foot of the Blue Ridge Mountains on the west. The Fall Line is a low-profile, east-facing scarp that separates crystalline rocks of the Piedmont province (west) from Cretaceous-age (>65 million years) to Quarternary-age (current), less-resistant, marine and terrigenous sediments of the Coastal Plain province (east).

The crystalline rocks of the Piedmont province are Precambrian-age (>570 million years) and Cambrian-age (570-225 million years) metamorphic and igneous rocks, and within the Piedmont province are several Triassic-age basins that contain sedimentary rocks.

The Piedmont province is characterized by deeply weathered bedrock and a relative paucity of solid rock outcrop. Specifically, Charlotte County is generally underlain by the following rock types (from west to east):

⁶⁸ 9 VAC 25-780-90 A.

Table 5-1 –Charlotte County Geologic Regions and Rock Types

Geologic Region	Geologic Age	Rock Types
Central Virginia Volcanic-Plutonic Belt	Cambrian-Ordovician	Metamorphic rocks: Island-arc-related metavolcanic and metasedimentary mica schist, amphibolite, slate, quartzite, and gneiss
Blue Ridge and Piedmont	Late Proterozoic to Mississippian	Intrusive Igneous rocks: granite, quartz monzonite, and granodiorite
Mesozoic Basin	Triassic	Sedimentary rocks: conglomerate, sandstone, siltstone, and shale; the Mesozoic Basin also includes a shear zone (mylonite and phyllonite) near the central portion of the County
Central Piedmont	Paleozoic	Metamorphic rocks: biotite gneiss, mica schist, gabbro, and amphibolite
Carolina Slate Belt	Cambrian	Metamorphic rocks: island-arc-related metavolcanic and metasedimentary mica schist, metabasalt, phyllite, slate, quartzite, schist, and gneiss

Overall regional fracture orientations would be northeast-southwest, with some localized variation possible. In-situ weathering of these rocks would produce clays and silts. According to the USDA, the soils of Charlotte County are predominantly of loamy texture.

The granite, gneiss, and schist of the County support ridges that gradually slope toward the streams and break into steeper relief adjacent to the stream channels. Of the many different soils derived from these rocks, the most important to the agriculture are members of the Cecil, Appling, Georgeville, Herndon, Cullen, Madison, Chewacla, Congaree, Turbeville, Creedmoor, Mayodan, Iredell, Vance, and Helena series. The soils derived from the Triassic rock materials are of the Pinkston, Mayodan, Creedmoor, and Steinsburg series.

Areas immediately adjacent to the Roanoke River and the creeks are strongly dissected. These areas are undulating and rolling to hilly, steep, and broken. The interstream ridges have relatively mild relief. The bottom lands along streams have level to nearly level surfaces.

5.2 Hydrologic Conditions

5.2.1 *Ground Water Hydrology*

The hydrologic setting is a function of the underlying geologic features.

Generally, ground water flow is a function of fracture density, which is generally a function of geologic structure.

Charlotte County is underlain by metamorphosed pre-Cambrian rocks of sedimentary and igneous origin, Lower Cambrian quartzites, and Triassic sediments. In general, Charlotte County is characterized as having one distinct geologic unit; the Piedmont Crystalline Bedrock System. The Piedmont system is dependent on fractures for ground water production, yield and recharge.

The Piedmont, generally to the west of I-95, is an area of crystalline bedrock containing numerous fracture zones from ancient faulting. Ground water in the Piedmont area tends to be plentiful where wells intersect the fracture zones. However, wells that are developed outside of the fracture zones are likely to experience low yields, especially during dry and excessively dry periods. The depth of wells is a less important determinant of well yield and stability than proximity to a fracture zone. Bored wells in the soil horizons are impractical and vulnerable to deep well pumping in this region.

Shallow bored wells are usually less than 50 feet deep and generally yield less than 20 gallons per minute. Based on representative records reviewed for this report, the deepest drilled well was 440 feet below the ground surface (bgs) in Red House in District 1 with a yield of 20 gpm. The Town of Phenix reportedly has a well that is 405 feet bgs and yields 30 gpm. A 235-foot deep well near Drakes Branch reportedly yields 75 gpm. Groundwater from both types of wells is generally soft and free of excessive mineralization; however, locally the groundwater may be hard or contain excessive iron.

5.2.2 *Surface Hydrology*⁶⁹

Most of Charlotte County is in the Roanoke River watershed. A very small area on the eastern boundary is in the Chowan River watershed. The major surface water features are the Roanoke (Staunton) River on the western and southwestern boundary, creeks and small dams located throughout the county, and the John H. Kerr Reservoir at the southern end of the County.

The dendritic system of rivers and small tributary streams affords good drainage in nearly all parts of the County. Nearly every farm has one or more runoff outlet. The only places inadequately drained are bottoms along streams, sleepy places near the bases of slopes, and nearly level places on interstream divides.

There are three USGS stream gaging stations located on the Roanoke (Staunton) River and Cub Creek. The table below depicts the location and general statistics for each gauge in Charlotte County.

Table 5-2 – River and Stream Flow Rates 1990 - 2003⁷⁰

Body of Water	Annual Mean Streamflow (ft ³ /sec.)		
	High	Low	Average
Staunton River at Brookneal	4,523	988	2,533
Cub Creek	203	51	106.9
Staunton River at Randolph	5,601	1,206	3,100

5.2.3 *Watersheds*

Charlotte County, for the most part, is located within the Roanoke River watershed. A small area of Charlotte County along the eastern border drains into the Chowan watershed. However, both the Roanoke River watershed and the Chowan watershed eventually drain into the Albemarle Sound in the northeastern region of North Carolina. There are several sub-watersheds in the Charlotte County. The following table depicts these sub-hydrologic watersheds along with their area percentage of the County. The following figure portrays the major watersheds in Charlotte County.

⁶⁹ *Soil Survey of Charlotte County, Virginia*. United States Department of Agriculture – Soil Conservation Services in cooperation with Virginia Agricultural Experiment Station, USDA, 1974.

⁷⁰ Source: USGS stream gage records.

Table 5-3 – Hydrologic Watersheds in Charlotte County⁷¹

Watershed ID	Percentage of County
Roanoke Creek/ Wallace Branch	31.10
Cub Creek	21.62
Wards Fork Creek	10.85
Horsepen Creek	9.11
Buffalo Creek/ Sandy Creek/ Difficult Creek	8.03
Catawba Creek/ Buckskin Creek/ Turnip Creek	8.00
Bluestone Creek	6.26
Middle Meherrin River/ Meherrin River	2.14
North Meherrin River/ Falling River	1.90
Little Falling River/ Falling River	0.54
Straightstone Creek/ Seneca Creek/ Bull Creek	0.45

A map of the major watersheds in Charlotte County is presented in **Figure 5-2**.

71 USDA Virginia Hydrologic Unit Atlas – Charlotte County.

5.3 Ground Water

Ground water is the primary source of potable water for a majority of county households. Water for homes and for livestock is supplied by springs, intermittent streams, and wells. On many of the larger farms, water is obtained from drilled wells. On most small farms, the water supply comes from wells or from springs.

Underground water that flows from fissures and crevices in the granite rocks is clear and contains little calcium. It is considered to be “freestone” or soft water.

Some farmers have built ponds by impounding water behind dams in small drainage-ways. These ponds provide fishing, swimming, and other recreation, and in dry seasons are reserve water supplies for livestock.

Perennial streams run clear only in dry weather. After rains, they are usually muddy from silt and other debris. Most streams have little gradient and are seldom used for power.

5.3.1 Ground Recharge Potential

The recharge potential, also known as the available ground water supply, can be calculated based on several known variables. These variables are total surface area, average rainfall, and percentage of undeveloped area. The equation for recharge potential does not take into account the geology or hydrogeologic characteristics of the area. This is a theoretical method of calculating the amount of ground water that should be available for extraction. The equation and parameters for Charlotte County are as shown below.

As indicated and assuming that 25% of the total recharge potential can be extracted through wells, approximately 30.6 mgd of ground water is potentially available for use. However, the cost and feasibility of capturing this water will require much more extensive study, but it can be used as a general guide for planning purposes.

Table 5-4 – Ground Water Recharge Potential

Equation:
Recharge Potential = Total Surface Area X 43,560 ft ² per acre X Estimated Recharge X Estimated Percentage of Undeveloped Area X 7.48 gallons per cubic foot
Known Variables:
Total Surface Area = 304,960 acres ⁷²
Estimated Recharge = 43.41 inches ⁷³
Estimated Variables:
0.5 feet = Estimated Recharge from Annual Precipitation
90% = Estimated Percentage of Undeveloped Area (Agriculture, Wooded) ⁷⁴
Recharge Potential = 304,960 X 43,560 X .05 X .90 X 7.48 = 44,714,137,882 gallons per year
Assume 25% can be developed through the use of wells, then:
Recharge Potential = 11,178,534,470 gallons per year, or,
Recharge Potential = 30,626,122 gallons per day

5.4 Licensed Dams

There are 20 state-licensed dams in Charlotte County. Sixteen dams are categorized as low hazard dams, three are categorized as significant hazard dams and one is categorized as a high hazard dam. Fourteen dams were constructed in the 1960's as flood control dams. Together, these fourteen dams contain a total of approximately 2,229 acre-feet of water; their watersheds encompass an area of 77.4 square miles, which is approximately 16% of the entire area of the county. The watershed areas of the two largest lakes impounded by these dams – Keysville Town Lake and Drakes Branch Lake – are particularly large and are situated in the vicinity of the towns of Drakes Branch and Keysville. Keysville Town Lake (containing approximately 91.6 million gallons) is the municipal water supply for the Town of Keysville. Drakes Branch Lake (containing approximately 148.3 million gallons) is included as the water source in the preliminary design of a water treatment plant to supply the Town of Drakes Branch area if future demand increases significantly. The table below provides statistical information for all of the state-licensed dams in Charlotte County.

⁷² Surface Area as per 1997 Comprehensive Plan.

⁷³ Average Annual rainfall from 8/22/1948 to 9/30/2005, Southeast Regional Climate Center.

⁷⁴ Undeveloped Area from 1997 Comprehensive Plan.

Table 5-5 – State Licensed Dams

Name	Approximate Contained Water (acre feet)	Watershed Area (acres)	Hazard Classification⁷⁵
Devin Lower Dam	not available	not available	Low
Devin Upper Dam	not available	not available	Low
Eastern Pines Dam	not available	not available	Low
Four Locusts Dam	not available	not available	Significant
Roanoke Creek Dam #4A	46	1,070	Low
Roanoke Creek Dam #5B	112	3,335	Low
Roanoke Creek Dam #6A	164	3,520	Low
Roanoke Creek Dam #31B	143	3,002	High ⁷⁶
Roanoke Creek Dam #35A	74	1,460	Low
Roanoke Creek Dam #43A	129	3,046	Significant ⁷⁷
Roanoke Creek Dam #49A	131	3,735	Low
Roanoke Creek Dam #54	203	4,704	Low
Roanoke Creek Dam #61A	59	1,700	Low
Roanoke Creek Dam #62	173	7,090	Low
Roanoke Creek Dam #67	119	2,518	Low
Roanoke Creek Dam #68	140	2,660	Low
Roanoke Creek Dam #70A ⁷⁸	281	1,754	Low
Roanoke Creek Dam #72A ⁷⁹	455	9,926	Significant
Willies Dam	not available	not available	Low
Roanoke Creek Dam #43A	129	3,046	Low

5.1 Meteorological Conditions

Charlotte County has warm summers, relatively mild winters, and normally adequate rainfall. The growing season is approximately 190 days, long enough to allow maturity of a wide variety of crops. The pasture season is slightly longer, but winter months are cold enough to require feed and shelter for livestock. Monthly average precipitation amounts vary greatly from year to year for any given month. Charlotte County is more than 150 miles from the Atlantic Ocean, remnants of hurricanes or tropical storms may pass over the county from the east or south, occasionally causing flooding and wind damage. The following table reveals meteorological statistics within Charlotte County.

⁷⁵ Low: No deaths or significant damage in the event of a breach; Significant: No deaths, but economic, environmental, or lifeline damage in the event of a breach.

Source: Southside Soil and Water Conservation District, Commonwealth Regional Council.

⁷⁶ Roanoke Creek Dam #31B was upgraded to “High” hazard following the inundation study.

⁷⁷ Roanoke Creek Dam #49A was upgraded to a “Significant” hazard following the inundation study.

⁷⁸ Keysville Town Lake.

⁷⁹ Drakes Branch Lake.

Table 5-6 – Climate⁸⁰

Criteria	Data
Average Annual Rainfall	40.4 inches
Average Annual Snowfall	14.6 inches
Average Annual Temperature	56.5 ⁰ F
January Average Temperature	36 ⁰ F
Avg. # Days Min. Temp. Lower Than 32 ⁰ F	98
July Average Temperature	76 ⁰ F
Avg. # Days Max. Temp Higher Than 90 ⁰ F	43
Prevailing Winds	Southwest
Average Annual Minimum Temperature	0 ⁰ -5 ⁰ F

5.2 Existing Environmental Conditions that Pertain to or May Affect In-Stream Flow, In-Stream Uses, and Sources that Provide the Current Supply⁸¹

5.2.1 State or Federal Listed Threatened or Endangered Species or Habitats of Concern

The Virginia Department of Game and Inland Fisheries and the Department of Conservation and Recreation list a number of threatened or endangered species as “known or likely to occur” within Charlotte County. These endangered or threatened species are shown below.

Table 5-7 –Endangered or Threatened Species

Class	Scientific Name	Common Name	Federal / State Status
Fish / darter	Percina rex	Roanoke Logperch	Federal and State Endangered
Mussel	Alasmidonta heterodon	Dwarf Wedgemussel	Federal and State Endangered
Plant / shrub	Nestronia umbellula	Nestronia	State Endangered
Bird	Haliaeetus leucocephalus	Bald Eagle	State Threatened
Bird	Lanius ludovicianus migrans	Migrant Loggerhead Shrike	State Threatened
Bird	Ammodramus henslowii	Henslow’s Sparrow	State Threatened
Bird	Aimophila aestivalis	Bachman’s Sparrow	State Threatened
Bird	Lanius ludovicianus	Loggerhead Shrike	State Threatened
Fish	Notropis alborus	Whitemouth Shiner	State Threatened
Fish	Etheostoma collis	Carolina Darter	State Threatened
Bird	Bartramia longicauda	Upland Sandpiper	State Threatened

⁸⁰ Sources: Charlotte County Administrator’s Office, Virginia Tech, USDA Soil Conservation Service.

⁸¹ 9 VAC 25-780-90 B.

Additionally, a search of the Department of Conservation and Recreation's National Heritage Resources database, revealed the Green Floater (*Lasmigona subviridis*) as a listed state threatened species in Charlotte County.

The Roanoke Logperch and Whitemouth Shiner are species of fish that are found in small to medium sized freshwater streams, such as the Roanoke River. The Dwarf Wedgemussel and Green Floater are mollusks found in fast-flowing, clean water with relatively firm rubble, gravel, and sand substrates. Water supply strains and drawdown of the Roanoke River could adversely impact the aquatic ecosystem for these species.

Bald Eagles and other avian species generally nest along rivers. The Shrike Loggerhead, Upland Sandpiper, and Henslow's Sparrow are part of the Virginia Wildlife Action Plan, listed as needing "critical conservation". The Bald Eagle and Carolina Darter are listed in the Virginia Wildlife Action Plan as needing "very high conservation".

The Department of Conservation and Recreation recommends coordination with the Virginia Department of Game and Inland Fisheries to ensure compliance with protected species legislation. To minimize adverse impacts to the aquatic ecosystem as a result of any proposed activities, the Department of Conservation and Recreation also recommends the implementation of and strict adherence to erosion and sediment control measures during all land disturbing activities.

5.2.2 *Anadromous, Trout and other Significant Fisheries*

The Virginia Fish and Wildlife Information service database maintained by VDGIF does not indicate the presence of anadromous, trout or other significant fisheries within Charlotte County.

5.2.3 *River Segments that have Recreational Significance including Scenic River Status*⁸²

The Virginia Scenic Rivers program began in 1970 with passage by the General Assembly of the Virginia State Scenic River Act.⁸³ Since then, 22 river segments totaling approximately 505.85 miles have been designated state scenic rivers.⁸⁴

The intent of the Virginia Scenic Rivers program is to identify, designate and help protect rivers and streams that possess outstanding scenic, recreational, historic and natural characteristics of statewide significance for future generations.

According to the Virginia Department of Conservation and Recreation, the Roanoke River along the southern border of Charlotte County, has been categorized as a Qualifier Virginia Scenic River.

According to the *2007 Virginia Outdoors Plan (VOP)*, set forth by the Virginia Department of Conservation and Recreation, several natural areas in Virginia have been recommended for outdoor recreation and land conservation. The VOP indicates the presence two river segments that have recreational significance within Charlotte County;

- The Staunton River Battlefield State Park (300 acres) is in Charlotte and Halifax counties. The park is split by the Staunton River, and includes a 0.8-mile segment of abandoned rail corridor that crosses the Staunton River Bridge and travels past the Randolph Depot.
- The proposed Trans Virginia Southern Trail also passes through Charlotte County bisecting several streams and ultimately crossing the Staunton River.

The VOP does not indicate the presence of any river segments with scenic river status within Charlotte County.

⁸² *Virginia Scenic Rivers*. Prepared by the Virginia Department of Conservation and Recreation; 2007 and *Virginia Outdoors Plan 2007*. Prepared by the Virginia Department of Conservation and Recreation.

⁸³ Code of Virginia: Title 10.1, Chapter 4 Sections 10.1-400 through 10.1-418.

⁸⁴ As of July 16, 2007.

5.3 Sites of Historic Significance⁸⁵

The Virginia Department of Historic Resources lists approximately 332 historic architectural sites in Charlotte County. Of these, fifteen are on the National Register of Historic Places. Table 5-8 lists fifteen historic sites that are on the National Register of Historic Places.

Table 5-8 – Sites of Historic Significance

VDHR ID	Site	USGS Quadrangle
019-0006	Gravel Hill	Charlotte Court House
019-0008	Greenfield	Charlotte Court House
019-0024	Mulberry Hill	Clover
019-0027	Red Hill	Brookneal
019-0029	Roanoke Plantation	Clover
019-0030	Staunton Hill	Brookneal
019-0034	Woodfork	Charlotte Court House
019-0057	Maple Roads	Eureka
019-0086	Clarkton Bridge	Nathalie
019-5121	Salem School	Clover
019-5146	Toombs Tobacco Farm	Wylliesburg
019-5168	Watkins House	Eureka
019-5169	Westview	Aspen
185-0001	Charlotte County Courthouse	Charlotte Courthouse
185-0023	Charlotte County Court House Historic District	Charlotte Courthouse

In addition to the historic structures described above, three sites on the *Civil Rights in Education Heritage Trail* are located in the county, as well as sections of the *Wilson-Kautz Raid Driving Trail*, part of *Lee's Retreat (Virginia Civil War Trail)*, and part of the *Tobacco Heritage Trail*. A map showing all known historic sites follows.

⁸⁵ 9 VAC 25-780-90 B.4.

The table includes the USGS Quadrangle in which the site is located. Some of the USGS Quadrangles include counties other than Charlotte County. For example, the Clover Quadrangle includes portions of both Charlotte and Halifax counties. Therefore, while the table lists the Roanoke Plantation, Mulberry Hill and Salem School, for example, in the Clover Quadrangle, this is not meant to imply that the sites are in the Town of Clover, but rather in that USGS Quadrangle.

Figure 5-3 – Historic Sites

5.4 Sites of Archaeological Significance⁸⁶

The Virginia Department of Historic Resources (VDHR) lists approximately 76 archaeological sites in Charlotte County. Of these 76, only one is listed on the National Register of Historic Places:

- ◆ VDHR ID 019-5200 – Wade Archaeological Site, Saxe quadrangle.

A map showing all recognized archaeological sites located in Charlotte County is presented in **Figure 5-4**.

Should any archaeological resources be discovered during water supply projects, the County should notify VDHR as soon as possible.

5.5 Unusual Geologic Formations or Special Soil Types⁸⁷

According to the USDA⁸⁸, organic-matter content in Charlotte County is generally low. Bottom-land soils contain a little more organic matter than upland soils. Most of the soils are acid with reactions in the subsoil being very strongly acid to neutral. Natural fertility ranges from high to very low.

The Department of Mines, Minerals, and Energy⁸⁹ lists “Edison Ridge”, a ridge south of Public Fork in the Clover, Virginia quadrangle, as containing mineralized quartz with occurrences of gold and silver deposits.

The Virginia Department of Conservation and Recreation Natural Heritage database maintained by the VDCR does not indicate the presence of any significant geologic formations identified by the 2007 Virginia Outdoors Plan.

⁸⁶ 9 VAC 25-780-90 B.4.

⁸⁷ 9 VAC 25-780-90 B.5.

⁸⁸ *Soil Survey of Charlotte County, Virginia*. United States Department of Agriculture – Soil Conservation Services in cooperation with Virginia Agricultural Experiment Station, 1974.

⁸⁹ *Virginia Minerals*. Virginia Division of Mineral Resources – Department of Mines, Minerals, and Energy, 1991..

Figure 5-4 –Archaeological Sites located in Charlotte County

5.6 Wetlands

Wetlands are a unique and valuable asset to any community, particularly to a rural area with significant agriculture and forest lands. Detailed maps of wetlands in Charlotte County were produced by the U.S. Fish and Wildlife Service as a part of the 1990 National Wetlands Inventory. These maps are based on analysis of aerial photography, and may be viewed in the office of the Southside Soil and Water Conservation District in Charlotte Court House. The wetlands in Charlotte County generally follow existing watercourses, primarily the Staunton River, Roanoke Creek, and the Kerr Reservoir. There are some very small isolated areas in the county's higher elevation areas.

According to a GIS database search, there are 12,089 acres of non-tidal wetlands located in Charlotte County.⁹⁰ These areas are highly protected from disturbance as Section 404 of the Clean Water Act empowers the U.S. Environmental Protection Agency to regulate the placement of fill or dredged material into the waters of the United States, including wetlands. The existing wetlands in Charlotte County are presented in **Figure 5-5**.

5.7 Riparian Buffers⁹¹

A riparian forest buffer encompasses the area from the streambank in the floodplain to, and including, an area of trees, shrubs, and herbaceous vegetation located upslope from the body of water. Buffers are established and managed to reduce the impact of adjacent land use. The buffers serve several important functions: they preserve the stream's natural characteristics, protect water quality, and improve habitat for plants and animals on land and in the water.

Continued development and clearing of land along streams and other waterways increases the potential for nutrient and sediment runoff. Retention of a vegetated buffer along streams can act as a natural filter to control runoff. A map depicting riparian buffers located in Charlotte County is presented in **Figure 5-6**.

⁹⁰ 2006 *Comprehensive Plan of Charlotte County, Virginia*. Prepared by Charlotte County Planning Commission.

⁹¹ *Riparian Forest Buffers*, U.S. Dept. of Agriculture, Forest Service; 1996.

Figure 5-5 – Wetlands, Charlotte County

Figure 5-6 – Riparian Buffers, Charlotte County

5.8 Conservation Easements⁹²

A conservation easement (or conservation restriction) is a legal agreement between a landowner and a land trust or government agency that permanently limits uses of the land in order to protect its conservation value. In Virginia, most conservation easements are held by the Virginia Outdoors Foundation, a state agency founded in 1966. In Charlotte County, over 3,527 acres of conservation easements exist. These conservation easements are tabulated below.⁹³

Table 5-9 – Land Conservation Easements in Charlotte County

Easement Name	Designation	Managing Agency	Acreage
Staunton River Battlefield	State Park	Virginia Department of Conservation and Recreation	345.03
Hogan Creek WMA – Kerr Reservoir	Federal Wildlife Management Area	U.S. Department of Army	526.35
Cargills Creek WMA – Kerr Reservoir	Federal Wildlife Management Area	Army Corps of Engineers	237.98
Buffalo on the Staunton	Federal Wildlife Management Area	Army Corps of Engineers	430.02
Clover WMA	Federal Wildlife Management Area	Army Corps of Engineers	283.07
CHL-VOF-1941	VOF Easement	Virginia Outdoors Foundation	1,440.00
CHL-VOF-2448	VOF Easement	Virginia Outdoors Foundation	264.67

5.9 Land Use and Land Coverage⁹⁴

According to the U.S. Census Bureau, the county has a total area of 477 square miles (1,237 km²), of which, 475 square miles (1,230 km²) is land and 2 square miles (6 km² and 0.51%) is water. There are four incorporated towns in Charlotte County: Charlotte Court House, Drakes Branch, Keysville and Phenix. The three major land uses in Charlotte County are agriculture, forestry, and commercial/industrial.

Agricultural and forest land use encompass the majority of Charlotte County. According to the County’s 2006 Comprehensive Plan, “Charlotte County is overwhelmingly rural. It has large areas of valuable farmland and forest cover. The land cover type is 68.7% forest

⁹² 9 VAC 25-780-90 B.7.

⁹³ Department of Conservation and Recreation. *Land Conservation Data Explorer*.

⁹⁴ 9 VAC 25-780-90 B.8.

and 19.7% pasture/field. Overall population density is 26.3 persons per square mile, but density is only 22.6 persons per square mile in the areas outside the towns.”⁹⁵

Forested land makes up the majority of Charlotte County’s land coverage. Estimates obtained from the Virginia Department of Agriculture and Consumer Services place the market value of forestry products sold in the County in 2001 at over \$5 million.

Agricultural land makes up almost 20% of the land coverage in Charlotte County. Estimates obtained from the Virginia Department of Agriculture and Consumer Services place the market value of farm products sold in the County in 2002 at approximately \$16 million.

According to the 2004 Situation Analysis,

“Charlotte County has a diverse agricultural economy with tobacco comprising the largest segment. Other principal enterprises include beef, dairy, forages, wine grapes, soybeans, small grains, timber, feeder pigs, ornamentals, vegetables, and equine.

The county’s number one agriculture industry, tobacco, has taken major hits in the last five years in loss of quota and rising labor and production costs, and with the recent elimination of the tobacco program, its future is uncertain. The second largest industry, beef cattle, has seen positive growth every year during the period and wine grape acreage has increased by 75% in the past two years. Following the same trend as wine grapes, the horticulture crop industry has seen a significant increase in the number of small nurseries and the increase in acreage in shade and ornamental trees. Dairy, sheep, and row crop industries have all decreased in size.”⁹⁶

Manufacturing, transportation warehousing, and retail establishments make up the majority of the industrial/commercial land uses in Charlotte County. The following figure depicts the existing land use in Charlotte County.

⁹⁵ 2006 Comprehensive Plan of Charlotte County, prepared by the Charlotte County Planning Commission.

⁹⁶ 2004 Situation Analysis, Charlotte County, Prepared by the Virginia Cooperative Extension.

Figure 5-7 – Charlotte County Zoning Map

5.10 Land Use and Zoning

Charlotte County is predominately rural. It has large areas of valuable farmland and forest cover. The land cover type is 68.7% forest and 19.7% pasture/field.

Table 5-10 - Land Cover Type⁹⁷

Land Cover Type	Percent
Pasture/Hay	19.7
Row Crops	2.6
Woody Wetlands	5.0
Open Water	0.8
Transitional	2.2
Deciduous Forest	38.1
Evergreen Forest	12.8
Mixed Forest	17.8
Herbaceous Wetlands	0.5

The following figure shows the Charlotte County Zoning Map. As shown, Charlotte County is almost completely an agricultural zone outside the towns, with very small industrial zones north and south of Keysville, adjacent to the southern border of Drakes Branch, and in the Wylliesburg area.

Worthy of particular note is land owned or controlled by the U.S. Army Corps of Engineers. The Corps of Engineers land borders the Roanoke River⁹⁸ and the John H. Kerr Reservoir from the southern tip of the county continuously to the Route 746 Bridge (See **Figure 5-9**). Although very small in total area compared with the rest of the county, this land is significant; it preserves the wetlands along the river and reservoir, protects wildlife, and acts as a flood control buffer. The Corps of Engineers also requires an extensive permitting process for construction on this land.

5.11 Soil, Farmland, and Forest

Charlotte County contains a wide variety of soils, with agricultural productivity ratings ranging from very good to very poor. A county-wide soil survey and analysis is found in the publication “Soil Survey – Charlotte County Virginia”,⁹⁹ The Soil Conservation

⁹⁷ Source: National Land Cover Dataset, UVA Geostat Center.

⁹⁸ Also known as the Staunton River.

⁹⁹ United States Department of Agriculture Soil Conservation Service and Virginia Polytechnic Institute and State University, July 1974.

Service has also produced a map of important farmlands in Charlotte County (see **Figure 5-9**). This map shows that 81,777 acres (26.9%) are classified as prime farmland, and 78,466 (25.8%) acres are classified as additional farmland of statewide importance. Thus, 52.7% of the county's total land area is classified as significant farmland. **Figure 5-9** also shows that the significant farmland is distributed uniformly throughout the county.

5.12 Drakes Branch Reservoir

The Town of Drakes Branch owns a reservoir that is not currently used to supply water to the Town's water system. The reservoir is in the Roanoke Creek watershed and is fed by Reeses Creek. The dam is 41 feet high, the surface area of the reservoir is 86 acres and the drainage area is approximately 9,926 acres. The reservoir contains approximately 455 acre feet or 148.3 million gallons of water. There is currently no water supply pipe. The following USGS map shows the location of the Drakes Branch Reservoir and related watershed (See **Figure 7-5**).

5.13 Mineral Resources

Figure 5-12 shows mineral resources in Charlotte County. In 2005, more than 15,000 tons of sand was produced in Charlotte County from two operations along the Roanoke River in the southwestern part of the county. A granite quarry in the central part of the county opened in 2005, and has produced more than 19,000 tons of granite in the first months of operations.

In the past, copper minerals were developed southwest of Keysville and near Laconia. Mica has been mined in the vicinity of Charlotte Court House and Cullen. Granite rocks have been quarried near Saxe and Drakes Branch and along the Roanoke River. Clay materials have been produced near Drakes Branch. Kyanite-bearing quartzite occurs in the vicinity of Madisonville. Syenite that is found near Drakes Branch and Charlotte Court House is a possible source of decorative and construction stone. Vermiculite occurs in an area from the vicinity of Phenix southwestward. Graphite has been found in the vicinity of Drakes Branch and Saxe, and amethyst has been collected at a site west of Charlotte Court House¹⁰⁰.

¹⁰⁰ Source: Virginia Department of Mines, Minerals, and Energy, Division of Mineral Resources, May 23, 2006.

5.14 Flood Zones

Figure 5-14 shows flood zones in Charlotte County, which are based on U.S. Department of Housing and Urban Development maps dated July 7, 1978. These zones are classified as Federal Emergency Management Agency Zone A. Land in a FEMA Zone A is subject to an annual probability of flooding of one percent or greater, based on a 100-year flood, with the base flood elevation undetermined. All of the flood zones are along rivers, creeks, and other watercourses.

5.15 Presence of Impaired Streams and Type of Impairment¹⁰¹, ¹⁰²

The Virginia Fish and Wildlife Information Service database maintained by VDGIF indicates eleven “federally” threatened and endangered waters located within Charlotte County. The federally threatened and endangered water are identified as Bentleys Branch, Reeses Creek, Roanoke Creek, Spencer Creek, Spring Creek, Twittys Creek, Bluestone Creek, Wards Fork Creek, Horsepen Creek, Little Horsepen Creek, and an unnamed tributary of Reeses Creek. These waters are listed as needing “moderate conservation” for two aquatic species: the Carolina Darter and the Whitemouth Shiner.

The Virginia Department of Game and Inland Fisheries database listed several “impediments” located within the County, mostly relating to dams within tributaries to the Roanoke or Staunton River, which would impede the migration of aquatic species upstream from this river.

The Virginia Department of Environmental Quality has compiled a list of streams in Charlotte County that are impaired for failure to meet water quality standards for designated water uses. There are six designated uses for surface waters; aquatic life, fish consumption, shellfish consumption, swimming, public water supplies, and wildlife. The 2006 Water Quality Assessment Integrated Report is a summary of the water quality conditions in Virginia from January 1, 2000, to December 31, 2004. The Virginia Department of Environmental Quality lists the following Charlotte County bodies of water as “impaired”:

¹⁰¹ 9 VAC 25-780-90 B.9..

¹⁰² Final 2006 305(b)/303(d) Water Quality Assessment Integrated Report, prepared by the Virginia Department of Environmental Quality, 2006.

Table 5-11 –Impaired Waters of Charlotte County¹⁰³

Waterbody Name	Size	County	Impairment
Ash Camp Creek	7.46 miles	Charlotte	Sediments, Fecal Coliform
Berles Creek	2.18 miles	Charlotte	Escherichia coli
Big Cub Creek	25.11 miles	Charlotte	Escherichia coli
Bluestone Creek	8.17 miles	Charlotte, Mecklenburg	Escherichia coli
Buffalo Creek	2.34 miles	Charlotte	Escherichia coli
Unnamed tributary to Buffalo Creek	1.49 miles	Charlotte	Escherichia coli
Cub Creek	22.66 miles	Charlotte	Escherichia coli
Horsepen Creek	1.84 miles	Charlotte	Fecal Coliform
Little Cub Creek	8.75 miles	Charlotte	Escherichia coli
Louse Creek	8.45 miles	Charlotte	Escherichia coli
Roanoke Creek	2.67 miles	Charlotte	Escherichia coli
Sandy Creek	5.34 miles	Charlotte	Fecal Coliform
Staunton (Roanoke) River	43.96 miles	Charlotte, Halifax	PCB in fish tissue, Escherichia coli
Turnip Creek	4.70 miles	Charlotte	Escherichia coli
Wards Fork Creek	5.73 miles	Charlotte	Fecal Coliform

The Virginia Department of Environmental Quality has a separate designation for waters of concern where indicators show an apparent decline in water quality. These waters are *not* impaired and are included only for informational purposes. The VDEQ lists the Staunton (Roanoke) River as a “water of concern” in Charlotte County. According to the VDEQ, the Staunton (Roanoke) River is under a health advisory for PCBs (heptachlor epoxide) as well as exceedance of sediments from a non-point source.¹⁸

5.16 Location of Point Source Discharges¹⁰⁴

Point sources are fixed locations from which pollutants are discharged into a water source. A point source can be any single source of pollution, such as a pipe from a sewage treatment plant or a ditch. The following facilities have “water discharge permits”:

- ◆ Phenix Elementary School, Phenix, VA
- ◆ Town of Keysville Wastewater Treatment Facility, Keysville, VA

¹⁰³ Virginia Department of Environmental Quality. *Final 2006 305(b)/303(d) Water Quality Assessment Integrated Report.*

¹⁰⁴ 9 VAC 25-780 90 B.10.

- ◆ Town of Drakes Branch Wastewater Treatment Facility, Drakes Branch, VA

5.17 Other Potential Threats to the Existing Water Quantity and Quality

According to the 2006 Comprehensive Plan of Charlotte County, Virginia, “the potential exists for a few larger companies to move into the county. Water supply, sewer service, and good transportation are all necessary for job creation. Water supply will be critical to all segments of Charlotte County – residential, business and industry, and agriculture. Eventually, ground water sources will be inadequate to meet demand, so utilization of surface water will become necessary. The watersheds of the two lakes most able to meet this demand, Keysville and Drakes Branch, must be protected to ensure an adequate supply of useable water where it will be needed.”¹⁰⁵

¹⁰⁵ 2006 Charlotte County Comprehensive Plan, Prepared by the Charlotte County Planning Commission.

Figure 5-8 – U.S. Army Corps of Engineers Land in Charlotte County

Figure 5-9- Important Farmlands

Figure 5-10 – Charlotte County Rivers, Major Creeks, and State Licensed Watershed Dams

Figure 5-11 – Drakes Branch Reservoir and Watershed

Figure 5-12 – Non-Fuel Mineral Mines in Charlotte County

Figure 5-13 – Charlotte County Flood Plain Map

6.0 PROJECTED WATER DEMAND INFORMATION BASED ON POPULATION¹⁰⁶

There are several methods that can be used to estimate the future water (and wastewater) demands:

- ◆ Population growth projections for specific areas can be used to determine the necessary water (and wastewater) services that will be needed in future years.
- ◆ Zoning or comprehensive planning maps can be used to predict the utility services that will be necessary at complete or partial build-out of a growth area or for an entire county.

Typically, the demand will be relatively proportional to the population served. However, areas that have industries with high water demands can increase the per capita usage substantially. Also, industries that are located near a County boundary (where employees may live in another locality and are not accounted for in the County population projections) can increase the actual demands significantly. The following sections of this report discuss the projected water (and wastewater) demands through 2060 using both population-based projections and land use-based projections.

6.1 Historical Population

The following table depicts the Charlotte County population over the past five decades and includes the projected population through 2030.¹⁰⁷

Table 6-1 –Historical and Projected Population

Year	Population	Increase or (Decrease)	% Change
1950	14,057	-	-
1960	13,368	(689)	-4.9%
1970	12,366	(1,002)	-7.5%
1980	12,266	(100)	-0.8%
1990	11,688	(578)	-4.7%
2000	12,472	784	6.7%
2010	12,233	(239)	-1.9%
2020	12,170	(63)	-0.5%
2030	12,170	0	0.0%

¹⁰⁶ 9 VAC 25-780-100.

¹⁰⁷ Information for 1960, 1970, 1980, 1990, and 2000 is from the Census Bureau. The projections for 2010 – 2030 are from the Virginia Employment Commission.

Even though the County experienced moderate decreases in population between 1950 and 1990, the population increased between 1990 and 2000. Estimates of the 2006 population indicate continued moderate growth since 2000. Since 2000, the average annual growth rate is approximately .4% per year.

Table 6-2 –2000 – 2006 Population

Year	Population	Increase or (Decrease)	% Change
2000	12,472		
2006	12,762	290	2.3%

The Virginia Employment Commission provides population projections through 2030 for all political subdivisions within the state. Projections are provided in 10 year increments. Projections after 2030 are not available, so assumptions for growth for the next 30 years (through 2060) need to be made based on historical growth, recent growth, knowledge of local community development and economic development potential, and good judgment.

Further, in Charlotte County it is necessary to consider the location of the proposed growth due to the impact on the Town-owned community water (and wastewater) systems. As a result, the County has been divided into seven “growth areas” in order to facilitate analysis of growth and water demands in various areas of the County.

6.2 Population in 2000 by “Growth Area”

Figure 6-1 presents a breakdown of population by Census Block Group in 2000. The Census information was used as a starting point for projected growth in each of the seven growth areas. The growth areas are presented in **Figure 6-2**.

Figure 6-1 – Population by Census Block Group

Figure 6-2 –Charlotte County Future Land Use

The seven growth areas are as follows:

Table 6-3 –2000 Population by Growth Area¹⁰⁸

Area	2000 Population
Charlotte Courthouse	1,239
Drakes Branch	1,357
Keysville	2,682
Phenix	1,200
Northern Sector	1,649
Western Sector	1,019
Southern Sector	3,326
Total	12,472

6.3 Historical Population Trends in the Towns

The population of the Town of Charlotte Court House was 539 in 1970, and has decreased each decade. The 2000 Census reported a population of 463. Similarly, the populations in the Towns of Drakes Branch and Phenix have shown decreases in population over the past 30 years. The Town of Keysville’s population increased from 704 in 1980 to 817 in 2000.

Table 6-4 –Population in the Towns¹⁰⁹

Location	1970	1980	1990	2000
Charlotte Co. House	539	568	531	463
Drakes Branch	702	617	565	504
Keysville	--	704	671	817
Phenix	260	250	260	200

6.4 Projected Population - “Lower Level” Population Growth Estimates

Data published by the Weldon Cooper Center showed that in July 2006, the population of Charlotte County had increased to 12,762. This represents an average annual increase of 0.4% since the 2000 census. This value was used to project the “lower” growth projection. Assuming a 0.4% annual growth rate, the 2030 population for the entire County would be 14,059; the population in 2060 would be 15,847.

¹⁰⁸ As shown in **Figure 6-1**, the population for the town “growth areas” includes area outside of the municipal limits. The assumption is that much of the forecast growth will occur in close proximity to the Towns.

¹⁰⁹ Source: Census Bureau and Weldon Cooper Center for Public Service.

Table 6-5 –Projected “Lower Level” Population – Charlotte County

	2000	2010	2020	2030	2040	2050	2060
Charlotte County	12,472	12,980	13,509	14,059	14,631	15,227	15,847

The Virginia Employment Commission’s Virginia Economic Labor Market Analysis projections for through 2030 actually predict an overall decrease in population in Charlotte County. However, based on Weldon Cooper Center information and recent discussions with county planners, we believe the moderate annual growth rate of 0.4% is justified.

6.5 Projected Population - “Upper Level” Population Growth Estimates

The “upper level” projections are based on annual growth rates that range from 0.5% to 2.5%; assumptions for growth over the upcoming 50 years (2010 through 2060) are based on discussions with County personnel and include the location of a prison in the Drakes Branch area and several business park opportunities that exist in the growth areas around Keysville and Drakes Branch. The “upper level” projections yield a 2030 population of 18,413 for the entire County and a 2060 population of 27,615.

The following tables illustrate the growth rates applied to each growth area each decade and the projected population.

Table 6-6 –Population Growth Rates – 2010 – 2060 – Upper Level Projections

	2000-2010	2011-2020	2021-2030	2031-2040	2041-2050	2051-2060
Charlotte Court House	1.0%	1.0%	1.5%	1.5%	1.5%	1.5%
Drakes Branch	1.0%	1.5%	1.5%	1.5%	1.5%	1.5%
Keysville	1.0%	1.5%	2.5%	2.5%	2.5%	2.5%
Phenix	0.5%	1.0%	1.0%	1.0%	1.5%	1.5%
Northern Sector	0.5%	0.8%	0.8%	0.8%	0.8%	0.8%
Western Sector	0.5%	0.8%	0.8%	0.8%	0.8%	0.8%
Southern Sector	0.5%	0.8%	0.8%	0.8%	0.8%	0.8%

Table 6-7 –Projected “Upper Level” Population – Charlotte County

	2000	2010	2020	2030	2040	2050	2060
Charlotte County	12,472	13,392	16,322	18,413	20,893	23,946	27,615

6.6 Projected Water Demands – “Lower Level”

A value of 130 gallons per person per day was used for the average daily water (and wastewater) demand. This value was established by analyzing the volume of water produced by each of the town water systems and averaging the water produced over the estimated population served.

Based on an average demand per person of 130 gallons per day, the projected 2030 demand would equate to 1.8 MGD¹¹⁰ and the 2060 demand would equate to 2.0 MGD on an average day.

The demands on the four existing community systems increase from 276,132 gpd in 2000, to 545,099 gpd in 2030, and 880,970 gpd in 2060.,

As shown on **Table 6-8**, this assumes that a portion of the population in some of the growth areas will remain on individual private wells or non-municipal water systems. It is estimated that the water demands met by individual wells and non-municipal water systems will be 1.1 MGD in 2030 and 854,740 gallons per day in 2060. These projections also assume that over this planning period, the existing municipal systems will expand and serve some of the population located in areas outside of the current service areas and, as a result, some homes currently served by individual wells will be served by the municipal systems in the future.

Table 6-8 provides the detailed projected population, average day demands, demands met by community systems and the demands met by individual wells for the planning period.

As detailed in **Section 3-8** of this report, the estimated water usage by the agricultural sector averages 2.0 million gallons per day, or 764 million gallons per year. The estimated agricultural usage is not included in **Table 6-8**.

¹¹⁰ Million gallons per day.

6.7 Projected Water Demands – “Upper Level”

In projecting the “Upper Level” water demands, a value of 130 gallons per person per day was used for the average daily water (and wastewater) demand. Based on an average demand per person of 130 gallons per day, the projected 2030 demand would equate to 2.4 MGD and the 2060 demand would equate to 3.5 MGD on an average day.

This assumes that a portion of the population in some of the growth areas will remain on individual private wells or non-municipal water systems. It is estimated that the water demands met by individual wells and non-community water systems will be 1.2 MGD in 2030 and 1.1 MGD in 2060. These projections also assume that over this planning period, the existing municipal systems will expand and serve some of the population located in areas outside of the current service areas and, as a result, some homes currently served by individual wells will be served by the municipal systems or community water systems in the future.

Table 6-9 provides the detailed projected population, average day demands, demands met by community systems and the demands met by individual wells for the planning period.

As detailed in **Section 3.8** of this report, the estimated water usage by the agricultural sector averages 2.0 million gallons per day, or 764 million gallons per year. The estimated agricultural usage is not included in **Table 6-9**.

Table 6-8 –Water Demand Projections – Based on “Lower Level” Population Projections

Table 6-9 –Water Demand Projections – Based on “Upper Level” Population Projections

6.8 Projected Population within the Planning Area Served by the Community Water Systems¹¹¹

The following table shows the projected population for the “growth areas” surrounding the existing community water systems.

Table 6-10 –Projected Population in the “Growth Areas” of the Existing Community Water Systems

	2000	2010	2020	2030	2040	2050	2060
“Lower Level” Population Projections							
Charlotte Court House	1,239	1,290	1,342	1,397	1,454	1,513	1,574
Drakes Branch	1,357	1,412	1,470	1,530	1,592	1,657	1,725
Keysville	2,682	2,792	2,905	3,024	3,147	3,275	3,408
Phenix	1,200	1,249	1,300	1,353	1,408	1,465	1,525
“Upper Level” Population Projections							
Charlotte Court House	1,239	1,369	1,512	1,755	2,036	2,363	2,743
Drakes Branch	1,357	1,499	3,156	3,329	3,521	3,732	3,966
Keysville	2,682	2,963	3,439	4,402	5,635	7,213	9,233
Phenix	1,200	1,262	1,394	1,539	1,700	1,973	2,290

6.9 Projected Population within the Planning Area Served by the Community Water Systems¹¹²

The following tables summarize the projected water demands for each existing community water system and include both the annual average demands and peak monthly demands. The projected demands assume that community water systems will develop in the Western, Northern and Southern sectors as the population densities in those areas increase. For the existing community systems, peak month demands are based on the peak monthly demands recorded in 2006 and are as follows:

¹¹¹ 9 VAC 250780-100 D.1.

¹¹² 9 VAC 250780-100 D.3.

Table 6-11 –Peak Month Demands – Community Water Systems – Based on 2006 Records

	Peak Month (compared to average monthly demand)
Charlotte Court House	1.44%
Drakes Branch	1.39%
Keysville	1.20%
Phenix	1.23%
Northern Sector	1.60%
Southern Sector	1.60%
Western Sector	1.60%

Table 6-12—Projected Community Water System Demands – Annual Average and Peak Monthly Demands – “Lower Level”

Table 6-13—Projected Community Water System Demands – Annual Average and Peak Monthly Demands – “Upper Level”

6.10 Estimated Disaggregated Demands for Community Systems¹¹³

As outlined in **Table 4-10** of this report, the four community water systems serve a mix of residential and non-residential customers. The percentage of total residential consumption varies from approximately 20.5% in Keysville to 77.7% in Phenix (see **Table 4-10**). The disaggregated uses are projected to maintain similar characteristics in each of the Towns except in Drakes Branch where a 1,500 bed prison is expected to open before 2020. This prison location will not only increase the water demands in Drakes Branch, but will also add an institutional category.

Charlotte County has two business/industrial parks, both located adjacent to U.S. Route 360 near Keysville. The Charlotte County Industrial Park has 19 acres, with water and sewer service provided by the Town of Keysville. The Virginia's Heartland Business Park is approximately 400 acres, also with water and sewer service, and not only has lots for light industrial development, but also has areas intended for future retail and hospitality activities. Both of these parks are in a Virginia Enterprise Zone. The Heartland Business Park has many unique and innovative features to assist new tenants including a virtual building ready for construction, graded sites, a technology and training center, temporary office space, and a partnership with Southside Virginia Community College's heavy equipment operators' school for further site improvements.

There are two other industrial sites in Charlotte County with potential to accommodate major new manufacturing operations. The former WestPoint Stevens building is a 396,000 square foot facility on a 71-acre tract within the Drakes Branch town limits. A large undeveloped site, zoned General Industrial District, is located on the southern side of Drakes Branch, partially within the town limits and partially in the county.

It is important that the towns and the County be in a position to provide adequate water and sewer services to businesses or industries considering use of any of these sites.

¹¹³ 9 VAC 250780-100 D.4.

Further, it is assumed that community water systems will develop in the Northern, Western and Southern sectors of the County as population densities in those areas increase. It is assumed that these systems will serve a mix of residential and non-residential uses and the demand will be approximately 60% residential and 35% non-residential.

Table 6-14 –Estimated Disaggregated Use – Community Systems¹¹⁴

	Residential		Non-Residential ¹¹⁵		Estimated “Unaccounted” ¹¹⁶		Total	
	(MG)	%	(MG)	%	(MG)	%	(MG)	%
Town of Charlotte Court House	8.464	36.1%	6.682	28.5%	8.278	35.3%	23.424	100%
Town of Drakes Branch	10.181	53.4%	1.549	8.1%	7.318	38.4%	19.049	100%
Town of Phenix	4.857	77.7%	1.398	22.3%	.076	1.2%	6.331	100%
Town of Keysville	<u>11.528</u>	<u>20.5%</u>	<u>13.122</u>	<u>23.4%</u>	<u>31.481</u>	<u>56.1%</u>	<u>56.131</u>	<u>100%</u>
Totals	35.03	33.4%	22.751	21.7%	47.153	44.9%	104.935	100%

The following tables outline the projected disaggregated use in the existing and proposed community water systems. The “Upper Level” projections assume that a 1,500-bed prison locates in the Drakes branch area between 2010 and 2020.

¹¹⁴ Based on 2005 Billing Records. “Unaccounted for” water is an estimate, based on billing records compared to production records.

¹¹⁵ Includes commercial, light industrial and some public uses. There is no heavy industrial usage and no military water use.

¹¹⁶ Water used in water production processes and water used at the Keysville wastewater treatment facility is not included in unaccounted for losses. These “Unaccounted Losses” *are estimates only and require further study of billing and production records.*

Table 6-15 –Estimated Disaggregated Use – Community Systems – Lower Level Projections

**Table 6-16 –Estimated Disaggregated Use – Community Systems – Upper Level
Projections**

6.11 Projected Water Demand for Self-Supplied Nonagricultural Users of More than 300,000 Gallons per Month Estimated Disaggregated Demands for Community Systems¹¹⁷

As discussed in earlier sections of this report, there are currently no known self-supplied non-agricultural users of more than 300,000 gallons of water per month in the areas outside of the service areas of the community water systems. There are no proposed self-supplied non-agricultural users of more than 300,000 gallons of water per month.

6.12 Projection of Self-Supplied Agricultural Users¹¹⁸

As outlined in **Section 4** of this report, there are no known self-supplied agricultural users of more than 300,000 gallons of water per month.

6.13 Projected Number of Self-Supplied Users of Less Than 300,000 Gallons per Month Located outside of the Service Areas of the Community Water Systems

The following tables summarize the projected number of persons served by self-supplied ground water sources and the projected daily demands and annual average demands.

Table 6-16 shows the projected demands using the lower level population estimates and **Table 6-17** shows the projected demands using the “Upper Level” population estimates.

¹¹⁷ 9 VAC 250780-100 E.

¹¹⁸ 9 VAC 250780-100 F.

Table 6-17 –Projected Self-Supplied Users – Using “Lower Level” Projections

Table 6-18 –Projected Self-Supplied Users – Using “Upper Level” Projections

7.0 PROJECTED WATER DEMAND – BASED ON LAND USE

7.1 Projected Demands Using Comprehensive Plan

The projected water (and wastewater) demands were also estimated for the seven potential growth areas using the County Comprehensive Plan dated 2006. The land use designations shown in the Comprehensive Plan include general categories (see the Future Land Use Plan, **Figure 6-2**). Land-use categories include: Town/County Boundary Area, Town, Significant Watershed, Crossroads Community, Area of Anticipated Short-Term Growth, Areas of Anticipated Long-Term Growth and Agricultural/Forestry and Rural Use. We have assumed a reasonable mix of residential density and commercial/light industrial, which is common for a rural county. It is assumed that rural residential and agricultural areas will be served by individual wells and not by community water systems. For the land use designations, the following unit demands have been used:

- ◆ Residential; 300 gals/day/dwelling
- ◆ Commercial/Industrial; 750 gals/day/acre (not considered “wet” industry)
- ◆ Rural (>10 acre/lot); 50 gals/day/acre (individual self-supplied wells)

The dwelling densities were derived from the 2006 County Comprehensive Plan and the unit demands are based on typical design values recognized by the Virginia Health Department and are usually higher than the actual demands. Using these unit demands and the acreage shown for each of the land use designations, the projected water demands were determined for each potential growth area.

An assumption that significantly affects the projected demands is the percent buildout of each growth area by the year 2060. These percentages were assumed using projected growth patterns as a guideline.

Tables 7-1 and 7-2 present the projected average and peak daily flows for each of the potential growth areas. **Table 7-1** reflects the development that is realistic during the 50-year planning period (through 2060). Table 7-1 reflects partial buildout: 25% buildout for the four town areas, 15% buildout for the Northern and Western Sectors and 20% for the Southern Sector. **Table 7-2** reflects 100% buildout of all areas Charlotte County.

As shown on **Table 7-1**, this method predicts that up to 9.1 MGD (average day) may be required County-wide. Of this total, it is estimated that up to 8.4 MGD will be required for public systems and 0.7 MGD will be supplied by individual self-supplied wells. The peak day demands could be as high as 14.5 MGD County wide. These projections are significantly higher than those projected using the population growth method and are probably less realistic. The actual demands will probably be somewhere in between what the two methods predict. Some areas in the County may achieve the higher projections such as Keysville or Charlotte Court House.

7.2 Comparison of Demand Projections (Land-Use Projections to vs. Population-based Projections)

The following figures provide a comparison of the “Upper Level” and “Lower Level” population-based projections to the Land-Use Demand Projections.

Figure 7-1 – Charlotte Courthouse

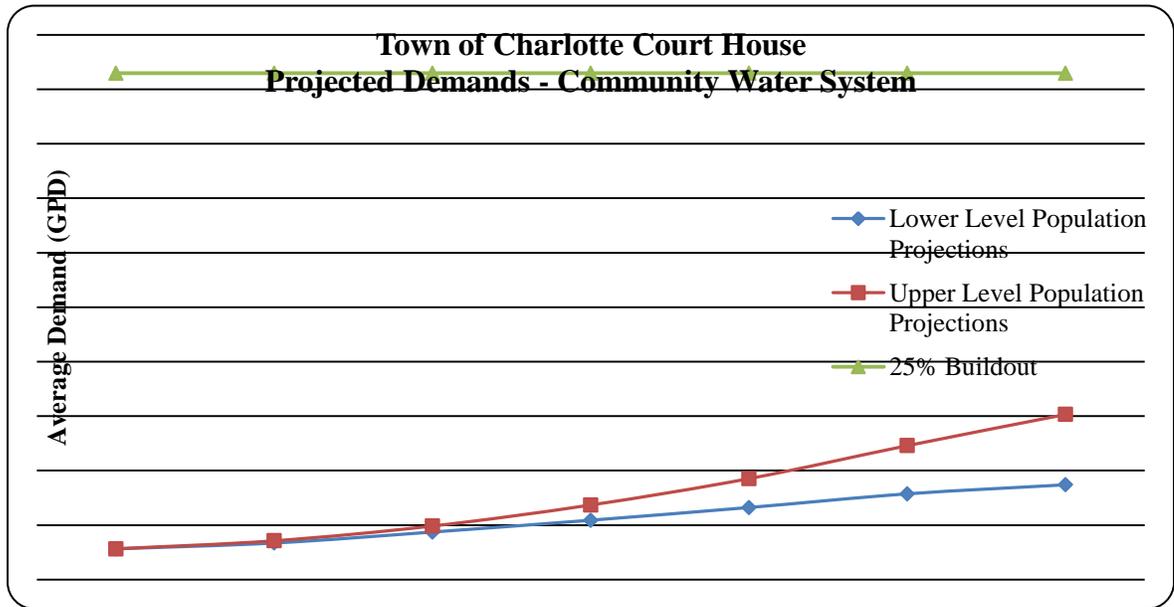


Figure 7-2 – Drakes Branch

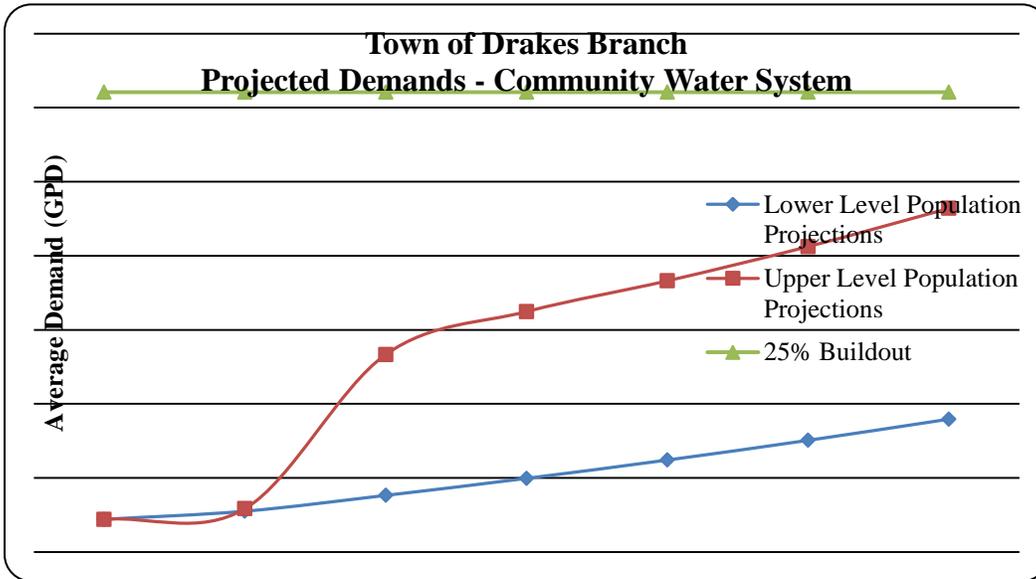


Figure 7-3 – Keysville

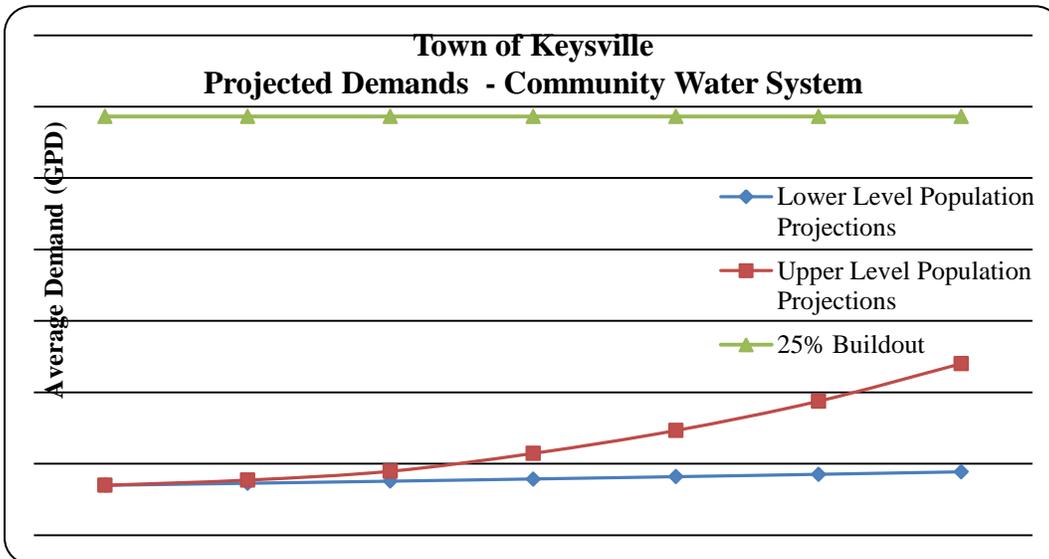
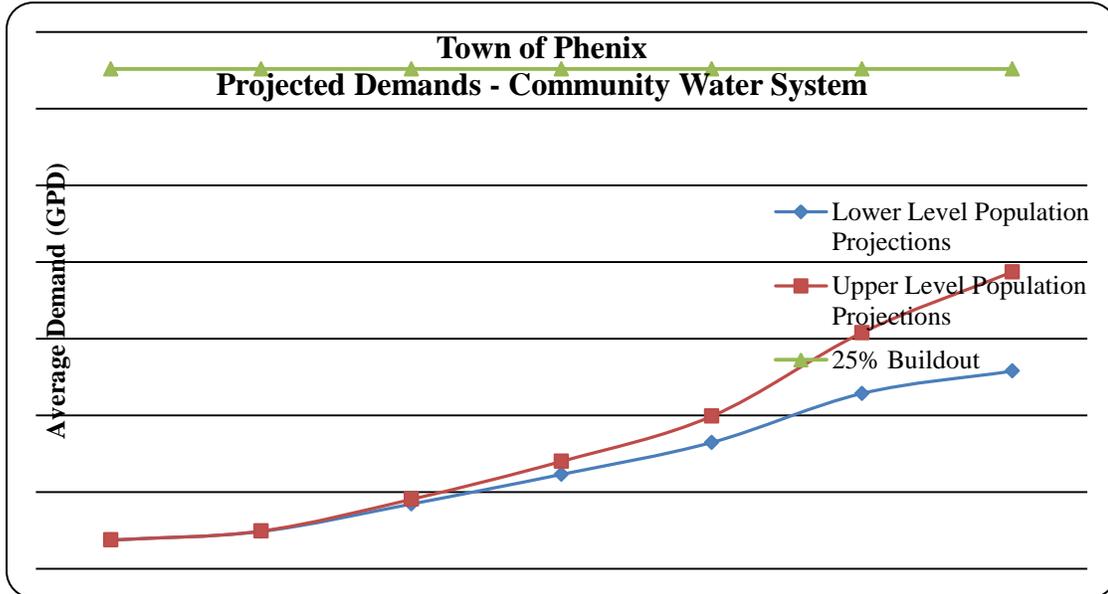


Figure 7-4 – Phenix



7.3 Summary of Projected Demands

As depicted in the tables above, not one of the four Towns would meet the 25% buildout demands during the next 50 years, even at the “upper level” population growth.

The purpose of estimating demands using these two methods is to illustrate that the projected water demand can vary significantly depending on the assumptions used. Demands at any point in the future will likely vary from these projections.

The following table summarizes the projected demands that are projected to be provided by community water systems – either the existing systems in the four towns or by community systems that will be developed over the upcoming 50-year period.

7.4 Cumulative Demand, Use Conflict, In-Stream Flow Information

There is no additional information available through the State Water Resource Plan; no additional information has been developed in accordance with 9 VAC 25-780-140 G.

Table 7-1 – Summary of Demand Projections - 2060– Community Systems

Potential Growth Area¹¹⁹	Current Consumption (Average Daily Consumption – MGD)¹²⁰	2060 Estimated Community Public Water System Demand (Based on Lower Level Population Projections) (Average Daily Consumption – MGD)	2060 Estimated Community Water System Demand (Based on Upper Level Population Projections) (Average Daily Consumption – MGD)	2060 Estimated Community Water System Demand (Based on Projected Land Use – 25% Buildout) (Average Daily Consumption – MGD)	2060 Estimated Community Water System Demand (Based on Projected Land Use – 100% Buildout) (Average Daily Consumption – MGD)
Charlotte CH	.056	.174	.303	.930	3.718
Drakes Branch	.044	.179	.464	.621	2.484
Keysville	.157	.399	1.080	2.931	11.726
Phenix	.019	.129	.194	.326	1.303
Northern Sector	0	.082	.101	.763	5.084
Western Sector	0	.050	.062	.735	4.903
Southern Sector	.017	.192	.237	2.033	10.163
Total	0.293	1.205	2.441	8.339	39.381

¹¹⁹ Includes an area larger than the Town Limits, as shown on **Figure 6-2**.

¹²⁰ Includes estimate of both public and private water usage in the Growth Area.

Figure 7-5 – Comparison of Results of Population and Land Use Demand Projections

8.0 WATER DEMAND MANAGEMENT

As required by the Water Supply Planning Regulation, this water plan addresses conservation as a part of overall water demand management.

8.1 Practices for Efficient Use of Water in the County

The Virginia Uniform Statewide Building code (USBC) is a state regulation promulgated by the Virginia Board of Housing and Community Development. The Board is appointed by the Governor of Virginia for the purpose of establishing minimum regulations to govern the construction and maintenance of buildings and structures.

The provisions of the USBC are based on nationally recognized building and fire codes published by the International Code Council, Inc. The 2003 editions of the International Codes are incorporated by reference into the USBC.

Charlotte County and the Towns of Charlotte Court House, Drakes Branch, Phenix and Keysville have adopted the USBC. The building inspectors of each locality have the responsibility and authority to enforce the USBC. The USBC requires 1.6 gallon-per-flush toilets and limits the maximum allowable flow rates for showerheads and faucets to 1.5 gallons-per-minute. The localities enforce these restrictions and do not have any more restrictive requirements.

8.2 Educational Programs that Encourage Conservation

The Southside Soil and Water Conservation District is responsible for a wide range of educational efforts regarding the use of water including:

- Youth education programs include watershed education programs, soils programs and natural resources programs that are developed and presented to school-age children; related activities include programs for teachers to provide teaching materials and training about watershed education programs, conservation, etc.
- Adult education programs include workshops on rain barrels, drought tolerant landscaping, and similar programs.

- The SWCD programs are advertised through news articles, mailing lists, etc.

8.3 Water Rates as a Conservation Tool

The Towns own and operate the four community water systems in Charlotte County. Each town has established a schedule of rates and fees for use of the water system. The schedules of rates and fees vary from one town to the other, however, all of the towns have established water rates where the customer’s bill increases as consumption increases. However, there is not “conservation price point” where the cost per 1,000 gallons increases to encourage conservation. None of the four towns implement “summer rates” or other rates to discourage use of water during the summer months.

Further, the residential water rates in the Drakes Branch, Phenix and Keysville compare favorably with water rates across Virginia; the rates in Town of Charlotte Court House are higher than the rates in the other towns and are higher than the State average and median.

Table 8-1 – Comparison of Existing Water Rates to Average Rate in Virginia

Community	Water (Usage of 5,000 gallons of water per month)
Town of Charlotte Courthouse	\$30.50
Town of Drakes Branch	\$15.00
Town of Phenix	\$25.50
Town of Keysville	\$20.25
Average in Virginia¹²¹	\$22.67
Median In Virginia¹²²	\$22.25

8.4 Practices to Reduce Unaccounted for Water

As outlined in **Section 4** of this report, the amount of “lost or unaccounted” for water was calculated based on a desktop review of the production records and the billing records. Based on this rudimentary analysis, only Phenix had an acceptable amount of “lost water”. However, it should be noted that the billing records do not detail or quantify any water used in the municipal water production process, for flushing of water lines, water

¹²¹ Source: 19th Annual Virginia Water and Wastewater Rate report 2007, Draper Aden Associates.

¹²² Source: 19th Annual Virginia Water and Wastewater Rate report 2007, Draper Aden Associates.

used in the wastewater treatment processes, water used for fire-fighting, and other municipal uses.

It is recommended that each of the Towns undertake a more detailed comparison of water produced to water billed to more accurately quantify unaccounted for water. Further, it is recommended that the Towns routinely review the production and billing records to better manage water losses. If necessary, each Town should develop a program of identifying areas where water is lost and repair or replace faulty water lines and meters to improve water accountability.

9.0 DROUGHT RESPONSE AND CONTINGENCY PLANS

The Regulation requires that the Water Supply Plan every community water system and every self-supplied user who withdraws more than an average of 300,000 gallons per month of surface water and groundwater include a drought response and contingency plan.

In Charlotte County, there is only one self-supplied user of more than 300,000 gallons of water per month – Cardinal Homes, Inc. In addition, each of the four towns is required to develop a drought response and contingency plan that addresses the unique characteristics of the water source that is being used and that addresses the nature of the beneficial use of the water. Further, it is recommended that Charlotte County develop a response plan to encourage self-supplied users throughout the County to voluntarily conserve water during times of low supply or drought.

In the drought of 2002, the Town of Keysville reported that the levels in the Keysville Reservoir were six, seven and eight inches lower than normal during the height of the drought. Similarly, individual users of both shallow and bored wells reported well failures or limited availability of water. This points out that droughts are a reality in Charlotte County and careful management of the water resources is crucial to ensuring continued availability of water.

Draft Drought Response and Contingency plans will be prepared by the Towns, County, and Cardinal Homes after all have reviewed this Water Supply Plan.

10.0 STATEMENT OF NEED AND ALTERNATIVES

The Regulations require that a water plan shall determine the adequacy of existing water sources to meet current and projected demand. A statement of need, which addresses the adequacy of the existing sources to meet current and projected need must be clearly stated.

As discussed in earlier sections of this report, Charlotte County is expected to experience moderate growth over the next 50 years, primarily in the areas of the four towns: Charlotte Court House, Drakes Branch, Keysville and Phenix. As each of these towns grows and as the customer base expands, more source capacity and infrastructure will be required to provide water service to new customers.

The future water demands are based on average use for domestic, institutional, commercial, and industrial establishments. However, two factors that cannot be specifically predicted could increase water requirements dramatically in a short period of time:

- ◆ Introduction of replacement crops for tobacco that will require irrigation.
- ◆ Construction of a facility in the county's industrial/business parks or other industrial-zoned sites that would consume a large amount of water.

The future emphasis of regulatory control over water will probably be on protection of groundwater and surface water resources that are currently available to Charlotte County. Effort should be made in the evaluation of subdivisions and any other small lot development to ensure that sewage is adequately collected, treated and disposed of to minimize the potential impact on groundwater.

In the future, State and Federal regulations will be concerned with improving and maintaining surface water quality and groundwater protection. New regulations are coming out in the near future to address bacterial quality of water and some of the associated viruses (cryptosporidium) that can pass through conventional water treatment plants. The Town of Keysville can expect to potentially have to improve filtration and possibly disinfection processes at their treatment facilities.

The following sections of this report discuss each of the four community water systems, outlines the timeframe during which additional source capacity might be required, and makes recommendations for meeting the projected water demands.

Table 10-1 - Possible Sources for Future Water Supply

Wells – for Community Systems and Self-Supplied Users
Keysville Reservoir
Drakes Branch Reservoir
Other Existing Impoundments
New Impoundment
Roanoke River

10.1 Town of Keysville

The Town of Keysville’s water treatment plant has a design capacity of 1 MGD. However, the safe yield of the reservoir is only .59 MGD. Based on the “Lower Level” population projections, the projected daily demand will not exceed .398 MGD in 2060. If the Town of Keysville’s actual increases in population and water demands are similar to the “Lower Level” population projections, the source may be adequate to serve the Town for several decades.

Based on the “Upper Level” demand projections, the average daily water demand in Keysville will reach .586 MGD in 2040. If the demands in Keysville increase as outlined in the “Upper Level” projections, the Town may need additional water by 2040, or, if the Town provides water to another nearby Town (Drakes Branch or Charlotte Court House), the Town may approach the safe yield of the Town’s reservoir at an earlier date.

Alternatives for additional supply include increasing the safe yield of the existing reservoir and use of water from the Drakes Branch Reservoir. Further, water demand management actions as well as reducing the amount of unaccounted for water may increase the Town’s ability to meet demand with the existing source.

10.2 Town of Drakes Branch

Drakes Branch has an average water usage of 53,000 gpd. The system is currently permitted for an average daily withdrawal of 112,800 gpd. However, a new, 1,500-bed state prison is expected to be constructed in the Town of Drakes Branch within the next

ten years. It is projected that this facility will demand approximately 200,000 gallons of water per day.

Based on the projected demands, and assuming the prison is built, an additional water source will be required in the next ten years to accommodate the prison and expected increases in population. To provide the additional water required, the town will need to execute one of two options. Option 1 is to construct a 12-inch waterline to Keysville, which has adequate capacity in its system to support Drakes Branch. This waterline would combine the two systems into one regional system. Option 2 is to continue to serve Drakes Branch through its existing groundwater well system. This upgrade will include both an additional groundwater well, with well pump, and a new storage tank.

In the next 20 to 50 years, the Town is expected to develop average daily demands in the range of 99,442 to 463,978 gpd. Additionally, as the area becomes more developed, new housing and business areas may require fire protection. This increased demand will require an additional source of water. The reservoir at Drakes Branch could be used as a water source and already has been determined to have a safe yield of 2.0 million gallons per day.

Should the region choose to develop a regional water system, serving multiple town areas, an additional water source will need to be developed. A water treatment facility, along with waterlines connecting Drakes Branch to Charlotte Court House and Keysville, could form the “backbone” of regional water system with adequate water for all three towns for the next 50 years.

10.3 Town of Charlotte Court House

Charlotte Court House has an average water usage of 64,000 gpd. The system is currently permitted for an average daily withdrawal of 89,600 gpd. Based on the projected flows presented previously, an additional water source will be required in the 10 to 20 year range to keep up with the proposed growth in the area. This upgrade will include both a new groundwater well, with well pump, and a new storage tank.

In the next 20 to 50 years, the Town is expected to develop average daily demands in the range of 108,946 to 303,066 gpd. This increased demand will require additional source

water; in addition, as the area becomes more developed, new residential and business areas may require fire protection as well.

To provide adequate source capacity, fire flow, and storage for the projected demands in 20 to 50 years, the Town may need to interconnect with either Drakes Branch or Keysville through the construction of 12-inch diameter water mains between the towns. This connection would create a single, regional system to serve the interior of Charlotte County, with the potential to connect new customers between the towns or outside of the town limits.

10.4 Town of Phenix

Phenix has an average water usage of 21,000 gpd. The system is currently permitted for an average daily withdrawal of 24,400 gpd. Based on the projected demands presented previously, an additional water source will be required within the next ten years to meet the needs of the proposed growth in the area. This upgrade will include both a new groundwater well, with well pump. A new storage tank will be needed in the next 10 to 20 years.

In the next 20 to 50 years, the Town is expected to develop average daily demands in the range of 61,557 to 193,523 gpd. This increased demand will require additional source water; in addition, as the area becomes more developed, new housing and business areas might require fire protection as well. To provide adequate source capacity, fire flow, and storage for the 20 to 50 year future flow, the Town will need to interconnect with Charlotte Court House through the construction of a new 12-inch diameter water main between the towns. This connection, in addition to the connections between Charlotte Court House, Drakes Branch, and Keysville, would create a single, regional system to serve the interior of Charlotte County, with the potential to connect new customers between the towns, outside of the town limits.

10.5 Groundwater Resource Recommendations

Although high-producing wells (greater than 50 gpm) are difficult to find in Charlotte County, it is recommended that consideration be given to developing groundwater resources in selected areas for the following reasons:

- ◆ Development of new well fields is likely to cost significantly less than developing new surface water sources or extending long transmission mains, at least initially.
- ◆ The quality of groundwater is generally higher than that of surface waters and requires less treatment prior to distribution.
- ◆ The volume of groundwater in storage, because of the thick residual soils through much of the County, is large. As a result, adequate yields are more likely during droughts.
- ◆ The footprint of a well field is minor when compared to the footprint of a surface water impoundment, such that well fields permit additional uses of the land, as deemed appropriate with respect to well-head protection. Well-head protection areas should be considered in addition to the sum of the footprints of the individual well sites.
- ◆ Give higher priority to areas associated with the thickest regolith, as measured by casing length of existing wells.
- ◆ Place well fields close to the contacts between major rock types where the probability of encountering fault zones may be maximized.
- ◆ Place individual wells in broad draws having relatively large catchment areas.
- ◆ Since a significant number of borings will not yield commercially significant quantities of groundwater, the number of proposed drill sites should be at least three, and as much as five, times the number of wells that are ultimately planned for the well field.
- ◆ More single-family residential units can be served by communal well networks than can be served by individual (private) wells because the former makes a larger geographic area available for consideration as potential well sites and pools resources, which permits the construction of deeper wells of larger diameter than any single resident could afford.

10.6 Potential Water Savings from Water Demand Management Actions

The following table depicts the average residential consumption per household in the four towns (based on review of the 2005 billing records). As shown below, the average residential consumption in the four towns is less than 4,000 gallons per month. This is less than the average monthly residential consumption from across Virginia which is 4,765 gallons per month.¹²³

¹²³ 2006 Water and Sewer Rate Survey, Draper Aden Associates.

Table 10-2 – Average Residential Consumption

Community	Average Residential Consumption (Gallons per Household Per Month)
Town of Charlotte Courthouse	3,732
Town of Drakes Branch	3,394
Town of Phenix	3,187
Town of Keysville	3,224

Due to the fact that average residential consumption is fairly conservative in all four towns, it is not reasonable to expect significant reduction in residential consumption.

While it is recommended that the Towns all provide consumer information that encourages wise water use and conservation, it may not be realistic to achieve great savings from the residential class.

As shown in **Table 6-14**, Keysville, Charlotte Courthouse and Drakes Branch have a combined estimated “unaccounted for water” of approximately 56 million gallons of water per day. If this was reduced by 10%, an additional 5.6 MGD would be available; if this amount is reduced by 50%; 28 MGD would be made available.

10.7 Potential Sources for New Supply

There are several options to increase the available supply of water:

- ◆ Reevaluate the safe yield of the Keysville Reservoir (VDEQ has approved a safe yield of .598 MGD) but an earlier study indicates the safe yield may be as high as 1 MGD. Of course, considering the impact of recent droughts on the reservoir, a re-evaluation of the safe yield may not result in an increased safe yield.
- ◆ Develop additional wells in Drakes Branch, Charlotte Court House and Phenix. Wells in these areas would likely have yields similar to existing wells (10,000 – 50,000 gpd).
- ◆ Develop the Drakes Branch Reservoir, including a water treatment plant. The Drakes Branch Reservoir is reported to have the potential to provide up to 2 MGD.
- ◆ Examine the feasibility of piping water from the Sandy River Reservoir, located in Prince Edward County. As Prince Edward County starts to use water from the reservoir, the municipal water suppliers in Charlotte County should discuss options for use of that water.
- ◆ Interconnect the systems. Charlotte Court House could interconnect with either Drakes Branch or Keysville. Drakes Branch could interconnect with Keysville.

Phenix could receive water from Charlotte Courthouse. These interconnections would not increase the available supply, but would allow the Towns to provide water where it is needed.

- ◆ Self-supplied users in the more rural areas of the County will continue to rely on individual wells; most of which will be drilled as opposed to bored. As the rural population grows, the County should be mindful of groundwater protection policies to assure availability.
- ◆ As areas of the County develop with denser housing or commercial development, it may become feasible to establish community water systems to serve denser development. These community systems could be owned and operated by a local government (a town, Charlotte County, or a water authority) or could be owned and operated by a developer or private water company. These systems could rely on ground water or, could possibly use water from the Drakes Branch reservoir, if that reservoir is developed as a water source.

10.8 Potential Resource Issues or Impacts

The use of water from either of the existing reservoirs (Keysville or Drakes Branch) will not have an adverse impact on existing resources described in **Section 5** of this report.

Development of additional wells to serve projected additional self-supplied users in the more rural areas of Charlotte County will not have an adverse impact on the ground water.

Development of additional sources of surface water, for example, either a new reservoir or impoundment, or development of an intake on the Staunton/Roanoke River will need to be carefully studied to meet permitting requirements and to avoid adverse impacts on the natural environment, historical and archaeological resources. At this time, it is not envisioned that a new surface water source will be needed over the next 50years.

10.9 Water Reuse

The Towns of Drakes Branch and Keysville operate wastewater treatment facilities and Water reuse is an option for reducing non-potable water demands. In order to be economically feasible, the use of the reclaimed water need to be located near a wastewater treatment facility that produces highly treated water and, the wastewater treatment plant need to be able to deliver required quantities of reclaimed water when needed. Both Towns should be aware of opportunities to provide reclaimed water to business/industrial users or other uses such as irrigation.

11.0 SUMMARY

As Charlotte County grows it is anticipated that much of the increased residential and business growth will occur in the areas in and around the four towns. The projected growth will place additional demands on the four municipal water systems. The evaluations included in this report will assist the communities in both quantifying future needs and in planning for future supply. Planning for future needs will ensure that adequate and safe drinking water will be available to all the citizens of Charlotte County while serving to encourage, promote and protect the other beneficial uses of the water resources.

APPENDIX

- APPENDIX I. VDH Engineering Descriptions of Water Systems**
- APPENDIX II. Photographs of the Reservoirs and Keysville Water Plant**
- APPENDIX III. Ground Water Survey Data Summary (Private Wells)**
- APPENDIX IV. Public Meeting Information**
- APPENDIX V. VDEQ Withdrawal Records**
- APPENDIX VI. VDEQ Safe Yield Report**

APPENDIX I. – VDH Engineering Descriptions of Water Systems

Community Water Systems

Town of Charlotte Courthouse

Town of Drakes Branch

Town of Phenix

Town of Keysville

Nontransient Noncommunity Water Systems

Cardinal Homes, Inc.

J.M. Jeffress Elementary School

Eureka Elementary School

Bacon District Elementary School

Transient Noncommunity Water Systems

Keysville Save-U-Time

Wylliesburg Diner

Tastee Freeze

Sheldon's Motel and Restaurant

Staunton River Battlefield State Park

Paradise Grill

**APPENDIX II. – Photographs of the Reservoirs and Keysville
Water Plant**

**APPENDIX III. – Ground Water Survey Data Summary (Private
Wells)**

APPENDIX IV. – Public Meeting Information

APPENDIX V. VDEQ Withdrawal Records

APPENDIX VI. VDEQ Safe Yield Report