Dewberry

WATER AND WASTEWATER MASTER PLAN

PRINCE GEORGE COUNTY
ENGINEERING AND UTILITIES DEPARTMENT

DEI Project No.: 50068442

January 2016

SUBMITTED BY:
Dewberry
4805 Lake Brook Drive, Suite 200
Glen Allen, Virginia 23060
804.290.7957

PREPARED FOR:
Prince George County
Engineering and Utilities Department
6602 Courts Drive
Prince George, VA 23875

Table of Contents

APPENDICES

Chapter 1 Executive Summary

1.1 Purpose and Scope

The purpose of this Water and Wastewater Master Plan is to provide Prince George County with a road map for planning improvements and upgrades to meet future needs in maintaining cost-effective water and wastewater service to a growing number of County customers.

This Plan provides a comprehensive evaluation of the County's water and wastewater systems and identifies recommended improvements projected to be required through the Year 2045.

The general approach for development of the Water and Wastewater Master Plan incorporated the following steps:

1. Collect and review available information on the County's existing water and wastewater systems.
2. Conduct an evaluation of the existing water and wastewater infrastructure.
3. Conduct workshops with representatives from Engineering and Utilities, Economic Development, and Community Development Departments to gather information and develop concurrence regarding the methodologies used to develop the Plan.
4. Obtain information from Prince George County on proposed land use, targeted growth areas, and population projections.
5. Develop demand projections through 2045 and distribute the demand projections throughout the various Prince George Service Areas in areas projected to be developed during several future time steps. Note that data from January 2013 to December 2013 was used as the baseline year for demand projections, since this time frame was the latest year that complete data was available when the population demand projections were developed.
6. Develop models for the water and wastewater systems to identify Master Plan Projects that will address existing system deficiencies as well as provide for growth within the County.

7. Develop the Water and Wastewater Master Plan to summarize project activities and provide budget cost estimates and recommendations for projects throughout the planning period.

1.2 Existing Water Systems

There are currently eight (8) existing public water systems within Prince George County which are owned and operated by the County. The systems are separated into services areas as shown below:

Johnson Road Service Area:

- Johnson Road System
- Fort Hayes System

Route 301 Service Area:

- Route 301 System
- Cedarwood System

Central Service Area:

- Central System
- Food Lion System
- Prince George Woods System
- River Road System

Route 10 Service Area:

- Beechwood Manor / Jordan on the James System
- River's Edge System

The majority of the water systems are smaller community systems supplied by well water. The major water system is the Central water system which is supplied by the (arwa Water Authority (ARWA). This system contains a water booster station which pumps water into three (3) 0.5 million gallon elevated water storage tanks.

1.3 Existing Wastewater Systems

There are nine (9) existing public wastewater systems within Prince George County which are owned and operated by the County. Each wastewater system is divided into service areas based upon the wastewater treatment facility to which wastewater is discharged. Systems within each service area are then subdivided by discharge locations. The County owns and operates a total of 25 sewer pump stations.

Prince George Petersburg/South Central Wastewater Authority (SCWWA) Service Area

- Johnson Road Wastewater System
- Route 301 Wastewater System
- Route 460 Wastewater System
- Puddledock Wastewater System
- Flank Road Wastewater System

Prince George Hopewell Regional Wastewater Treatment Facility (HRWTF) Service Area

- Route 36 Wastewater System
- Bailey's Creek Wastewater System
- Manchester Run Wastewater System
- River Road Wastewater System

1.4 System Modeling

Water and wastewater system computer models were developed in order to evaluate system conditions throughout the planning period and to identify improvements required to meet future needs. InfoWater, developed by Innovyze, was used to model the water system and InfoSewer, also developed by Innovyze, was used to model the wastewater system.

The models were calibrated to reflect actual conditions, and average, maximum day, and peak hour scenarios were run for each of the time increments within the planning period to evaluate the scope and timing of system improvement requirements. This modeling analysis led to the development of the water and wastewater system improvement programs through 2045.

1.5 Existing Water System Evaluation

The calibrated water system model was used to conduct a water system analysis for the public water systems within the County. Based on the analysis, the majority of the small community well water systems did not meeting residential fire flow goal of 1,000 gpm for a 2 hour duration. This is due to a combination of small pipe sizes, low storage volume, and low pumping rate. In order to achieve the fire flow goals, these systems would have to be connected to the Central system, which is outlined in Chapter 9.

Additionally, there were a few sections within the Central system that were modeled to have fire flow availability below the fire flow goal. This was the result of small diameter piping within these areas. Chapter 6 details recommended improvements to increase fire flow availability within these sections.

In addition to the modeling analysis, a condition assessment was performed for each water facility including tanks, well facilities, and booster stations. The deficiencies found ranged from minor operational issues through significant condition and safety concerns. These are detailed further in **Appendix B**.

1.6 Existing Wastewater System Evaluation

The calibrated wastewater system model was used to conduct a wastewater system analysis for the public wastewater systems within the County. Based on this analysis, all gravity sewer, force mains, and pump stations have adequate capacity for existing flows and do not require improvements to increase capacity. The majority of pump stations within the service area contain a range of deficiencies which are further identified in the condition assessment found in **Appendix B**.

1.7 Future Demand Projections

Future conditions in Prince George County were evaluated to identify water and wastewater system improvements required to meet future needs. Recommended improvements within the planning period (2015-2045) were identified based on land use phasing within the service area and the development and geographic distribution of demand projections throughout the service area. These projections were developed utilizing methodologies consistent with the provisions of Prince George County's 2012 Comprehensive Plan and input from the County's Public Utilities, Planning, and Economic Development departments.

1.8 Water System Improvements

Water system improvements will be required to provide water service within the County's planning area through the Year 2045. In general, the water system improvements program involves improvements to water supply, water storage, and water distribution to ensure adequate supply and pressures throughout the planning period.

1.8.1 Water Supply

An evaluation of the planning period from 2015 to 2045 indicates that the County's available water supply, based upon existing agreements, will not be sufficient to meet maximum day water demands through the end of the planning period as water demands increase within each service area. It is recommended that a major water supply project be constructed to provide adequate water supply through the end of the planning period.

Based on coordination with Prince George County, two adjacent water supply sources were identified as being viable long term supply sources to accommodate future projected demands. The first option includes maximizing water supply from the existing ARWA connection on Temple Avenue, and the second option includes obtaining the majority of future water supply from the Virginia American Water Company (VAWC) system located in the City of Hopewell.

It is understood that ARWA will be required to undergo capacity upgrades in both their water treatment plant and transmission mains. In order to fund these capacity upgrades, all members of

ARWA will be charged higher rates for their water supply and will be required to share in the costs of the improvements.

Through coordination with Virginia American Water, it is understood that the existing City of Hopewell water treatment plant has some excess capacity and is easily expandable to an additional 6.0 MGD of treatment capacity. Due to the County's proximity to the Virginia American water treatment plant at Route 10, the majority of capital invested in water transmission infrastructure would be within the County, through the proposed 24-inch water transmission main along Ruffin Road.

Based on the above reasons as well as capital cost, the alternative utilizing the VAWC water supply source was recommended to provide water supply for the County.

The recommended water supply option consists of utilizing the VAWC supply from Hopewell as the main water supply supplement to the Central system while continuing to utilize the existing ARWA connection at Temple Avenue serving the Central system. Under this scenario, it is assumed that Prince George County would maintain the existing ARWA allocated water supply capacity at the Temple Avenue connection with the remainder of the required supply being provided through connections with the VAWC City of Hopewell water system. Based on discussions with VAWC, in order for the City of Hopewell water system to be able to provide the estimated water supply required to serve the projected demands of the Prince George water system through the end of the planning period, some transmission and water treatment upgrades would be required to the VAWC system. It is understood that the existing VAWC water treatment plant has room to expand to an additional 6 MGD capacity at a relatively minimal cost. Also, the Prince George County boundary at Route 10 is within close proximity of the VAWC water treatment plant, which would minimize the required transmission upgrades needed within the Hopewell water system. The main water supply connection from the VAWC system would be located at Route 10 for this option. In order to be able to supply the water from the proposed VAWC connection point at Route 10, the construction of a booster station and water transmission main in Prince George County would be required.

In the initial phase, this option would include the construction of a 3.0 MGD water booster station with a 1.0 MG ground storage tank and a 24-inch transmission main from the Southpoint elevated storage tank running north along I-295, Courthouse Road, and Ruffin Road then west along Route 10 to the proposed booster pump station. The booster pump station would be expandable to 6.0 MGD to accommodate for future demand. The existing Central System booster pump station would continue to operate and provide a pumping capacity of approximately 2.0 MGD to the Central system. In order to provide additional storage capacity it is recommended that the Food Lion System be connected into the Central System in this initial phase to allow for the use of the existing 1 million gallon storage tank. A more detailed description of this project is provided in Section 6.4.4.

A 1.5 MGD booster pump station, located near the border with Hopewell along Route 156, would be constructed in the next phase to provide supplemental flow to the system to accommodate for additional future demand.

In order to provide water supply to meet projected demands through the 2045 planning period, the 3.0 MGD booster pump station would need to be expanded to 6.0 MGD with an additional 1.0 MG ground storage tank. Additionally, to extended service north along River Road and maximize the use of ARWA supply capacity, a new 2.0 MGD booster pump station and 0.5 MG ground storage tank would be constructed near the intersection of Temple Avenue and River Road and the existing Central System booster pump station would be decommissioned. The construction of the new booster pump station would extend the high pressure zone to the River Road area, which is required due to higher elevations.

1.8.2 Water Storage

The Central system currently has a total nominal storage volume of 2.5 MG, including the Food Lion system. The Central system contains 1.5 MG of storage in the three (3) elevated storage tanks, and the other 1.0 MG of storage is found in the ground storage tank located at the Food Lion water supply facility.

An additional ground storage tank volume of 2.5 MG will be included to buffer peak demands as part of the proposed booster pump stations at Route 10 and Puddledock. Based on modeling, an additional 1.0 MG elevated water storage tank at the Southpoint Business Park is also recommended to provide additional system redundancy by the end of the planning period.

The Route 10 service area is proposed to have a 0.5 million gallon elevated water storage tank, which is sufficient to meet the projected storage requirements of the service area through the end of the planning period.

The existing Route 301 0.5 million gallon elevated water storage tank is sufficient to meet the projected storage requirements of the service area through the end of the planning period.

1.8.3 Water Distribution

The improvements recommended to serve future development within the water distribution system are generally required to address one or more of the following issues:

- Improvements upgrades needed to meet growing system demands in areas already served.
- Improvements desired to improve system reliability and/or service.
- Improvements needed to provide service to new areas or existing subdivisions within the Water Service Area(s).

1.9 Wastewater System Improvements

Wastewater system improvements will be required to provide wastewater service within the County’s planning area through the Year 2045. In general, the wastewater system improvement program involves improvements to wastewater collection, conveyance, and wastewater treatment capacity to provide adequate and reliable service throughout the planning period.

1.9.1 Wastewater Treatment and Disposal

Based on the sewer loading projections, the County will be required to obtain additional wastewater treatment and disposal allocations for wastewater loadings through the end of the planning period. It is recommended that the County acquire additional conveyance and treatment capacity from adjacent municipalities to provide sufficient allocation through the end of the planning period.

Based upon available information, it is anticipated that significant improvements to the City of Petersburg's wastewater conveyance system would be required to convey the projected wastewater loadings to the SCWWA Treatment Plant. It is not anticipated that the existing Petersburg conveyance system has adequate capacity to convey the projected flows without significant and costly capital improvements within the City's wastewater collection system.

It is understood that significant wastewater conveyance upgrades would be required for the City of Hopewell wastewater collection system to increase capacity beyond the current allocation at the existing discharge locations. Through coordination with the City of Hopewell, it was determined that in order to avoid extensive upgrades to their wastewater conveyance system, additional wastewater loading beyond the current allocation should be discharged just upstream of the Hopewell Regional Wastewater Treatment Facility (HRWTF), in the vicinity of Route 10.

1.9.1 Wastewater Collection, Conveyance, and Disposal

In order to determine the best long term option for the wastewater collection and conveyance of future projected loadings, two long term planning options were evaluated within the Route 460 and Manchester Run wastewater systems.

The first option consists of maintaining the current flow path of the existing sewer system and upgrading infrastructure as necessary to accommodate future flows. The second option includes the construction of regional pump stations which would collect wastewater from centralized gravity interceptors located along low lying areas such as swamps and creeks. It was determined that the second option is preferable to develop a regionalized wastewater collection and conveyance concept in which larger gravity sewer interceptors and pump stations are constructed versus the current system configuration of many small pump station, which has significant upgrades costs and is operation and maintenance intensive.

It appears that the source with the most available future capacity is the City of Hopewell system, in the vicinity of Route 10; but, there is currently no infrastructure conveying wastewater to this location. It is recommended that improvements reflecting the regionalized wastewater collection and conveyance concept referenced above be constructed in order to convey flow to the HRWTF.

The major initial phase project within the Route 460 wastewater system in this option would be the Blackwater Swamp interceptor. This 30-inch gravity interceptor would be constructed along the Blackwater Swamp to receive projected industrial wastewater loadings from the Southpoint and Crosspointe Business Parks. The interceptor would also allow the future decommissioning of SPS-001, SPS-002, and SPS-003, which are the three oldest County owned pump stations. The 30-inch gravity interceptor will discharge flow to a 3.25 MGD (expandable to 6.5 MGD) Blackwater regional pump station. This pump station would convey flow north along Route 156 and Ruffin Road where it would discharge to a 36-inch Route 10 interceptor. This interceptor would also collect flow from the entire Route 10 service area. The 36-inch interceptor would discharge flow to a 4.5 MGD (expandable to 9.0 MGD) Route 10 Regional pump station. This pump station would convey flow through a 24-inch force main to the HRWTF influent force main near the intersection of Route 10 and Hummel Ross Road.

The Second Swamp interceptor is a future phase project that would collect wastewater along the Route 460 corridor and convey the wastewater to the Blackwater regional pump station. The Second Swamp interceptor would allow the County to take SPS-009, SPS-010, and SPS-015 offline, all of which will require significant improvements in the planning period as identified in the condition assessment, shown in **Appendix B**. The second phase of the Second Swamp interceptor would extend to the Cedarwood and Wildwood subdivisions where SPS-016 and SPS-008 would be decommissioned and taken offline. Projected wastewater loadings from future developments along Rives Road would also be collected by the Second Swamp interceptor project. By collecting projected loadings from this project, the existing 12-inch gravity interceptor along Route 460 would not need to be upgraded.

Based on coordination with the City of Hopewell, it is understood that the HRWTF has excess capacity to receive wastewater flows from Prince George County. The Route 10 area is in close proximity to the HRWTF which would minimize conveyance improvements required within the City of Hopewell.

In addition to the greater treatment and conveyance capacity, the recommended option would also meet the goal of regionalizing the wastewater collection and conveyance system, which would minimize the number of pump stations. Since the recommended option includes taking nine (9) existing pump stations offline, the total number of pump stations projected by the end of the planning period would be 14 less than in the alternative option. This would greatly reduce the pump station operation and maintenance costs for the County.

1.10 Implementation

The implementation plan outlined in Chapter 11 of the Master Plan establishes the steps associated with the design and construction of water and wastewater improvement projects that are needed to meet projected growth in service demand during the planning period. **Timing of the proposed projects will depend on the actual or desired rate of development within the County and available project funding**.

Tables 1-1 through 11-4 outline the projected water and wastewater system improvements by service area, summarizing the following information:

- Name of system improvement.
- Budgetary cost estimate in 2015 dollars.
- The type of project is distinguished by whether the purpose is to primarily increase service reliability (S), provide capacity for growth (G), or to rehabilitate existing infrastructure (R).
- Planning period in which the project is projected to be needed based on demand estimates. It should be noted that the planning, permitting, engineering, and construction for projects can take at least 3 to 5 years (actual timeframe dependent on project complexity); therefore, adequate time should be planned for to complete projects.
- The recommended projects included in this Master Plan are conceptual and are for high-level planning purposes. When the County is ready to proceed with a specific project, it is recommended that a Preliminary Engineering Report (PER) be completed to evaluate the project in detail and to provide more refined budget cost estimates. The PER will also be required to obtain state regulatory approvals.

Community Improvements projects listed in **Table 1-5** for water and wastewater improvements are listed in general order of priority. The priority for the fire flow improvements were generally based on difference between fire flow availability and fire flow goals. Sewer system priority was based on a few factors including service reliability and system capacity. The final project priority should be determined by the County.

Figures showing the location of these projects are located in Chapters 9 and 10.

Table 1-1 Prince George Route 301 Water and Wastewater Service Area (Recommended Projects Needed Based on Growth Projections)

Water Improvement Project	**Planning Period**				
	Com. Improvements	**A**	**B**	**C**	**D**
w301-A-01: Route 301 Water Supply Extension (G)		$ 5,080,000			
w301-C-01: Cedarwood Service Extension (S)				$ 1,700,000	
w301-D-01: Route 301 Service Extension (G)					$ 1,120,000
w301-D-02: Route 301 Booster Pump Station Upgrade (G)					$ 100,000
w301-D-03: Walton Lake Road Service Extension (S)					$ 5,090,000
Prince George Water Improvements Subtotal	***$ -***	***$ 5,080,000***	***$ -***	***$ 1,700,000***	***$ 6,310,000***
Wastewater Improvement Project	**Planning Period**				
	Com. Improvements	**A**	**B**	**C**	**D**
s301-D-01: Route 301 Service Extension (G)					$ 1,120,000
s301-D-02: Route 301 Sanitary Sewer Upgrades (G)					$ 2,210,000
Prince George Wastewater Improvements Subtotal	***$ -***	***$ -***	***$ -***	***$ -***	***$ 3,330,000***
Total Prince George Route 301 Service Area Improvement Cost Estimate	**$ -**	**$ 5,080,000**	**$ -**	**$ 1,700,000**	**$ 9,640,000**

1. Budgetary cost estimates for water supply or wastewater disposal connections do not include improvements outside of Prince George County

Table 1-2 Prince George Route 10 Water and Wastewater Service Area (Recommended Projects Needed Based on Growth Projections)

Water Improvement Project	Planning Period				
	Com. Improvements	A	B	C	D
w010-A-01: Route 10 Water Supply Improvements (GS)		$ 5,290,000			
w010-C-01: Route 10 Booster Pump Station Upgrade (G)				$ 100,000	
Prince George Route 10 Water Improvements Subtotal	***$ -***	***$ 5,290,000***	***$ -***	***$ 100,000***	***$ -***
Wastewater Improvement Project	**Planning Period**				
	Com. Improvements	**A**	**B**	**C**	**D**
s010-2035-01: Route 10 Service Extension (G)				$ 6,850,000	
Prince George Wastewater Improvements Subtotal	***$ -***	***$ -***	***$ -***	***$ 6,850,000***	***$ -***
Total Prince George Route 10 Service Area Improvement Cost Estimate	**$ -**	**$ 5,290,000**	**$ -**	**$ 100,000**	**$ -**

1. Budgetary cost estimates for water supply or wastewater disposal connections do not include improvements outside of Prince George County

Table 1-3 Prince George Puddledock Wastewater Service Area (Recommended Projects Needed Based on Growth Projections)

Wastewater Improvement Project	Planning Period				
	Com. Improvements	A	B	C	D
sPUD-B-01: Puddledock Regional Pump Station (G)			$ 6,320,000		
sPUD-C-01: River Road Service Extension (G)				$ 5,610,000	
Prince George Wastewater Improvements Subtotal	***$ -***	***$ -***	***$ 6,320,000***	***$ 5,610,000***	***$ -***
Total Puddledock Service Area Improvement Cost Estimate	**$ -**	**$ -**	**$ 6,320,000**	**$ 5,610,000**	**$ -**

1. Budgetary cost estimates for water supply or wastewater disposal connections do not include improvements outside of Prince George County

Table 1-4 Prince George Central Water and Wastewater Service Area (Recommended Projects Needed Based on Growth Projections)

Water Improvement Project	Planning Period				
	Com. Improvements	A	B	C	D
wCEN-A-01: Central System Water Supply Project (GS)		$ 24,640,000			
wCEN-A-03: Food Lion Water Facility Improvements (GS)		$ 1,500,000			
wCEN-B-01: Route 156 Booster Pump Station and Water Service Extension (GS)			$ 4,190,000		
wCEN-B-02: Route 156 Water Service Extension (GS)			$ 2,870,000		
wCEN-C-01: Central System Water Supply Booster Pump Station Upgrade (GS)				$ 1,360,000	
wCEN-C-02: Rives Road Water Service Extension (G)				$ 1,320,000	
wCEN-C-03: River Road Water Service Extension (G)				$ 1,030,000	
wCEN-C-04: Puddledock Booster Pump Station (G)				$ 4,350,000	
wCEN-D-01: Route 156 Waterline Loop (GS)					$ 880,000
wCEN-D-02: Sandy Ridge Road Waterline Loop (GS)					$ 1,140,000
wCEN-D-03: Southpoint Elevated Storage Tank (G)					$ 2,680,000
Prince George Central Service Area Water Improvements Subtotal	***$ -***	***$ 26,140,000***	***$ 7,060,000***	***$ 8,060,000***	***$ 4,700,000***
Wastewater Improvement Project	**Planning Period**				
	Com. Improvements	**A**	**B**	**C**	**D**
sCEN-A-01: Blackwater Regional Sewer Interceptor (GS)		$ 24,140,000			
sCEN-A-02: Decommission SPS-002 (GS)		$ 810,000			
sCEN-B-01: Route 156 Service Extension (G)			$ 980,000		
sCEN-B-02: Second Swamp Regional Interceptor and Pump Station (Phase 1) (GS)			$ 8,720,000		
sCEN-B-03: Decommission SPS-003 (GS)			$ 450,000		
sCEN-B-04: 6.5 MGD Blackwater Swamp Regional Pump Station Upgrade (G)			$ 400,000		
sCEN-B-05: 9.0 MGD Route 10 Regional Pump Station Upgrade (G)			$ 500,000		
sCEN-C-01: Second Swamp Regional Interceptor (Phase 2) (GS)				$ 5,550,000	
sCEN-C-02: Decommission SPS-001 (GS)				$ 800,000	
sCEN-C-03: Decommission SPS-008 & SPS-016 (GS)				$ 1,040,000	
sCEN-C-04: Decommission SPS-021 (GS)				$ 1,330,000	
sCEN-C-05: Rives Road Service Extension (G)				$ 2,100,000	
sCEN-D-02: Route 106 and Route 156 Development Extension (G)					$ 5,870,000
Prince George Central Service Area Wastewater Improvements Subtotal	***$ -***	***$ 24,950,000***	***$ 11,050,000***	***$ 10,820,000***	***$ 5,870,000***
Total Prince George Central Service Area Improvement Cost Estimate	**$ -**	**$ 51,090,000**	**$ 18,110,000**	**$ 18,880,000**	**$ 10,570,000**

1. Budgetary cost estimates for water supply or wastewater disposal connections do not include improvements outside of Prince George County

Table 1-5 Prince George Community Improvement Projects

Water Improvement Project	Com. Improvements	Planning Period A	B	C	D
w010-CI-01: Beechwood Manor Fireflow Improvements (S)(2)	$ 890,000				
w010-CI-02: Jordan on the James Fireflow Improvements (S)(2)	$ 1,420,000				
w010-CI-03: Rivers Edge Fireflow Improvements (S)(2)	$ 1,360,000				
wCEN-CI-05: Birchett Estates Fireflow Improvements (S)	$ 1,290,000				
wCEN-CI-01: Commonwealth Acres Fireflow Improvements (S)	$ 710,000				
wCEN-CI-04: Manchester Mill Fireflow Improvements (S)	$ 840,000				
wCEN-CI-02: Lee Acres Fireflow Improvements (S)	$ 340,000				
wCEN-CI-03: Rolling Meadows and Hidden Oaks Fireflow Improvements (S)	$ 480,000				
wCEN-CI-06: Puddledock Fireflow Improvements (S)	$ 1,020,000				
wCEN-CI-07: River Road Fireflow Improvements (S)	$ 990,000				
wCEN-CI-08: Scott Park Water Service Extension Phase 1 (G)	$ 680,000				
wCEN-CI-09: Scott Park Water Service Extension Phase 2 (G)	$ 580,000				
Prince George Central Service Area Water Improvements Subtotal	***$ 4,380,000***	***$ -***	***$ -***	***$ -***	***$ -***
Wastewater Improvement Project	**Com. Improvements**	**Planning Period A**	**B**	**C**	**D**
s301-CI-01: SPS-006 Pump Station Rehabilitation (RG)	$ 713,000				
sCEN-CI-01: Route 301 and Route 460 I&I Evaluation	$ 25,000				
sCEN-CI-02: Scott Park Sewer Service Extension Phase 1 (G)	$ 340,000				
s010-CI-01: Rivers Edge Service Extension (S)	$ 1,430,000				
s010-CI-02: Beechwood Manor Service Extension (S)	$ 1,250,000				
Prince George Central Service Area Wastewater Improvements Subtotal	***$ 3,045,000***	***$ -***	***$ -***	***$ -***	***$ -***
Total Community Improvement Cost Estimate	**$ 7,425,000**	**$ -**	**$ -**	**$ -**	**$ -**

1. Budgetary cost estimates for water supply or wastewater disposal connections do not include improvements outside of Prince George County

2. Route 10 Fire Flow Improvements are dependent upon the Route 10 water supply improvements project (w010-A-01).

Chapter 2 Introduction

2.1 Purpose

The Prince George County Department of Engineering and Utilities provides both water and wastewater service to an expanding population of customers within the County. Cost efficient, reliable, and environmentally sound water and wastewater service is a major contributor to the County's quality of life. To ensure a continued high quality of service, while keeping pace with the challenges of a growing community, the County has developed this Water and Wastewater Master Plan. The purpose of the Plan is to assist the County with its planning for improvements, upgrades, extensions, and expansions that are required to meet future needs. The Plan addresses improvements and upgrades projected to be needed through the Year 2045.

This Water and Wastewater Master Plan is based on the best information currently available. The plan serves as a road map for the County. It will need to be modified and refined periodically based on actual development in the County and in response to changes that the County makes to its Comprehensive Plan in the future.

2.2 Scope

Preparation of the Water and Wastewater Master Plan involved extensive coordination with the Prince George County Department of Engineering and Utilities to incorporate available information into the plan, including existing water and wastewater system records, design information for planned projects, and methodologies for demand projections and system modeling.

The development of the Water and Wastewater Master Plan also involved coordination with ARWA, Virginia American Water (VAWC), South Central Wastewater Authority (SCWWA), the City of Hopewell, the City of Petersburg, and the City of Colonial Heights. This coordination was important to ensure that the Water and Wastewater Master Plan incorporated the latest information available and meets the overall needs of the County.

The general approach for development of the Water and Wastewater Master Plan incorporated the following steps:

1. Collect and review available information on the County's existing water and wastewater systems.
2. Conduct an evaluation of the existing water and wastewater infrastructure.
3. Conduct workshops with representatives from Engineering and Utilities, Economic Development, and Community Development Departments to gather information and develop concurrence regarding the methodologies used to develop the Plan.
4. Obtain information from Prince George County on proposed land use, targeted growth areas, and population projections.
5. Develop demand projections through 2045 and distribute the demand projections throughout the various Prince George Service Areas in areas projected to be developed during several future time steps. Note that data from January 2013 to December 2013 was used as the baseline year for demand projections, since this time frame was the latest year that complete data was available when the population demand projections were developed.
6. Develop models for the water and wastewater systems to identify Master Plan Projects that will address existing system deficiencies as well as provide for growth within the County.
7. Develop the Water and Wastewater Master Plan to summarize project activities and provide budget cost estimates and recommendations for projects throughout the planning period.

Projects that were identified as improvements and upgrades to the County's existing water and wastewater systems are summarized in Chapters 9 and 10. The implementation plan for these improvements, outlining cost estimates and implementation schedules for each individual project, is included in Chapter 11.

Chapter 3 Existing Water System Overview

This chapter of the Water and Wastewater Master Plan provides an overview of Prince George County's existing water system.

3.1 Water System Overview

There are currently eight (8) existing public water systems within Prince George County which are owned and operated by the County. The systems are separated into services areas as shown below:

A plan schematic of the existing water systems are shown in Figure 3-1.

Johnson Road Service Area:

- Johnson Road System
- Fort Hayes System

Route 301 Service Area:

- Route 301 System
- Cedarwood System

Central Service Area:

- Central System
- Food Lion System
- Prince George Woods System
- River Road System

Route 10 Service Area:

- Beechwood Manor / Jordan on the James System
- River's Edge System

More detailed information on the County's waterlines, water supply facilities, storage facilities, and pumping facilities is provided in the following sections for each water system. Demand data given in this Chapter for the calendar year of 2013 is based upon billing data and does not account for flushing and unmetered water usage within the systems. Refer to **Table 3-1** at the end of this chapter for a full summary of demand data and water supply capacities.

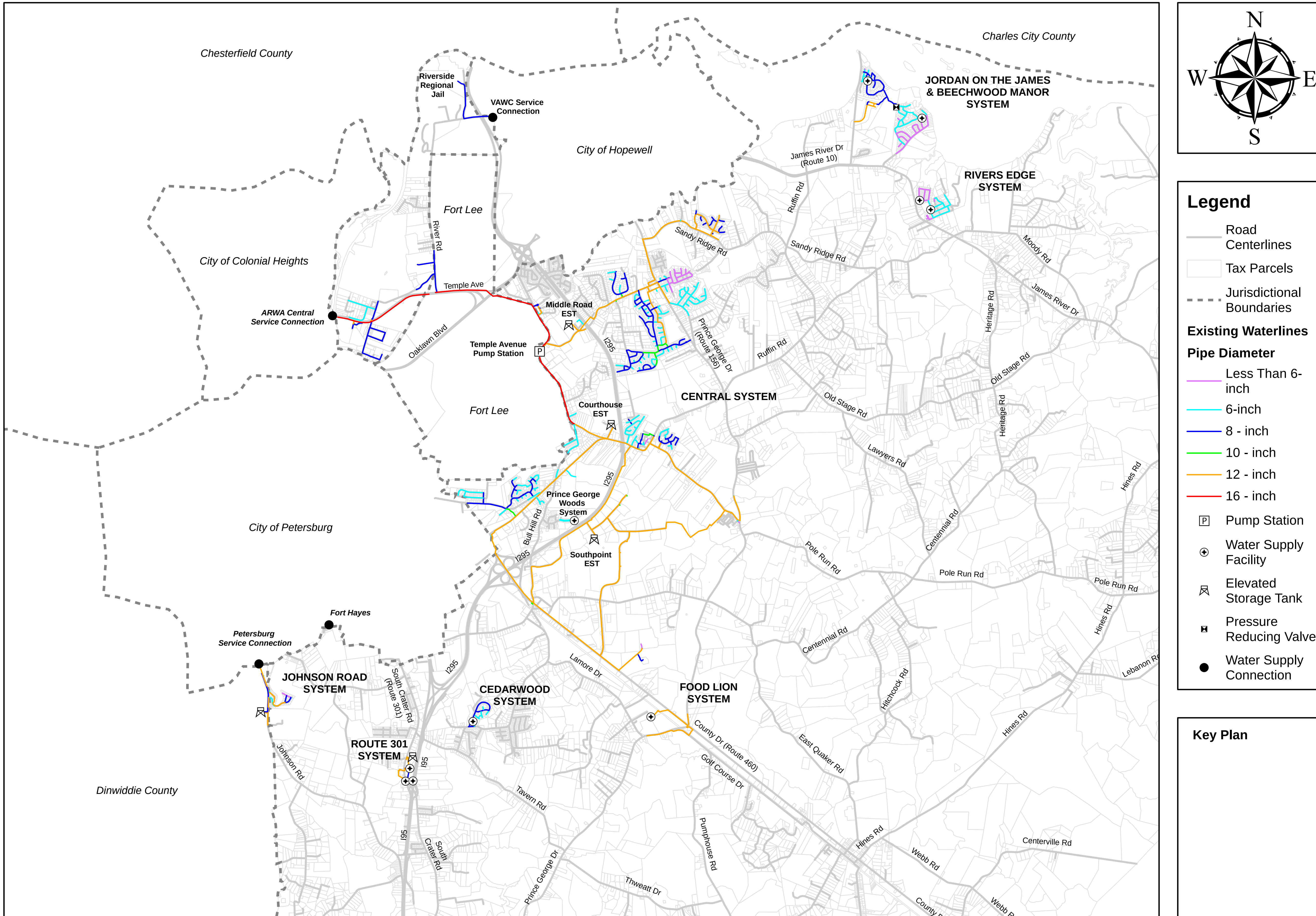


FIGURE NO. 3-1

TITLE
EXISTING WATER SYSTEM

SCALE
1 inch = 8,000 feet

PROJECT
WATER & WASTEWATER MASTER PLAN
PRINCE GEORGE COUNTY, VA

DATE
01/2016

PROJ. NO.
50068442

Dewberry
Dewberry Engineers Inc.
4805 LAKE BROOK DRIVE, SUITE 200
GLEN ALLEN, VIRGINIA 23060
PHONE: 804.290.7957
FAX: 804.290.7928

3.2 Johnson Road Service Area

The Johnson Road service area consists of the Johnson Road Water System, and the Fort Hayes Water System.

3.2.1 Johnson Road Water System

The Johnson Road water system is located along Johnson Road (Route 608), just north of Richard Bland Community College, which is the primary customer of the system. Based on the current water supply agreement with the City of Petersburg, Prince George County currently does not have a set water supply capacity. Water supply is limited to development which is constructed by the ABC Corporation (1986 agreement), Richard Bland College (1993 agreement), and MPC Associates, LLC (2003 agreement). All other development outside of these entities must be approved by the City to connect to the Johnson Road water system. In 2013, the average daily demand for the Johnson Road System was 27,900 gallons per day (GPD).

The water system consists of approximately 3.3 miles of waterlines ranging in diameter from 4 to 12 inches, a 500,000 gallon elevated water storage tank, and a booster pump station. Pipe age within the system ranges up to approximately 30 years old with materials including polyvinyl chloride (PVC), high-density polyethylene (HDPE), and ductile iron (DI) pipe. A single connection point to the City of Petersburg's water system, located along Johnson Road, provides water supply to the system. An 8-inch fill line tees from the 12-inch supply line approximately 800 feet south of the Petersburg connection point and runs parallel to Johnson Road to the elevated storage tank. A valve is located just south of the 8-inch tee location which separates the low pressure fill line from the high pressure Johnson Road service area. There are no existing connections to the fill line served from the Petersburg water system.

The Richard Bland elevated storage tank was constructed in 2008. The booster pump station, located within the column of the 500,000 gallon elevated water storage tank, pumps water from the Petersburg connection point through the 8-inch fill line and into the elevated water storage tank. The pump station consists of two (2) pumps, each with a capacity of 415 gallons per minute (GPM) at 100 feet Total Dynamic Head (TDH) and includes a generator for emergency backup.

The elevated storage tank includes a Tideflex mixing system and has an overflow elevation of 326 feet.

3.2.2 Fort Hayes Water System

The Fort Hayes water system is located along Fort Hayes Drive at the southern border to the City of Petersburg. The systems current users include approximately 15 residential condominiums within Prince George County. Based upon the existing agreement with the City of Petersburg, Prince George County has an average day water capacity of approximately 21,000 GPD. The existing system demand is within the capacity of the system and agreement.

The water system consists of approximately 500 linear feet of 6-inch PVC waterline, installed approximately 25 years ago, which is directly connected to the City of Petersburg's water system. Water supply facilities which provide service to Fort Hayes customers are operated and maintained by the City of Petersburg.

3.3 Route 301 Service Area

The Route 301 Service Area consists of two (2) water systems; the Route 301 water system, and the Cedarwood water system.

3.3.1 Route 301 Water System

The Route 301 water system is located just north of I-95 exit 45 on Route 301. The system's primary users include hotels and restaurants and serves the area along Route 301 between exit 45 and Clary Road. Currently, Prince George County is in the process of obtaining an updated Groundwater Withdrawal Permit (GWP) from DEQ. The draft GWP authorizes the water supply facilities to withdraw a limiting capacity of approximately 124,300 GPD. Based on the Virginia Department of Health (VDH) Engineering Description Sheet (EDS) for the three operating water supply facilities, Prince George County has a combined average day water capacity of approximately 272,200 GPD. In 2013, the average daily demand for the Johnson Road System was 34,200 GPD.

The system consists of approximately 1.17 miles of waterlines ranging from 6 to 12 inches, three (3) water supply facilities, and a 500,000 gallon elevated storage tank. Pipe age within the system ranges up to approximately 10 years old of DI pipe.

The Days Inn water supply facility was constructed in 1987 and consists of one (1) well, an offline atmospheric storage tank, a softening system, sodium hypochlorite feed system, two (2) offline booster pumps, and an offline 5,000 gallon hydro-pneumatic tank. The well has a yield of 145 GPM and is equipped with a submersible pump with a limiting pumping capacity of 110 GPM which pumps through the softening system. The treated water is then injected with sodium hypochlorite before entering to the distribution system.

The Hampton Inn water supply facility was constructed in 1988 and consists of one (1) well, a 125,000 gallon bolted steel atmospheric ground storage tank, softening system, sodium hypochlorite system, two (2) booster pumps, and a offline 5,000 gallon hydro-pneumatic tank. The well is equipped with a submersible pump with a pumping capacity of 30 GPM and has a limiting well yield of 29 GPM. The well pumps through the softening system and is injected with sodium hypochlorite and polyphosphate before entering the distribution system.

The Howard Johnson water supply facility was constructed in 1962 and the original facility included one (1) well, a softening system, and six (6) bladder tanks. The well has a yield of 110 GPM and is equipped with a submersible well pump with a limiting pumping capacity of 50 GPM. When the well was in service, it pumped through the softening system before entering the distribution system. This water facility is currently not in service and requires significant improvements to make it operable.

The 500,000 gallon elevated storage tank is located approximately 500 feet west of Route 301 across from the Clary Road intersection. The elevated storage tank was constructed in 2007 and is filled by the three water supply facilities along Route 301. The water supply facilities are currently activated based upon timer controls adjusted based on seasonal demands. The overflow elevation of the elevated storage tank is 310 feet.

3.3.2 Cedarwood Water System

The Cedarwood water system is located just southeast of the I-95/I-295 interchange and north of Union Branch Road. The system's users include residents within the Cedarwood subdivision. Currently, the DEQ Groundwater Withdrawal Permit permits the water supply facility a limiting average day withdrawal capacity of 19,400 GPD and a maximum month capacity of 694,400 gallons. Based upon the VDH EDS, the system has a design capacity of 19,600 GPD. In 2013, the average daily demand for the Cedarwood System was 15,800 GPD.

The system consists of approximately 1.6 miles of waterlines ranging from 6 to 8 inches, and a single water supply facility located at the corner of Cedar Run Road and Rothwood Court. Pipe age within the system ranges up to approximately 27 years old of PVC pipe. The water supply facility was constructed in 1982 and consists of one (1) well, a 25,000 gallon horizontal atmospheric ground storage tank, two (2) booster pumps, and a 1,000 gallon hydro-pneumatic tank. The well has a yield of 64 GPM and is equipped with a 120 GPM submersible pump which pumps into the ground storage tank. The two booster pumps, each with an individual capacity of 125 GPM and a combined capacity of 154 GPM, pump out of the ground storage tank and into the hydro-pneumatic tank which provides pressure to the system. Provisions are made for the booster pumps to discharge directly to the distribution system. The Cedarwood water system has a normally closed interconnect on Union Branch Road with the adjacent, privately owned, Lundie Water System which provides a redundant water source for both systems.

3.4 Central Service Area

The Central Service Area consists of four (4) water systems; the Central Water System, the Food Lion Water System, and the Prince George Woods Water System, and the River Road System.

3.4.1 Central Water System

The Central Water System is the largest water system in Prince George County and serves the majority of customers. The system covers the service area north of the Food Lion system up to the City of Hopewell, and west along Temple Avenue to the City of Colonial Heights. Based on the current water supply agreement with ARWA, Prince George has a maximum day plant capacity of 2.69 million gallons per day (MGD) at the ARWA water treatment plant (See **Table 3-1**). However, the ARWA supply system has transmission limitations which do not allow full usage of the plant capacity because Prince George County is at the end of the transmission system. In 2013, the average daily demand for the system was 600,600 GPD and a maximum day water demand of just under 1.0 MGD.

The Central System consists of approximately 64.2 miles of waterline ranging from 4 to 16 inches, a 2.0 MGD booster pump station, and three (3) elevated storage tanks. Pipe age within the system ranges up to approximately 40 years old with materials including AC, cast iron (CI), PVC, and DI pipe. A single connection point located in the City of Colonial Heights along Temple Avenue west of the Appomattox River bridge supplies the system through an ARWA 16-inch supply waterline. The system is divided into two (2) pressure zones which are separated by a booster pump station located just south of the intersection of Middle Road and Jefferson Park Road. The low pressure zone serves the Temple Avenue and Puddledock Road areas, the southern ends of River Road, and Jefferson Park Road north of Middle Road. The booster pump station pumps water from low pressure zone into the high pressure zone to fill the three (3) elevated storage tanks located throughout the high pressure zone. The booster pump station is operated by a timer as a supervisory control and data acquisition (SCADA) system is not in place to control the booster pump station (BPS) based on tank level at this time.

The Central System booster pump station was constructed in 1988 and consists of three (3) 50 Horsepower (HP) Aurora end suction centrifugal pumps contained in a block building. Each pump is designed to pump approximately 1,000 GPM at 135 feet TDH. Based on system condition, the booster pump station has an approximate pumping capacity of 2.0 MGD. The facility includes a diesel generator, automatic transfer switch (ATS) for emergency backup, and a meter vault located on site which measures flow entering the high pressure zone south and east of the booster pump station.

The Middle Road elevated storage tank was constructed in 2002 and is located approximately 1,500 feet west of the intersection of I-295 and Middle Road. The elevated storage tank has a capacity of 500,000 gallons and an overflow elevation of 285.75 feet. An offline altitude valve is located just outside the tank in a valve vault.

The Courthouse elevated storage tank was constructed in 1988 and is located approximately 1,400 feet northeast of the intersection of Courthouse Road and Allin Road. The elevated storage tank has a capacity of 500,000 gallons and an overflow elevation of 285.25 feet. An offline altitude valve is located just outside the tank in a valve vault.

The Southpoint elevated storage tank was constructed in 2000 and is located at the end of Quality Drive in the Southpoint Business Park. The elevated storage tank has a capacity of 500,000 gallons and an overflow elevation of 285.75’. An offline altitude valve is located just outside the tank in a valve vault.

3.4.2 Food Lion Water System

The Food Lion water system is located south of the Central System along Route 460 near the intersection of Prince George Drive (Route 156). The system’s primary user is the Food Lion Distribution Center located along Route 460. Based on the current DEQ Groundwater Withdrawal Permit, the water supply facility has a limiting average day withdrawal capacity of 65,700 GPD and a maximum month capacity of 774,200 gallons. In 2013, the average daily demand for the system was 37,900 GPD.

The Food Lion system consists of approximately 3.9 miles of waterline ranging from 6 to 12 inches, and a single water supply facility located approximately 500 feet south of the Food Lion Distribution Center. There is another well in the system that is current out of service and not in use. Pipe age within the system ranges up to approximately 30 years old with materials including PVC and DI pipe.

The water supply facility was constructed in 1982 and consists of two wells, a 1,000,000 gallon atmospheric ground storage tank, an 8,000 gallon hydro-pneumatic tank, a sodium hypochlorite feed system, and two (2) booster pumps. Of the two wells, one is currently offline and the other has a yield of approximately 430 GPM and is equipped with a submersible pump with a capacity of 400 GPM. The well that is in service pumps into the 1.0 MG ground storage tank. The two booster pumps, which have a combined capacity of 900 GPM, then pump out of the ground storage tank and into the hydro-pneumatic tank which provides pressure to the system. Based upon the VDH EDS, the system has a design capacity of 184,400 GPD.

3.4.3 Prince George Woods Water System

The Prince George Woods water system is located along Bickings Lane between Leland Drive and Mandie Drive. The system serves approximately 20 single family residential customers. Prince George County does not require a DEQ Groundwater Withdrawal Permit due to a groundwater withdrawal of less than 10,000 GPD (300,000 gallons per month). In 2013, the average daily demand for the system was 1,700 GPD.

The Prince George Woods systems consists of approximately 1,300 feet of 6-inch waterline, installed approximately 25 years ago, and a water supply facility located along Bickings Lane. The water supply facility was constructed in 1988 and consists of one (1) well and a 5,000 gallon hydro-pneumatic tank. The well has an unknown yield and is equipped with a 116 GPM submersible pump. The well pumps into the hydro-pneumatic tank which provides pressure to the distribution system. Based upon the VDH EDS, the Prince George Wood system has a design capacity of 167,000 GPD, although the water supply facility is limited to the withdrawal of 10,000 GPD without a DEQ Groundwater Withdrawal Permit.

3.4.4 River Road Water System

The River Road water system is located along River Road at the intersection of I-295 and north along Folar Trail. Currently, the system only serves the Riverside Regional Jail and the Fort Lee North Range Facility and has no capacity limitations with the VAWC. In 2013, the average daily demand for the system was 123,900 GPD according to data from the master meter at Atwater Road.

The River Road system consists of approximately 6,000 feet of 8-inch PVC waterline which directly connects to the VAWC distribution system in the City of Hopewell. The Riverside Regional Jail also has a 0.4 MG elevated storage tank and booster pump station which is owned and operated by Riverside Regional Jail.

3.5 Route 10 Service Area

The Route 10 Service Area consists of two (2) water systems; the Jordan on the James/Beechwood Manor System, and the River's Edge System.

3.5.1 Jordan on the James / Beechwood Manor Water System

The Jordan on the James / Beechwood Manor System is located north of Route 10 between Jordan Point Road and Beaver Castle Road. The system currently only serves residential customers within the Jordan on the James, Beechwood Manor, and Eagle Preserve subdivisions. Currently, the DEQ Groundwater Withdrawal Permit allows the water supply facilities a limiting average day withdrawal capacity of 135,700 GPD and a maximum month capacity of 5,600,000 gallons. This DEQ GWP includes two (2) Chappell Creek wells which have been permitted but are currently offline. It should be noted that the Lemonwood well facility currently has reduced capacity at the well's new depth which limits the facility to 40 GPM. Based upon the VDH EDS, the system has a design capacity of approximately 226,400 GPD. In 2013, the average daily demand for the system was 57,400 GPD.

The system consists of approximately 8.1 miles of waterline ranging from 4 to 8 inches, two (2) pressure zones, and two (2) water supply facilities. Pipe age within the system ranges up to approximately 40 years old with materials including AC, PVC, and DI pipe. The system's two pressure zones are separated by a pressure reducing valve (PRV) with a set point of 40 psi located on a connecting 8-inch waterline between the Jordan on the James and Beechwood Manor subdivisions. The Beechwood Manor high pressure zone contains the Lemonwood water supply facility and the Jordan on the James low pressure zone contains the Jordan on the James water supply facility.

The Beechwood Manor water supply facility was constructed in 1975 and consists of one well equipped with a 40 GPM submersible pump, a 95,000 gallon atmospheric underground storage tank, two (2) booster pumps individually rated at 229 GPM with a combined capacity of 458 GPM, a softening system, a filtering system, a sodium hypochlorite feed system, and a 5,000 gallon hydro-pneumatic tank. Under normal operation, the well pumps through the softeners and into the ground storage tank. When pressure in the hydro-pneumatic tank drops, the booster pumps will turn on to meet system demand, filling the hydro-pneumatic tank and pumping water into the system. A chlorine solution is injected by a metering pump into the well discharge prior to distribution. A generator and ATS are also provided for emergency backup.

The Jordan on the James water supply facility was constructed in 1986 and consists of one well equipped with a 136 GPM submersible pump, a 61,000 gallon ground storage tank, two (2) booster pumps rated at 180 GPM each, greensand filters, a sodium hypochlorite feed system, and a 3,000 gallon hydro-pneumatic tank. Under normal operation, sodium hypochlorite is injected prior to filtration at the well discharge. The well then pumps through the filters and into the ground storage tank. When pressure in the hydro-pneumatic tank drops, the booster pumps will turn on to meet system demand, filling the hydro-pneumatic tank and pumping water into the system. A generator and ATS are provided for emergency backup.

3.5.2 River’s Edge Water System

The River’s Edge system is located southeast of the Jordan on the James / Beechwood Manor System along Route 10. The system serves residential customers within the River’s Edge subdivision. Currently, the DEQ Groundwater Withdrawal Permit allows the water supply facility a limiting average day withdrawal capacity of 32,365 GPD and a maximum month capacity of 1,475,000 gallons. Based upon the VDH EDS, the system has a design capacity of approximately 53,200 GPD. In 2013, the average daily demand for the system was 18,800 GPD.

The system consists of approximately 2.9 miles of waterline ranging from 4 to 6 inches, and two water supply facilities. Pipe age within the system ranges up to approximately 50 years old with materials including AC, PVC, and galvanized steel pipe.

The Liverman water supply facility is located along Liverman Road west of the intersection of Emily Road. The facility was constructed in 1973 and consists of one well, and a 5,000 gallon hydro-pneumatic tank. The 105 GPM well pumps directly into the hydro-pneumatic tank to provide pressure to the system.

The Bicors water supply facility is located at the intersection of Ridge Road and Bicors Drive. The facility was constructed in 1962 and consists of one well and a 5,000 gallon hydro-pneumatic tanks. The 105 GPM well pumps directly into the 5,000 gallon online hydro-pneumatic tank to provide pressure to the system. The facility also has a 5,000 gallon atmospheric storage tank which is connected to a single fire hydrant adjacent to the water facility site to allow for additional storage to be used during a fire event.

Table 3-1 Water System Demands and Supply Capacities

Water System	2013 System Average Day Demand (GPD)	Average Day Demand Capacity (GPD)[1]	Estimated Remaining Average Day Capacity (GPD)
Johnson Road	27,900	N/A[2]	N/A[2]
Fort Hayes	Not Available	21,000	N/A
Route 301	34,200	124,300	90,100
Cedarwood	15,800	19,400	3,600
Central System	519,700	1,000,000[3]	480,300[3]
Food Lion	37,900	65,700	27,800
Prince George Woods	1,700	10,000	8,300
River Road	123,900	N/A	N/A
Jordan on the James / Beechwood Manor	57,400	135,700	78,300
River's Edge	18,800	32,400	13,600

1. All groundwater system capacities were limited by their groundwater withdrawal capacity rather than their VDH EDS Design Capacity.
2. No currently set supply capacity (Refer to section 3.2.1)
3. Estimated capacity based on the assumption of a maximum day peaking factor of 1.5 and that the Temple Avenue Pump Station can operate up to 18 hours per day at a 2.0 MGD pumping rate. Additional supply capacity is limited by existing ARWA transmission system. See Chapter 9 for additional information.

Chapter 4 Existing Wastewater System Overview

This chapter of the Water and Wastewater Master Plan provides an overview of Prince George County's existing wastewater system.

4.1 Existing Wastewater System Overview

There are nine (9) existing public wastewater systems within Prince George County which are owned and operated by the County. Each wastewater system is divided into service areas based upon the wastewater treatment facility to which wastewater is discharged. Systems within each service area are then subdivided by discharge locations.

A plan schematic of the existing wastewater systems are shown in Figure 4-1.

Prince George Petersburg/South Central Wastewater Authority (SCWWA) Service Area

- Johnson Road Wastewater System
- Route 301 Wastewater System
- Route 460 Wastewater System
- Puddledock Wastewater System
- Flank Road Wastewater System

Prince George Hopewell Regional Wastewater Treatment Facility (HRWTF) Service Area

- Route 36 Wastewater System
- Bailey's Creek Wastewater System
- Manchester Run Wastewater System
- River Road Wastewater System

Prince George County currently owns and operates a total of twenty-five (25) sewer pump stations (SPS). See **Figure 4-2** for a flow schematic of all existing pump stations.

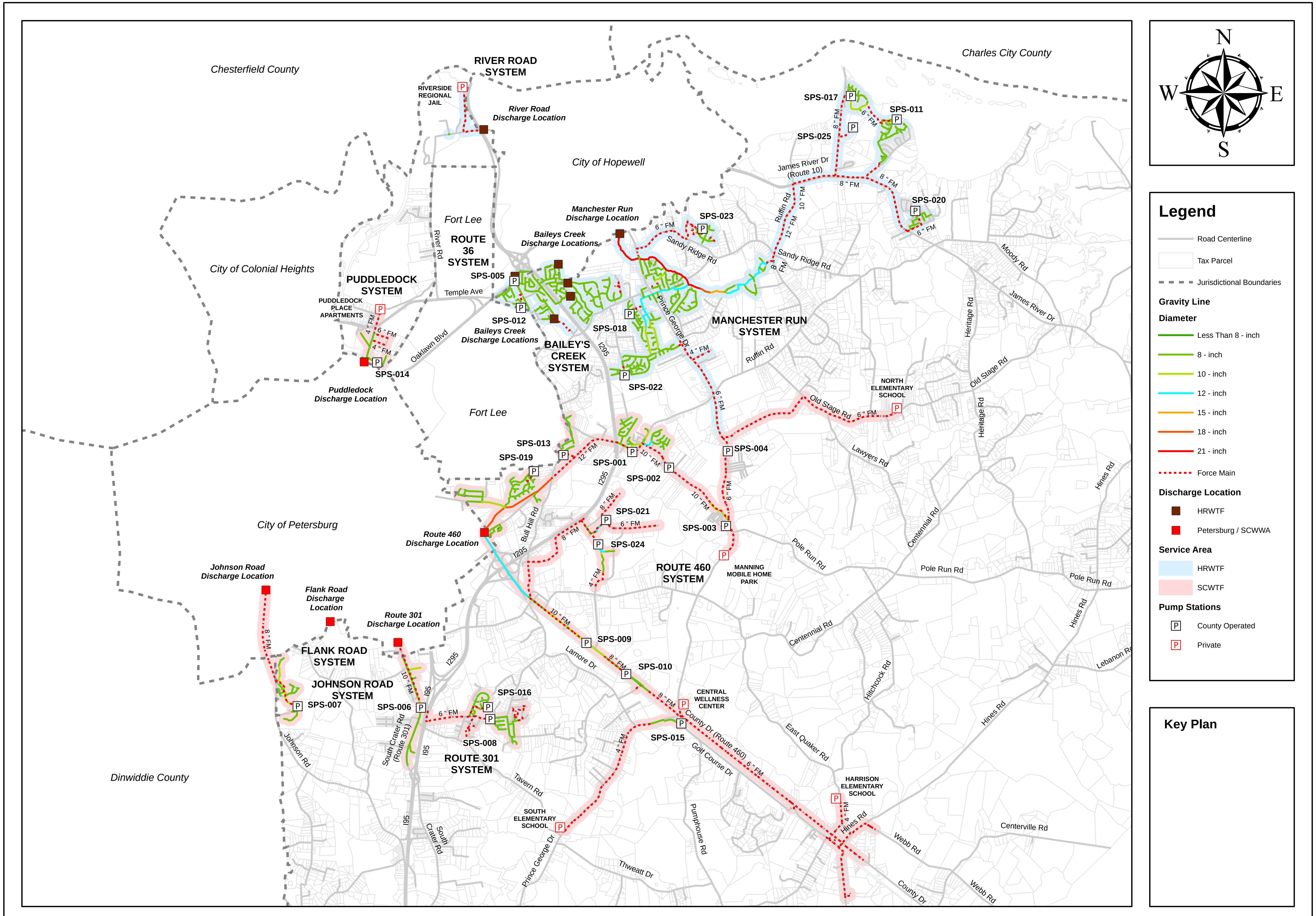


FIGURE NO. 4-1

TITLE EXISTING WASTEWATER SYSTEM

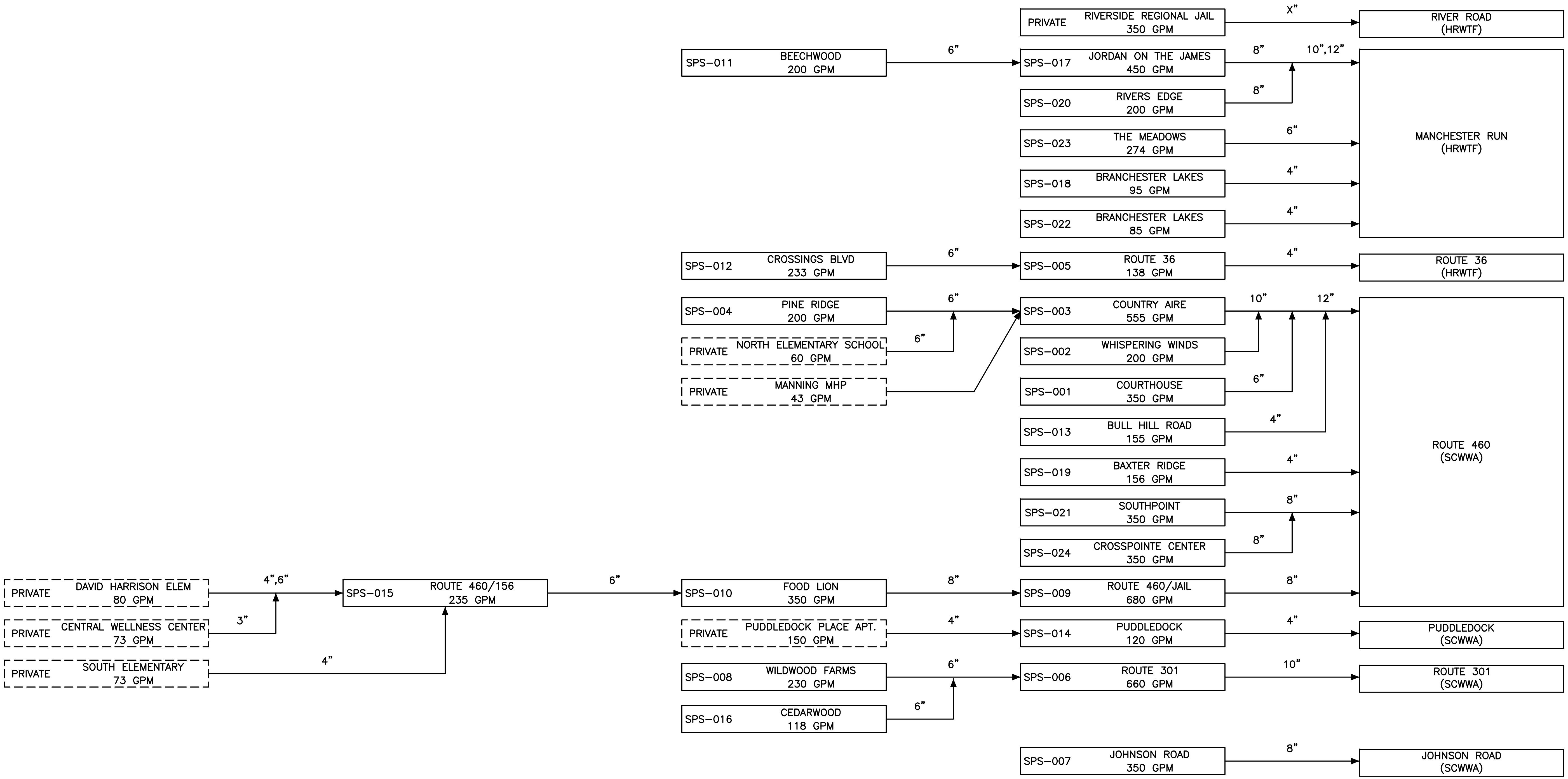
SCALE 1 inch = 8,000 feet

DATE 01/2016

PROJECT WATER & WASTEWATER MASTER PLAN PRINCE GEORGE COUNTY, VA

PROJ. NO. 50068442

Dewberry
Dewberry Engineers Inc.
4805 LAKE BROOK DRIVE, SUITE 200
GLEN ALLEN, VIRGINIA 23060
PHONE: 804.290.7957
FAX: 804.290.7928



NOTE:
PUMPING CAPACITIES ARE BASED UPON DESIGN POINTS AND ACTUAL PUMPING CAPACITIES MAY VARY BASED UPON FIELD CONDITIONS

FIGURE NO.	4-2
TITLE	EXISTING PUMP STATION FLOW SHEMATIC
SCALE	NA
PROJECT	WATER & WASTEWATER MASTER PLAN PRINCE GEORGE COUNTY, VA
DATE	01/2016
PROJ. NO.	50068442

Dewberry
Dewberry Engineers Inc.
4805 LAKE BROOKDRIVE, SUITE 200
GLEN ALLEN, VIRGINIA 23060
PHONE: 804.290.7957
FAX: 804.290.7928

4.2 Prince George Petersburg / SCWWA Service Area

The Prince George Petersburg / SCWWA Service Area consists of four (4) Wastewater Systems; the Johnson Road Wastewater System**,** the Route 301 Wastewater System, the Route 460 Wastewater System, the Puddledock Wastewater System, and the Flank Road Wastewater System. Wastewater treatment for the Petersburg / SCWWA Service Area is provided by the SCWWA treatment facility. Currently Prince George County has an average daily loading capacity of 1.72 MGD with SCWWA for the treatment of wastewater based on a first amendment to the service agreement that is yet to be adopted by the SCWWA Board of Directors. Prince George County also holds wastewater conveyance agreements with the City of Petersburg which limit capacity at each point of connection with Petersburg. See **Table 4-1** below for conveyance capacities at each point of connection with the City of Petersburg.

Table 4-1 Petersburg Discharge Location Average Daily Loadings and Conveyance Capacities

Discharge Location	Metered Discharge Locations Average Daily Loadings[1] (GPD)	Petersburg Average Daily Conveyance Capacity (GPD)
Johnson Road	26,500	180,000
Route 301	168,100	291,000
Route 460	507,400	1,000,000
Puddledock	18,800	100,000
Flank Road	Not Available	4,000
Total	**720,800**	**1,575,000**

1. Average daily loadings per discharge location metered data collected from April 2012 to March 2013.

4.2.1 Johnson Road Wastewater System

The Johnson Road wastewater system generally serves development along Johnson Road (Route 608), just north of Richard Bland Community College, which is the primary customer of the system. See **Table 4-1** for average daily sewer loadings and system capacity. The Johnson Road system consists of approximately 2.40 miles of gravity sewer ranging in diameter from 8 to 10 inches, 2.20 miles of 8-inch force main, and one (1) County owned and operated pump station. Pipe age within the system ranges up to approximately 35 years old of PVC gravity sewer and force main.

4.2.1.1 Wastewater Pump Stations

Johnson Road Sewer Pump Station (SPS-007) is located northeast of Richard Bland Community College and approximately 1,000 feet south of Bland Ridge Subdivision. This pump station was constructed in 1981, serves the entire service area, and consists of two (2) Smith & Loveless suction lift pumps contained in a fiberglass enclosure on top of the wet well. Each pump is designed to pump approximately 350 GPM at 65 feet TDH. These pumps lift wastewater out of a 5-foot diameter wet well and convey flow through approximately 11,700 linear feet of 8-inch force main routed generally along Johnson Road to the system's discharge location to the Petersburg collection system.

4.2.2 Route 301 Wastewater System

The Route 301 wastewater system is located along the Route 301 corridor west of I-95 from exit 45 and extends north to the City of Petersburg. The system also extends east to Union Branch Road to serve the Huckleberry Hills, Wildwood Farms, and Cedarwood subdivisions. See **Table 4-1** for average daily sewer loadings and system capacity.

The Route 301 system consists of approximately 6.0 miles of gravity sewer ranging in diameter from 8 to 10 inches, 4.4 miles of force main ranging from 2 to 10 inches, and three (3) County owned and operated pump stations. Pipe age within the system ranges up to approximately 40 years old with materials including PVC gravity sewer and force main. Note that the pipe material for the gravity sewer along Route 301 and connecting force main between Route 301 and the Wildwood and Cedarwood neighborhoods is unknown.

4.2.2.1 Wastewater Pump Stations

Route 301 Sewer Pump Station (SPS-006) is located along the eastern side of Route 301 between Wilham Road and Ethridge Drive. Wastewater is collected through gravity sewer for the entire service area including flow collected at SPS-008 and SPS-016 and conveyed to Route 301 through a 6-inch force main which discharges to gravity just north of SPS-006. SPS-006 was upgraded in 1979 to include Gorman Rupp pumps in a Smith & Loveless pump skid and is contained in a 20 foot x 20 foot building. The exact date of construction is unknown. Each pump is designed to pump approximately 660 GPM at 66 feet TDH. The pumps lift wastewater out of a 10 foot diameter wet well and discharge flow north along Route 301 through approximately 6,120 feet of 10 inch force main to the system's discharge location to the Petersburg system.

Wildwood Farms Sewer Pump Station (SPS-008) is located in Wildwood Farms Subdivision along the southern side of Union Branch Road between Drake Road and Morning Drive. Wastewater is collected through gravity sewer and low pressure force mains within the Wildwood Farms Subdivision. SPS-008 was constructed in 1981 and consists of two Smith & Loveless suction lift pumps contained in a fiberglass enclosure on top of the wet well. Each pump is designed to pump approximately 230 GPM at 49 feet TDH. The pumps lift wastewater out of a 5 foot diameter wet well and discharge flow east through approximately 7,530 feet of 6-inch force main which discharges to gravity along Route 301 just north of SPS-006 where it is collected.

Cedarwood Sewer Pump Station (SPS-016) is located in Cedarwood Subdivision at the end of Cedar Run Road. Wastewater is collected through gravity sewer within Cedarwood Subdivision. SPS-016 was constructed in 1989 and consists of two Smith & Loveless suction lift pumps contained in a fiberglass enclosure on top of the wet well. A precast concrete building was added at a later date. Each pump is designed to pump approximately 118 GPM at 50 feet TDH. The pumps lift wastewater out of a 5 foot diameter wet well and discharge flow south through approximately 2,420 linear feet of 6-inch force main which ties into a 6-inch force main along Union Branch Road and conveys flow west to Route 301 toward SPS-006.

4.2.3 Route 460 Wastewater System

The Route 460 system covers the Route 460 corridor from Disputanta to the Wagner and Courthouse Road intersection, the Southpoint Business Park, and the Courthouse Road corridor. The 6-inch force main along Prince George Drive (Route 156) is currently being routed south to the Route 460 wastewater system. All flow pumping into the Route 156 force main from private grinder pumps is also currently being routed south to the Route 460 wastewater system. See **Table 4-1** for average daily sewer loadings and system capacity for the Route 460 system.

The Route 460 system consists of approximately 18.8 miles of gravity sanitary sewer ranging in diameter from 4 to 18 inches, 23.2 miles of force main ranging from 2 to 12 inches, eleven (11) county owned and operated pump stations, and four (4) privately owned pump stations. Pipe age within the system ranges up to approximately 40 years old with gravity sewer materials including AC, DI, PVC, and reinforced concrete pipe (RCP) and force main materials including DI, HDPE, and PVC.

4.2.3.1 Wastewater Pump Stations

Route 460 Corridor

Route 460/Jail Farm Sewer Pump Station (SPS-009) is located along the southern side of Route 460 just north of Wells Station Road. Wastewater is collected through gravity sewer along Route 460. SPS-009 was constructed in 1982 and consists of two Fairbanks Morse suction lift pumps contained in a fiberglass enclosure on top of the wet well. Each pump is designed to pump approximately 680 GPM at 105 feet TDH. The pumps lift wastewater out of an 8 foot diameter wet well and discharge flow north through approximately 6,500 linear feet of 8-inch force main before discharging to 12-inch gravity main just west of Rives Road, and eventually flowing into SPS-009.

Route 460/Food Lion Sewer Pump Station (SPS-010) is located along the southern side of Route 460 south of Wells Station Road and North of Enterprise Drive. Gravity sewer along Route 460 collects wastewater both north and south of SPS-010. SPS-010 was constructed in 1982 and consists of two Fairbanks Morse suction lift pumps contained in a fiberglass enclosure on top of the wet well. Each pump is designed to pump approximately 350 GPM at 55 feet TDH. The pumps lift wastewater out of an 8 foot diameter wet well and discharge flow north through approximately 2,500 linear feet of 8-inch force main before discharging to gravity just south of Wells Station Road which eventually flows into SPS-009.

Route 460/Route 156 Sewer Pump Station (SPS-015) is located along the southern side of Route 460 just south of Prince George Drive (Route 156). Wastewater is collected through gravity sewer along Golf Course Drive, the force main collection system along Route 460 in Disputanta, and two private pump stations north and south of Route 156. SPS-015 was constructed in 1989 and consists of two Gorman Rupp suction lift pumps contained in a fiberglass enclosure on top of the wet well. Each pump is designed to pump approximately 235 GPM at 60 feet TDH. The pumps lift wastewater out of a 6 foot diameter wet well and discharge flow north through approximately 4,500 feet of 6-inch force main before discharging to gravity south of Enterprise Drive which eventually flows into SPS-010.

Southpoint and Crosspointe Business Park

Southpoint Sewer Pump Station (SPS-021) is located along the eastern side of Hardware Drive just south of Quality Way in the Southpoint Business Park. Wastewater is collected through gravity sewer and low pressure force mains in Southpoint Business Park along Quality Way. SPS-021 was constructed in 1998 and consists of two suction lift pumps contained in a 16 x 20 foot precast concrete building. Each pump is designed to pump approximately 350 GPM at 95 feet TDH. The pumps lift wastewater out of a 6 foot diameter wet well and discharge flow southwest through approximately 13,500 linear feet of 8-inch common force main to Route 460 where flow discharges to gravity just west of Bull Hill Drive.

Crosspointe Center Sewer Pump Station (SPS-024) is located west of Wells Station Road and South of Quality Drive. Wastewater is collected through gravity sewer west of Wells Station Road. SPS-024 was constructed in 2009 and consists of two Gorman Rupp suction lift pumps contained in a 16 x 20 foot building. Each pump is designed to pump approximately 350 GPM at 84 feet TDH. The pumps lift wastewater out of a 10 foot diameter wet well and discharge flow north through approximately 1,130 feet of 8-inch force main to tie in with the 8-inch force main from SPS-021.

Courthouse Corridor

The Courthouse Pump Station (SPS-001) is located along the southern side of Courthouse Road just east of I-295. Wastewater is collected through gravity sewer from Courthouse Complex Area, and the Rolling Meadows, Hidden Oaks, and Tinsley Charter Subdivisions. SPS-001 was constructed in 1977 and upgraded in 1998 to include two Gorman Rupp suction lift pumps contained in a precast concrete building. Each pump is designed to pump approximately 350 GPM at 77 feet TDH. The pumps lift wastewater out of an 8 foot diameter wet well and discharge flow into a 10-inch common force main running parallel to Courthouse Road which conveys flow to an 18-inch gravity sewer along Courthouse Road just south of Bull Hill Road.

Whispering Winds Sewer Pump Station (SPS-002) is located along the northern side of Laurel Spring Road just north of Whispering Winds Drive. Wastewater is collected through gravity sewer from the Whispering Winds Mobile Home Park, north of Laurel Spring Road. Based upon best available information, SPS-002 was constructed in 1976. The pump station consists of two dry pit pumps contained in a 3 foot diameter dry well located next to the wet well. Based upon available information, each pump is understood to pump approximately 200 GPM. The pumps lift wastewater out of a 4 foot diameter wet well and discharge flow to an 18-inch gravity sewer along Courthouse Road just south of Bull Hill Road.

Country Aire Sewer Pump Station (SPS-003) is located along the western side of Prince George Drive south of Laurel Springs Road. Wastewater is collected through gravity sewer along Laurel Spring Road, the force main system north along Route 156, and a private force main south along Route 156 serving Manning Mobile Home Park. SPS-003 was constructed in the 1970's with the pumps and control panel being replaced in the late 1990's. This pump station consists of two Gorman Rupp suction lift pumps contained in a precast concrete building. Each pump is designed to pump approximately 555 GPM at 90 feet TDH. The pumps lift wastewater out of a 9.5 foot diameter wet well and discharge flow west through approximately 20,900 feet of 10-inch force main along Laurel Spring Road and Courthouse Road which discharges to gravity south of the intersection of Courthouse Road and Bull Hill Road. Pump Stations 001, 002, and 013 pump into this common force main as well.

Pine Ridge Sewer Pump Station (SPS-004) is located along the eastern side of Prince George Drive approximately 1,100 feet south of Sebera Road. SPS-004 receives flow primarily from the Pine Ridge Mobile Home Park. SPS-004 originally constructed in 1976 and upgraded in 1996 to include to include two Gorman Rupp suction lift pumps and a precast concrete building. Each pump is designed to pump approximately 108 GPM at 88 feet TDH. The pumps lift wastewater out of a 4 foot diameter wet well and discharge flow into a 6-inch common force main running parallel to Prince George Drive which conveys flow south where it discharges to gravity just south of Laurel Spring Road along Route 156, and into SPS-003.

Bull Hill Road Sewer Pump Station (SPS-013) is located along the southern side of Bull Hill Road at the southern end of the Lee Acres subdivision. Wastewater is collected through gravity sewer from the Lee Acres subdivision. SPS-013 was constructed in 1985 and consists of two Smith & Loveless suction lift pumps contained in a steel enclosure approximately 5 feet deep on top of the wet well. Each pump is designed to pump approximately 150 GPM at 50 feet TDH. The pumps lift wastewater out of a 6 foot diameter wet well and convey flow southeast through approximately 1,100 linear feet of 4-inch force main and tie into a 10-inch common force main running parallel to Courthouse Road which conveys flow west to an 18-inch gravity sewer along Courthouse Road just south of Bull Hill Road.

Baxter Ridge Sewer Pump Station (SPS-019) is located northeast of the Wood Lane cul-de-sac in the Baxter Ridge subdivision. Wastewater is collected through gravity sewer from the Baxter Ridge subdivision. SPS-019 was constructed in 1996 and consists of two Gorman Rupp suction lift pumps contained in a 21 foot by 12.5 foot precast concrete building. Each pump is designed to pump approximately 156 GPM at 55 feet TDH. The pumps lift wastewater out of a 6 foot diameter wet well and convey flow south through approximately 1,400 linear feet of 4-inch force main and discharge into 8-inch gravity sewer at the intersection of Cross Point Court and Cross Point Lane.

4.2.4 Puddledock Wastewater System

The Puddledock wastewater system is located along Puddledock Road both north and south of Temple Avenue. The system primarily serves commercial and industrial customers south of Temple Avenue along Puddledock Road. A privately owned pump station serves Puddledock Place Apartments north of Temple Avenue. See **Table 4-1** for average daily sewer loadings and system capacity.

The Puddledock system consists of approximately 1.2 miles of 8-inch gravity sanitary sewer, 0.7 miles force main ranging in diameter from 4 to 6 inches, one (1) County owned and operated pump station, and one (1) private pump station. Pipe age within the system ranges up to approximately 30 years old with materials including PVC and HDPE pipe.

4.2.4.1 Wastewater Pump Stations

Puddledock Sewer Pump Station (SPS-014) is located along the southern side of East Whitehill Road. Wastewater is received for the entire Puddledock wastewater system through gravity sewer. SPS-014 was constructed in 1986 and consists of two Barnes submersible grinder pumps. Each pump is designed to pump approximately 100 GPM at 96 feet TDH. The pumps lift wastewater out of a 5 foot diameter wet well and convey flow west through approximately 1,500 linear feet of 4-inch force main to the City of Petersburg where it discharges into the Petersburg sewer conveyance system.

4.2.5 Flank Road Wastewater System

The Flank Road wastewater system is located along Fort Hayes Drive at the southern border to the City of Petersburg. The system's current users include approximately 15 residential condominiums within Prince George County. See **Table 4-1** for average daily sewer loadings and system capacity.

The Flank Road system consists of approximately 500 linear feet of PVC gravity sewer installed approximately 25 years ago which discharges directly to the City of Petersburg wastewater system. There are currently no pump stations within the system.

4.3 Prince George HRWTF Service Area

The Prince George HRWTF Service Area consists of four (4) wastewater systems; the Route 36 Wastewater System, the Bailey's Creek Wastewater System, the Manchester Run Wastewater System, and the River Road Wastewater System. Wastewater treatment for this service area is provided by the Hopewell Regional Wastewater Treatment Facility (HRWTF). Prince George County has an agreement with the City of Hopewell for a wastewater conveyance and treatment capacity of 2.0 MGD. See **Table 4-2** below for conveyance capacities at each point of connection with the City of Hopewell.

Table 4-2 Hopewell Discharge Location Maximum Daily Loadings and Conveyance Capacities

Discharge Location	Metered Discharge Locations Maximum Daily Loadings[1] (GPD)	Hopewell Maximum Daily Conveyance Capacity (GPD)
Route 36	114,800	2,000,000
Bailey's Creek	266,400	
Manchester Run	620,400	
River Road	124,800	
Total	**1,126,400**	**2,000,000**

1. Maximum daily loadings per discharge location metered data collected from April 2012 to March 2013. Maximum day multiplier of 2.0 times average daily flow.

4.3.1 Route 36 Wastewater System

The Route 36 wastewater system is located along Jefferson Park Road, Oaklawn Boulevard (Route 36), and Crossings Boulevard. Wastewater is collected from commercial and residential development in the Jefferson Park Road and Oaklawn Boulevard area north of Crossings Boulevard and Brandywine Drive and south of I-295. All wastewater collected in this system is conveyed to the Route 36 discharge location approximately 350 feet north of Jefferson Park Drive. See **Table 4-2** for sewer loadings and system capacity.

The Route 36 system consists of approximately 3.5 miles of gravity sewer ranging in diameter from 8 to 15 inches, 0.4 miles of force main ranging in diameter from 4 to 6 inches, and two (2) County owned and operated wastewater pump stations. Pipe age within the system ranges up to approximately 40 years old with gravity sewer materials including PVC, DI, and clay pipe and unknown force main materials.

4.3.1.1 Wastewater Pump Stations

Route 36 Sewer Pump Station (SPS-005) is located in a median along Oaklawn Boulevard (Route 36) at the intersection of Jefferson Park Road. SPS-005 receives all wastewater through gravity sewer from the Route 36 system. SPS-005 was constructed in 1976 and consists of two submersible grinder pumps. Based upon available information each pump is understood to pump approximately 138 GPM. The pumps lift wastewater out of a 6 foot diameter wet well and convey flow north through approximately 480 linear feet of 4-inch force main where the force main crosses Route 36 to the City of Hopewell wastewater collection system.

Crossings Boulevard Sewer Pump Station (SPS-012) is located along the southern side of Crossings Boulevard just west of Jefferson Park Road. Wastewater is collected through gravity sewer along the southern half of Crossing Boulevard and Jefferson Park Road. SPS-012 was constructed in the 1980's and consists of two Smith & Loveless suction lift pumps contained in a fiberglass enclosure on top of the wet well. Each pump is designed to pump approximately 233 GPM at 24 feet TDH. The pumps lift wastewater out of a 6 foot diameter wet well and convey flow north through approximately 1,700 linear feet of 6-inch force main which discharges to gravity along Jefferson Park Road approximately 400 feet north of Brandywine Drive.

4.3.2 Bailey's Creek Wastewater System

The Bailey's Creek wastewater system is located north of Middle Road at the intersection of I-295 and includes the Cedar Creek, Brickhouse Landing, Stafford Woods, Mulberry Woods subdivisions and Bailey's Ridge Apartments. The Bailey's Creek system consists of four metered discharge locations all of which discharge to the Bailey's Creek gravity interceptor that is owned by the City of Hopewell. The northernmost discharge point along Old Iron Road discharges to the Hopewell wastewater system which discharges to the Bailey's Creek interceptor in the City of Hopewell. See **Table 4-2** for sewer loadings and system capacity.

The Bailey's Creek system consists of approximately 10.0 miles of gravity sewer ranging in diameter from 8 to 10 inches, and approximately 0.7 miles of force main ranging in diameter from 2 to 4 inches. Pipe age within the system ranges up to approximately 38 years old with gravity sewer materials including DI, and PVC pipe and unknown force main materials.

4.3.3 Manchester Run Wastewater System

The Manchester Run wastewater system consists of a 15-inch to 21-inch gravity interceptor which runs along Manchester Run Creek and collects flow from surrounding developments such as Fountain Ridge, The Meadows, Branchester Lakes, Manchester Mill, and Birchett Estates subdivisions located along Prince George Drive at the intersection of Middle Road. Flow from the Route 10 system is collected by four (4) pump stations, three (3) of which pump into a common force main along Route 10 and discharge into the Manchester Run interceptor at Country View Lane. See **Table 4-2** for sewer loadings and system capacity.

The Manchester Run system consists of approximately 26.3 miles of gravity sanitary sewer ranging in diameter from 8 to 21 inches, 14.4 miles of force main ranging in diameter from 4 to 12 inches, and seven (7) wastewater pump stations. Pipe age within the system ranges up to approximately 40 years old with gravity sewer materials including AC, DI, PVC, and corrugated metal pipe (CMP) and force main materials including DI, HDPE, and PVC.

4.3.3.1 Wastewater Pump Stations

Beechwood Manor Sewer Pump Station (SPS-011) is located 400 feet west of Jenny Creek Drive cul-de-sac in Beechwood Manor subdivision. Wastewater is collected through gravity sewer from the Beechwood Manor subdivision. SPS-011 was constructed in the 1980’s and consists of two submersible grinder pumps. Based upon available information, each pump is understood to pump approximately 200 GPM. The pumps lift wastewater out of an 8 foot diameter wet well and convey flow west through approximately 3,800 linear feet of 6-inch force main to the Jordan on the James subdivision where flow is discharged to gravity along Jordan Parkway and conveyed to SPS-017.

Jordan on the James Sewer Pump Station (SPS-017) is located along the northern side of Jordan Parkway just east of Waters Edge Road in the Jordan on the James subdivision. Wastewater is collected through gravity sewer from the Jordan on the James subdivision. SPS-017 was constructed in 1989 and consists of four Gorman Rupp suction lift pumps (duplex in-series configuration). The concrete building was added at a later date. Each series of pumps is designed to pump approximately 450 GPM at 180 feet TDH. The pumps lift wastewater out of a 6 foot diameter wet well and convey flow south through approximately 7,700 feet of 8-inch force main along Jordan Point Road and ties into a 10-inch common force main along Route 10 and Ruffin Road which conveys flow west and south towards Manchester Run gravity interceptor.

Rivers Edge Sewer Pump Station (SPS-020) is located along the Western side of Buxton Street north of Ridge Road in the Rivers Edge subdivision. Wastewater is collected through gravity sewer from the Rivers Edge subdivision. SPS-020 was constructed in 1997 and consists of two Gorman Rupp suction lift pumps contained in a 12 x 20 foot precast concrete building. Each pump is designed to pump approximately 200 GPM at 80 feet TDH. The pumps lift wastewater out of a 6 foot diameter wet well and convey flow south along Buxton Street through a 6-inch force main. Flow is conveyed through a force main running along Route 10 and Ruffin Road where it eventually discharges to gravity at Manchester Run interceptor.

North Branchester Lakes Sewer Pump Station (SPS-018) is located south of Blair Court and north of Snow Geese Lane in the Branchester Lakes subdivision. Wastewater is collected through gravity sewer from the surrounding Branchester Lakes subdivision. SPS-018 was constructed in 1995 and consists of two Gorman Rupp suction lift pumps contained in a precast concrete building. Each pump is designed to pump approximately 95 GPM at 45 feet TDH. The pumps lift wastewater out of a 6 foot diameter wet well and convey flow east through approximately 1,300 linear feet of 4-inch force main across Branchester Parkway where flow discharges to gravity north of Lake Road.

South Branchester Lakes Sewer Pump Station (SPS-022) is located along the southern side of Takach Road just south of Rachael Court in the Branchester Lakes subdivision. Wastewater is collected through gravity sewer from the surrounding Branchester Lakes subdivision. SPS-022 was constructed in 2000 and consists of two Gorman Rupp suction lift pumps contained in a precast concrete building. Each pump is designed to pump approximately 85 GPM at 61 feet TDH. The pumps lift wastewater out of a 6 foot diameter wet well and convey flow north through approximately 900 linear feet of 4-inch force main along Takach Road where flow discharges to gravity approximately 150 feet north of Silver Fox Lane.

The Meadows Sewer Pump station (SPS-023) is located just south of the Sugar Run Road cul-de-sac in the Meadows subdivision. Wastewater is collected through gravity sewer from The Meadows subdivision. SPS-023 was constructed in 2006 and consists of two Gorman Rupp suction lift pumps contained in a precast concrete building. Each pump is designed to pump approximately 274 GPM at 74 feet TDH. The pumps lift wastewater out of an 8 foot diameter wet well and convey flow west through approximately 9,750 linear feet of 6-inch force main where flow discharges to gravity along Prince George Drive, 750 feet south of Sandy Ridge Road

Eagle Preserve Sewer Pump station (SPS-025) is located in the Eagle Preserve subdivision off Jordan Point Road just south of the Jordan on the James subdivision. Wastewater is collected through an 8-inch gravity submain along Eagle Place Road. SPS-025 was constructed in 2014 and consists of two submersible pumps. Each pump is designed to pump approximately 105 GPM at 180 feet TDH. The pumps lift wastewater out of a 6 foot diameter wet well and convey flow west through approximately 1,700 linear feet of 4-inch force main along Eagle Place Road and ties into an 8-inch common force main along Jordan Point Road.

4.3.4 River Road Wastewater System

The River Road water system is located along River Road at the intersection of I-295 and north along Folar Trail. Currently, the system only serves the Riverside Regional Jail. See **Table 4-2** for sewer loadings and system capacity.

The River Road wastewater system consists of approximately 4,400 linear feet of 6-inch force main and 2,500 linear feet of 10-inch force main. The system also consists of 6-inch to 10-inch gravity main and a private pump station which is owned and operated by the Riverside Regional Jail.

Chapter 5 System Modeling

5.1 General

Models were developed of Prince George County's water and wastewater systems to evaluate system conditions throughout the planning period and to identify improvements required for existing system and to meet future needs. Computer modeling software was used to develop the system models, which were loaded with existing water demands and wastewater loadings provided by Prince George County and calibrated to reflect actual conditions within the County. Future demand projections were developed as described in Chapter 8 and loaded into the model as well to reflect future scenarios within the County.

Brief summaries of the water and wastewater system modeling software packages, model development activities, system loading procedures, assumptions, calibration techniques, and modeling scenarios are provided in the following sections.

5.2 Water Model

Water system modeling activities were conducted utilizing the Innovyze InfoWater Water Distribution Modeling Software. InfoWater is a water distribution system modeling package that includes a complete geographic information management system for water utilities. Its hydraulic analysis engine includes the capability to evaluate storage goals, analyze water quality, determine fire flow goals, and calibrate large distribution networks, making it a useful tool for water system master planning activities.

5.2.1 Model Build

For the purposes of this Water and Wastewater Master Plan, a new water system model was constructed utilizing data from the County's GIS and supplemented by available record drawing information and field verification of above ground features. Elements that were included in the water system model consisted of the following:

- Water distribution lines ranging in diameter from 2" to 24"

- Water storage tanks
- Booster pump stations
- Wells and water supply facilities
- Other source water connections (ARWA, the City of Petersburg, and VAWC)
- Water meter locations (based on address)

Pipe modeling geometry information was based on the GIS geodatabase provided by Prince George County and updated by Dewberry where necessary. The GIS data provided by Prince George included lengths, diameters, pipe material, and year of installation for a minority of the pipes. Additionally, Dewberry updated missing portions of the GIS data utilizing record drawing information provided by Prince George County.

Junctions in the model were created automatically by InfoWater at each change in pipe size, change in pipe direction (such as intersections) and any "break" in the GIS pipes, such as valves. Additional junctions were placed on long stretches of pipe with no junctions to create additional points of analysis for model accuracy. Each junction was assigned an elevation in the model based on 2-foot GIS topography contours provided by Prince George County. These contours were converted to a high resolution raster image from which interpolated elevations were extracted and applied to each junction.

Once the water model was initially built, minor headloss coefficients were assigned to pipes at water facility locations such as storage tanks, pump stations, and water supply facilities.

5.2.2 Existing Water Demands

Baseline demands were estimated based on 2013 water meter data from existing water customers including residents, and commercial/industrial developments. These estimated usages from metered connections were compared with water production and supply data from 2013 to determine the amount of unaccounted for water within each pressure zone or discrepancies with metering demands. Typical sources of unaccounted for water includes unrecorded flushing activities, water leakage in waterlines resulting from aging pipes and loose connection, faulty meters, and unmetered connections. Refer to **Table 5-1** below for a summary of unaccounted water usage within the system.

Table 5-1 Comparison of Prince George Water Billing Data and Production Data (2013)

Pressure Zone	Billing Data (GPD)	Production Data (GPD)	Unaccounted Water Usage (GPD)	Unaccounted Water Usage (%)
Central Low Pressure	114,273	105,405	-8,868	-8%
Central High Pressure	485,418	504,058	18,640	4%
Beechwood	34,809	37,295	2,486	7%
Rivers Edge	18,826	18,220	-606	-3%
Jordan on the James	22,598	27,651	5,053	18%
Prince George Woods	1,765	2,249	484	22%
Cedarwood	15,815	16,278	463	3%
Food Lion	37,846	45,008	7,162	16%
Route 301	34,182	35,004	822	2%
Total	765,531	791,166	25,635	7%

Unaccounted for water usage within the County systems as a whole is within American Water Works Association (AWWA) recommended standard of 10% or less, as recommended by the AWWA Leak Detection and Accountability Committee in 1996. There are a few smaller systems such as Jordon on the James and Food Lion which are above the 10% recommendation. Also, as shown in **Table 5-1**, billing data within the Central low pressure zone and the Rivers Edge pressure zone is higher than production data. In order to determine the cause of the unaccounted for water, Prince George County could perform an audit within these systems.

5.2.3 Model Demand Allocation

Two (2) sets of steady state demands were allocated to the model in order to simulate system conditions under both average and maximum day demands. These demands were allocated in the model to the nearest node based on geo-coded service address for existing consumers or assumed connection points for future development. A detailed summary of system demands is provided in **Chapters 3 and 8**.

Four (4) typical diurnal demand patterns were utilized per AWWA M32 "Computer Modeling of Water Distribution Systems", Third Edition, Figure 6-2. These patterns were incorporated during extended period simulations to model the hourly fluctuations of water usage for each customer type including residential, commercial, industrial, and irrigation. See **Appendix C** for diurnal patterns. Each water demand was assigned one of the four diurnal patterns based upon the customer type provided by Prince George County for each water meter.

5.2.4 Model Calibration

The water distribution system model was calibrated to accurately represent existing function based on available meter billing data and hydrant testing. System operations calibrated as part of this Master Plan include demands, and pipe hydraulic roughness coefficients, and interconnections to adjacent municipalities.

A detailed comparison of Prince George metered demand and billing data was conducted to verify that allocated demands were within an acceptable range. Differences in metered demands on an average basis was assumed to be a result of unmetered water usage such as manual flushing by the County to maintain adequate water quality and/or water loss within the system. As discussed above, unaccounted for water was determined to be within acceptable industry standards and billing data was used as the basis for water demands.

To ensure that a hydraulic model accurately calculates system head loss due to friction, the Hazen Williams pipe roughness coefficients must be estimated for each pipe to account for pipe roughness or friction loss. To aid in model calibration, the piping network was divided into roughness groups based on location, pipe diameter, approximate installation date, and available pipe material information. Each roughness group was assigned an initial pipe roughness coefficient based on best engineering judgment, with the final pipe roughness coefficients being determined during the automated calibration process. InfoWater utilizes an iterative algorithm to adjust the pipe roughness coefficients of the roughness groups to best fit the hydrant test data given the system features and demand inputs.

Finally, the points of interconnection to adjacent municipalities (the City of Petersburg, ARWA, and VAWC) were modeled in various configurations based on available information provided by adjacent municipalities. At most connections, this included a fixed head reservoir. Water supply sources for each system which operate on wells were modeled in steady state scenarios as fixed head reservoirs with fixed pressure pumps to simulate hydro-pneumatic tanks. Wells which pump directly into the water system were modeled as fixed capacity pumps.

5.2.5 Model Scenarios

Once the model was calibrated, steady-state and expended period simulations (EPS) were run for each of the time increments (2015, 2020, 2025, 2035, and 2045) within the planning period to evaluate system improvement goals and identify Water and Wastewater Master Plan Projects.

Steady-state fire flow analysis was first completed to assess the system’s ability to respond to a two (2) to three (3) hour fire event, as specified by Prince George County, during maximum day system demands while maintaining a minimum system wide pressure of 20 psi. Fire events were simulated in each water system at nodes nearest each fire hydrant location, based on GIS data provided by the County which was confirmed when hydrant testing. Commercial, residential, and industrial fire flows were simulated at strategic locations throughout the system to confirm system adequacy. Based on direction by the County, fire flows were modeled as indicated in **Table 6-1**.

Following the steady state fire flow analysis, extended period simulations for a 60 day period, using average day demands, were performed to evaluate water age for the surface water source systems. The surface water source system included the Central water system supplied by ARWA and the Johnson Road water system supplied by the City of Petersburg. All other decentralized systems were evaluated utilizing steady state scenarios only.

By evaluating the adequacy of the system at each time increment through the planning period, the timing of individual project goals was determined. This analysis led to the development of the water system improvement program that is described in detail in **Chapter 9**.

5.3 Wastewater Model

Wastewater system modeling activities were conducted utilizing the Innovyze InfoSewer Modeling Software. InfoSewer is a sanitary modeling package that provides extensive scenario and facility management functionalities that make it a useful tool for analyzing existing and proposed sewer collection systems and their growth over time.

5.3.1 Model Build

For the purposes of this Master Plan, a new sewer system model was built, utilizing data from the County's GIS. Included in the system model developed for this Master Plan were the following elements:

- Gravity sewer lines 8-inches in diameter or greater (trunk sewer system), as determined to be necessary for accurate modeling
- Sanitary sewer pump stations
- Force main piping 6-inches in diameter or greater from County and privately owned pump stations

Note that individual grinder pumps which utilize low pressure force mains were not individually modeled to reduce model complexity. Grinder pump demands were grouped together and modeled as a single pump stations in accordance with **Table 3** found in **Appendix C**. It was assumed that each individual grinder pump station operated at approximately 10 GPM.

5.3.2 Existing Sewer Loadings

Similar to water demands, sewer loadings were estimated based on billing data from existing water customers whose discharge to the sewer system was assumed to be equal to their water demand. County sewer loadings also consisted of select "flat rate" customers whose assumed daily discharge to the sewer system was approximately 156 GPD.

In addition to flows in the sewer collection system that result from water consumption, other sources of unaccounted sewer flow can occur within the system. One major contributor to additional flow is inflow and infiltration (I&I). Inflow results from open point sources that allow direct surface water to flow into the system, such as an open cleanout or manhole cover. Infiltration results from ground water that seeps through the sewer pipes at lose connections, poorly constructed joints or manhole connections, and old pipe.

Similar to water demand projections, it is necessary to apply a peak hour factor to the sewer flows in the system to account for a reasonable amount of I&I and variation of flows throughout the day for sizing of existing and future wastewater infrastructure. This peak factor was determined using the Harmon Peaking Equation which calculates the peak factor based upon the upstream flow being received by the pipe and determining the population by which that flow corresponds as seen below:

$$\text{Peak Factor} = 1 + (14/(4+P^{1/2}))$$

Where,
P= Population = Average daily flow / 100 GPD

The equivalent population was determined by dividing the average daily flow by an assumed 100 GPD/capita, based on the Virginia Department of Environmental Quality Sewage Collection and Treatment Regulations.

5.3.3 Model Loading

Average Daily loadings were allocated to the model and peaked using the Harmon Peaking Equation in order to assess system capacity. These loadings were allocated in the model to the nearest manhole based on geo-coded service address for existing consumers or assumed connection points for future development. A detailed summary of system demands is provided in **Chapters 4 and 8**.

5.3.4 Model Calibration

Dry weather sewer loadings, based on billing data, were used in the model as baseline loadings. Loading calibration included a comparison of Prince George billing data and metered discharge location data. The difference between billing data and metered data was assumed to be a result of I&I. These unaccounted for loadings were uniformly distributed to each system in order to account for the excess flows. It should be noted that the Harmon Peaking Equation used to calculate peak hourly loadings also accounts for a reasonable amount of I&I within a system during a peak hour event. A detailed I&I investigation was not conducted as part of this master plan and would be needed to more accurately calibrate peak sewer loadings.

5.3.5 Model Scenarios

Analyses were run for each of the time increments (2015, 2020, 2025, 2035, and 2045) within the planning period to evaluate system improvement goals and identify Master Plan projects. The peak hour steady state analysis was used to evaluate system capacity during a peak hour event.

By evaluating modeled system flows at each of the time increments, the timing of individual project goals was determined. This analysis led to the development of the wastewater system improvement program that is described in detail in **Chapter 8**.

Chapter 6 Existing Water System Evaluation

6.1 General

This chapter of the master plan evaluates the existing condition of each water system and presents improvements to address any deficiencies. Each service area and water system will be discussed separately.

6.1.1 Existing Water System Evaluation

As discussed in Chapter 5 of this report, a model of the County's water distribution system was used to evaluate domestic pressures, fire flow availability, and water age to assess the existing condition of the system. Water storage was also evaluated for each system to determine if existing available storage is adequate to meet peak daily demands and fire flow goals.

Minimum domestic pressures and fire flow availability were evaluated under a maximum day demand scenario while water age was evaluated under an average day demand scenario. Steady-State scenarios were used to simulate minimum domestic pressures and extended period scenarios (EPS) were used to simulate water age. Both EPS and steady state scenarios were used to evaluate fire flow availability.

Goals for both fire flow and domestic pressures were provided by the Prince George County Engineering and Utilities Department through coordination with the Prince George County Director of Fire, EMS, and Emergency Management to establish a minimum baseline for evaluation purposes. Minimum domestic pressures were assumed to be acceptable when above 35 psi. Fire flow availability is assumed to be acceptable when meeting the following goals:

Table 6-1 Prince George County Fire Flow Goals

Fire Flow Type	Flow (GPM)	Duration (Hours)
Residential	1,000	2
Commercial	2,000	2
Industrial[1]	2,000	2

1. Based on initial guidance received from the Prince George County Fire Director, a fire flow goal of 3,500 GPM for a duration of 3 hours was set for the Southpoint Business Park. After initial modeling and evaluation of fire flow availability, it was determined that this was not feasible with the existing infrastructure and this goal was changed to match the commercial fire flow of 2,000 GPM for 2 hours. Prince George may wish to pursue the 3,500 GPM goal for industrials areas with future infrastructure improvement projects.

Water age analysis was only conducted for surface water systems (Central system and Johnson Road system) as water quality concerns with high water age are typically associated with surface water systems. Additionally, the well systems in Prince George County are very small and it is assumed that water age is not an issue. For the water age analysis in each of the surface water systems, water entering the Prince George system was assumed to have a baseline water age of zero. Based on information received from ARWA's engineer, the estimated water age at the point of connection at the Temple Avenue connection was 3 to 6 hours. The estimated water age at the point of connection to the Johnson Road system is unknown.

When evaluating water storage, both equalization storage and fire flow storage were totaled to determine the minimum storage required for each system. Equalization storage is needed for a system to meet daily peak demands and should be equal to approximately 30-40 percent of the maximum day demand over 24 hours per AWWA Manual of Water Supply Practices M31. Fire flow storage is based upon the fire flow goals stated above in **Table 6-1**, and is equal to the fire flow over the duration of the fire flow event. Additionally, VDH has a system storage requirement of 200 gallons per Equivalent Residential Connection (ERC). An ERC is defined as having a demand of 400 gallons per day (GPD). The AWWA standard resulted in a more conservative storage requirements; therefore, it was used for the storage evaluation. A summary of available water storage and storage requirements for each system can be found in **Table 6-2** below.

Table 6-2 Existing Water Storage Evaluation

System	Available Storage (Gallons)	Required Storage (Gallons)	Surplus/Deficit (Gallons)
Johnson Road	500,000	256,800	243,200
Route 301	625,000	260,600	364,400
Cedarwood	25,000	129,500	-104,500*
Central	1,500,000	551,900	948,100
Food Lion	1,000,000	262,800	737,200
River's Edge	10,000	131,300	-121,300*
Jordan on the James and Beechwood Manor	156,000	154,500	1,500

*Water facility is unable to meet fire flow goals due to inability to provide 2 hours of 1,000 GPM residential fire flow storage (120,000 gallons) in addition to system demands.

6.1.2 Water System Improvements

After evaluating and identifying system deficiencies based upon the above criteria, the water model and condition assessment were utilized to evaluate system improvements. These improvements are discussed in each water system improvements section.

Water facility evaluations were completed in a separate condition assessment during the time of the master plan. The results of this condition assessment which include deficiencies, suggested improvements, and associated budget level cost estimates for each water facility can be found in **Appendix B**.

6.2. Johnson Road Service Area

The water model and condition assessment were utilized to evaluate existing system conditions and identify any deficiencies.

6.2.1 Johnson Road Existing Water System Evaluation

In order to evaluate minimum domestic pressures in the Johnson Road system, a minimum tank level of 14.5 feet below tank overflow was set based upon the lag pump on level. The connection point to the Petersburg system located along Johnson Road was set to a fixed head of 250 feet based upon static pressure readings at the nearest hydrant to the connection location. The booster pumps located in the column of the elevated storage tank were inactive during this steady state scenario. As shown in **Figure 6-1**, minimum domestic pressures under these conditions were estimated to be greater than 60 psi in the high pressure zone of the system which is above the minimum 35 psi standard.

A separate scenario was run in which both booster pumps were turned on to estimate minimum pressures on the low pressure line. Based on the results of this analysis, with two pumps on, the minimum pressure is approximately 20 psi just upstream of the pumps. Since there are no connections to the low pressure line, 20 psi is acceptable as it meets the minimum required VDH system pressure.

Both commercial and residential fire flows were simulated in the Johnson Road water system corresponding to the fire flow goals found in **Table 6-1**. One of the booster pumps located in the column of the Johnson Road elevated storage tank were assumed to be on as the facility has an emergency generator. The elevated storage tank levels were initially set at 17.5 feet below the tank overflow based upon the maximum level of fire storage. As shown in **Figure 6-2**, the Johnson Road system meets all fire flow availability goals.

To evaluate water age within the Johnson Road water system, a 60 day extended period simulation was performed under average day demand conditions. Based on available information, the pump on level was set to 14.5 feet below overflow elevation and the pump off level was set to 1 foot below overflow elevation indicating a working volume of 13.5 feet. The Johnson Road elevated storage tank was assumed to have complete mixing in the model due to the existing Tideflex mixing system. As shown in **Figure 6-3**, the results indicate high water age throughout the system. High water age within the system is a cause of poor turnover within the elevated storage tank and low demand within the system. With a baseline water age of 0 days at the point of connection, the water age within the low pressure waterline was approximately 8 days and the water age in the high pressure service area was between 18 to 21 days. Based on available information, it is difficult to predict the water age at the point of connection; however, since the connection point is at the end of the Petersburg system, it is assumed that the starting water age is a minimum of 5 days. This means that the water age at the end of the Johnson Road system is over 25 days. County staff have indicated that low chlorine residual is present in some parts of the water system, which is assumed to be due to the high water age.

6.2.2 Johnson Road Water System Improvements

As discussed above, the Johnson Road water system meets all requirements for minimum domestic pressures and fire flow availability. However, the system has fairly high water age, which is mainly a function of low system demand and the single inlet/outlet pipe configuration at the tank. Therefore, it is recommended that the County install an automatic flusher at the end of Fairway Drive to help improve water turnover throughout the system. It is also recommended that the pump controls be adjusted to increase the tank operating range to maximize tank turnover. The pump on level should be set at 14.5 feet to allow for fire storage and the pump off level should be set to 28 feet (1 foot below the overflow elevation).

Based upon the condition assessment of the Richard Bland elevated storage tank, minimal deficiencies were found which affect the operation of the elevated storage tank. It is recommended that the County address critical deficiencies identified in **Appendix B**.

6.2.3 Fort Hayes Existing Water System Evaluation

The Fort Hayes water system is a very small system with only a short public water main and was not evaluated as part of this master plan.

6.3 Route 301 Service Area

The water model and condition assessment were utilized to evaluate existing system conditions and identify any deficiencies.

6.3.1 Route 301 Existing Water System Evaluation

In order to evaluate minimum domestic pressures in the Route 301 system, a steady state analysis was run assuming a minimum tank level of 25 feet below overflow elevation which was the minimum level recorded during hydrant testing. Note that the elevated storage tank level is dictated by the well system hydro-pneumatic tanks as discussed in section 3.3.1. The Days Inn, Hampton Inn, and Howard Johnson water supply facilities were inactive during this analysis. As shown in **Figure 6-1**, minimum domestic pressures under these conditions were approximately 53 psi, which is above the minimum 35 psi standard.

Commercial fire flows were simulated in the Route 301 water system corresponding to the fire flow goals found in **Table 6-1**. The Days Inn, Hampton Inn, and Howard Johnson water supply facilities were assumed to be off during a fire event because there is no backup generator to provide power in an emergency situation. The Route 301 elevated storage tank initial level was set to 13 feet below overflow elevation. This is the recommended minimum level to provide fire storage which meet the commercial fire flow goals. As shown in **Figure 6-2**, the Route 301 system meets all fire flow availability goals.

During the review of hydrant testing data and associated tank level recordings, it appeared that the altitude valve on the tank inlet/outlet line was not set up correctly and may be closing the tank inlet/outlet line during normal operation. It is recommended that the County conduct a detailed investigation of this control valve to ensure that it is set correctly to provide the required flow and pressure during normal operating conditions as well as during a fire event. The altitude valve may also be bypassed as altitude valves on a single tank system are not recommended in order to provide an overflow in the event of a supply pump control malfunction.

6.3.2 Route 301 Water System Improvements

As discussed above, the Route 301 water system meets all requirements for minimum domestic pressures and fire flow availability.

During field investigation there appeared to be a few locations (i.e. tank overflow/drain) that showed signs of excessive scaling, which is typically a result of hard water. Additionally, based on the hydrant testing and model calibration, the average Hazen Williams C Value was estimated at 100, which greatly reduces pipe capacity. This is much lower than was expected for this piping as it was installed approximately 10 years ago. The low C values could be due to scale build up which has occurred on the inside of the pipes which effectively reduces the pipe diameter. It is recommended that the County investigate the functionality of the existing water supply facility water softening systems and determine if a scale build up is present within the pipes. If scaling is present, it is recommended that the County look into options, such as pigging, for reducing the scale buildup.

As seen in **Appendix B**, the condition assessment identified many critical deficiencies to the Days Inn and Hampton Inn water facilities. It is recommended that the critical deficiencies be addressed to improve the facility conditions and safety concerns. It is understood that Prince George County is in the process of adding a SCADA system for automatic control of the water facilities to operate based upon the elevated storage tank levels. It is recommended that minimal maintenance and improvements of the hydro-pneumatic tanks at the water facilities are performed based upon the recommendation of removing the tanks from service and installing controls for automatic operation.

6.3.3 Cedarwood Existing Water System Evaluation

In order to evaluate minimum domestic pressures in the Cedarwood system, a steady state analysis was run with the hydro-pneumatic tank located at the Cedarwood water supply facility set to a pressure of 40 psi based upon operation information. As shown in **Figure 6-1,** minimum domestic pressures under these conditions were approximately 36 psi which is above the minimum 35 psi standard.

Residential fire flows were simulated in the Cedarwood water system corresponding to the fire flow goals found in **Table 6-1**. The Cedarwood water supply facility was assumed to have one booster pump out of service during the fire flow analysis. As shown in **Figure 6-2**, the Cedarwood system does not meet the fire flow availability goals. Fire flow pumping capacity and water storage are inadequate at the Cedarwood water supply facility to supply 1,000 GPM for 2 hours. The Cedarwood water system is assumed to have a fire flow availability of 140 GPM equaling the capacity of the single booster pump in service.

6.3.4 Cedarwood Water System Improvements

Currently, the Cedarwood system is limited by both pumping and storage capacity, as seen in **Table 6-2**, to provide fire flow availability which meet the goals set in **Table 6-1**. Future improvements in Chapter 9 include connecting the Cedarwood system to the Central system to provide adequate fire flow and water storage.

Based upon future recommendations, it is anticipated that the Cedarwood water facility will be operational for some time until it is connected with the Route 301 water system. Therefore, it is recommended that both critical and secondary deficiencies identified in the condition assessment found in **Appendix B** are addressed to improve the facility's operation.

6.4 Central Service Area

The water model and condition assessment were utilized to evaluate existing system conditions and identify any deficiencies.

6.4.1 Central Existing Water System Evaluation

In order to model minimum domestic pressures in the high pressure zone of the Central system, the minimum operation level of each tank was estimated based on pressure recorder data that was gathered over a three month period. During this time, a minimum hydraulic grade line of 264 feet (approximately 22 feet below tank overflow) was observed. This level was used as the minimum tank level for modeling minimum domestic pressures in the Central system. The Central System booster pump station was off for this analysis. As shown in **Figure 6-4**, minimum domestic pressures were approximately 49 psi in the high pressure service area, which is above the minimum 35 psi standard.

Minimum domestic pressures in the low pressure service area along Temple Avenue between the ARWA connection point and the booster pump station were evaluated separately with two pumps on at the Central System booster pump station. As shown in **Figure 6-4,** minimum domestic pressures were approximately 25 psi in the low pressure service area, which is below the minimum 35 psi standard. Low pressures just upstream of the Central System booster pump station are present when the Central System booster pump station turns on and causes high head loss through the 16-inch transmission main along Temple Avenue. Significant elevations changes ranging from approximately 40 feet at Puddledock Road up to 100 feet east of River Road which also contribute to low pressures found east of River Road. It should be noted that the areas in which pressures were below the 35 psi standard were closer to the Central System booster station in an area in which there are minimal customers currently connected to the system.

The model was used to simulate fire flow availability within the Central water system and compared to the fire flow goals found in **Table 6-1**. Initial tank levels for the three elevated storage tanks were set to 13 feet below tank overflow elevation. This is the recommended minimum level to provide fire storage which meet the commercial fire flow goals. It should be noted that based on pressure recorder data, the tank levels dropped below this level periodically as there presently is no way to control the pump operation based on tank level. The Central System booster pump station was assumed to have two pumps on as it is equipped with three booster pumps and an emergency generator. Fire flow availability for the high pressure service area of the Central system is shown in **Figure 6-5 and Figure 6-6.** Select residential neighborhoods such as Birchett Estates, Manchester Mill, Lee Acres, Commonwealth Acres, and Rolling Meadows have limited fire flow due to small diameter waterline sizes less than 8-inches.

Fire flow availability in the low pressure service area along Temple Avenue between the ARWA connection point and the booster pump station was evaluated separately with the Central System booster pump station off. The Central System booster pump station manual bypass valve was assumed to be open to allow flow from the high pressure zone. The Colonial Heights elevated storage tanks was assumed to be at 12 feet below overflow elevation (200 feet HGL), based on available information provided for system operation. Fire flow availability for the low pressure zone of the Central system is as shown in **Figure 6-5.** Generally, fire flow availability on branches off the 16-inch line along Temple Avenue do not meet commercial fire flow goals.

To evaluate water age within the Central water system, a 60 day extended period simulation was performed under average day demand conditions. Two compartment mixing was assumed for the three (3) elevated storage tanks during the simulation since none of the tank have mixing systems. The Central System booster pump station was turned on twice daily being controlled by a 5 foot working volume in the Middle Road elevated storage tank of 18 and 23 feet below overflow elevation. As shown in **Figure 6-7**, water age within the majority of the central water system is generally less than 7 days with the exception of the Southpoint Business Park. Maximum water ages in the Southpoint area are approximately 18 days at the end of dead end lines and range from 7 to 14 days in transmission lines surrounding the business park. No known water quality concerns are present in the system therefore it is assumed that the water age is within acceptable limits.

6.4.2 Central Water System Improvements

Before evaluating improvements projects, system operation optimization was first evaluated to minimize infrastructure upgrades. In order to generally increase fire flow throughout the high pressure zone as well as reduce water age throughout the Southpoint area, it is recommended that the Central System booster pump station be controlled by maintaining a minimum tank level of 13 feet below overflow elevation in the Southpoint elevated storage tank and utilizing a larger working volume. Note that all fire flow availability shown in F**igures 6-5 and 6-6** assume this maintained minimum tank level. It is understood that Prince George County is in the process of evaluating a SCADA system implementation which will allow the control of the booster pumps based on tank level. The associated SCADA system is not included as a cost estimate in this master plan.

The majority of the fire flow availability deficiencies found throughout the system are a function of under sized waterlines or inadequate looping. In order to meet the fire flow goals in these residential areas, the following improvements are recommended:

1. Upsize existing 8-inch waterline along the Baxter Road connection from Commonwealth Acres to Courthouse Road to 12-inch. Upsize existing 6-inch waterlines in Commonwealth Acres to 8-inch. (wCEN-CI-01)
2. Upsize existing 6-inch waterlines in Lee Acres to 8-inch. (wCEN-CI-02)
3. Upsize existing 6-inch waterlines in Rolling Meadows and Hidden Oaks to 8-inch. (wCEN-CI-03)
4. Upsize existing 6-inch waterlines in Manchester Mill to 8-inch. (wCEN-CI-04)
5. Upsize existing 4-inch and 6-inch waterlines in Birchett Estates to 8-inch. (wCEN-CI-05)
6. Install 8-inch and 12-inch waterline loops off Puddledock Road. (wCEN-CI-06)
7. Upsize existing 8-inch waterlines along River Road to 12-inch. (wCEN-CI-07)

Improvements to increase low pressures west of River Road in the low pressure service area are recommended in future phases by extending the high pressure zone north along Jefferson Park Road and Temple Avenue up to and including River Road.

As seen in **Appendix B**, many deficiencies were identified in the condition assessment for the three elevated storage tanks within the Central system. It is recommended that both critical and secondary deficiencies be addressed to improve facility condition, safety, and operation as the elevated storage tanks are anticipated to be in commission for the duration of the planning period. The Central System booster pump station is anticipated to be decommissioned in future phases of this master plan. It is recommended that minimal maintenance and capital cost be expended on the booster pump station and only critical deficiencies be addressed.

6.4.3 Food Lion Existing Water System Evaluation

In order to evaluate minimum domestic pressures in the Food Lion system, a steady state analysis was run with the hydro-pneumatic tank located at the Food Lion Distribution Center water supply facility set to a pressure of 50 psi based upon operation information. As shown in **Figure 6-2,** minimum domestic pressures under these conditions were approximately 50 psi which is above the minimum 35 psi standard.

Commercial, and industrial fire flows were simulated in the Food Lion system assuming the largest booster pump out of service at the Food Lion water supply facility. Fire flow in this system is currently limited to the pumping capacity of the smallest pump in service equaling 180 GPM. While the Food Lion water supply facility does not have the pumping capacity to meet fire flow goals, it should be noted that the Food Lion Distribution Center has a separate fire system with a direct connection to the 1.0 MG ground storage tank. However, the remaining Food Lion water service area has inadequate fire protection due to the small booster pump size with the exception of Standard Motor Products near the intersection of Route 156 and Route 460 which has a fire system tank which provides fire protection. It should be noted that JEJ Moore, which is the County's designated emergency shelter, currently does not meet the fire flow goals found in **Table 6-1**.

6.4.4 Food Lion Water System Improvements

In order to provide fire flow availability which meet the goals set in **Table 6-1**, improvements to the Food Lion water supply facility are recommended. Based on available information, the two booster pumps are rated for 180 GPM and 750 GPM. Both pumps are inadequate to provide the 2,000 GPM fire flow goal for commercial developments. In order to provide the fire flow goal, the County could either install pumps to provide a 2,000 GPM firm pumping capacity (i.e. capacity with largest pump out of service) or connect the Food Lion water system to the Central system via a 12-inch water line along Route 460. The connection to the Central system would allow for lower pumping requirements (1,000 GPM firm capacity) and would provide for additional storage and a redundancy to both systems. The existing well would either be taken offline or converted to chloramines by installing an ammonia feed system. It is recommended that the Food Lion water system be connected to the Central water system, as seen in **Figure 6-6**, due to the benefits described above.

Based upon the above recommended improvements, both critical and secondary deficiencies identified in the condition assessment found in **Appendix B** are recommended for the Food Lion water facility due to extended service life.

6.4.5 Prince George Woods Existing System Evaluation

The Prince George Woods water system was not evaluated using modeling as part of this master plan.

6.4.6 River Road Existing System Evaluation

The River Road water system was not evaluated using modeling as part of this master plan.

6.5 Route 10 Service Area

The water model and condition assessment were utilized to evaluate existing system conditions and identify any deficiencies.

6.5.1 River's Edge Existing Water System Evaluation

Minimum domestic pressures were evaluated in this system by running a steady state analysis scenario with the Bicors, and Liverman water supply facility hydro-pneumatic tanks operating at minimum pressure set points based upon operational data provided by Prince George County as seen below:

Water Supply Facility	Hydro-pneumatic Tank Set point
Bicors	40
Liverman	44

As shown in **Figure 6-8**, minimum domestic pressures under these conditions were approximately 38 psi, which is above the minimum 35 psi standard.

Residential fire flows were simulated in the River's Edge water system and compared to the fire flow goals found in **Table 6-1**. As shown in **Figure 6-9**, the River's Edge system does not meet the fire flow availability goals. The Bicors and Liverman water supply facilities both have inadequate pumping and fire flow storage capacity to supply a fire flow of 1,000 GPM for 2 hours.

The River's Edge water system is assumed to have a maximum fire flow availability of 210 GPM equaling the capacity of the combined well pumps at the Bicors and Liverman water supply facilities. However, since neither facility has a permanent generator with an ATS, it is not guaranteed that even this flow would be available at all times.

6.5.2 River's Edge Water System Improvements

To meet fire flow availability goals, the Rivers Edge water system needs additional pumping capacity and water storage. A minimum water storage capacity of 131,300 gallons as seen in **Table 6-2** is required to meet fire flow availability goals and equalization storage requirements. In order to meet this storage requirement, the construction of an elevated tank will be required in the future as discussed in Chapter 9. In addition to these improvements, existing waterlines within the River's Edge system will need to be upsized to meet fire flow availability goals. These waterline upgrades will be discussed in Chapter 9 as they will not increase fire flow availability until storage capacity is increased.

As discussed above, the River's Edge system is anticipated to be connected to the Jordan on the James/Beechwood Manor system, elevated storage tank, and Route 10 water supply within the planning period. Therefore it is recommended that minimal improvements are conducted for the extensive deficiencies found in the Bicors and Liverman Drive water facilities identified in the condition assessment found in **Appendix B.** Critical deficiencies should be addressed as necessary to accommodate for operation through the service life of the facilities.

6.5.3 Jordan on the James/Beechwood Manor Existing Water System Evaluation

Minimum domestic pressures were evaluated in this system by running a steady state analysis scenario with the Lemonwood, and Jordan on the James water supply facility hydro-pneumatic tanks operating at minimum pressure set points based upon operational data provided by Prince George County as seen below:

Water Supply Facility	Hydro-pneumatic Tank Set point
Lemonwood	50
Jordan on the James	48

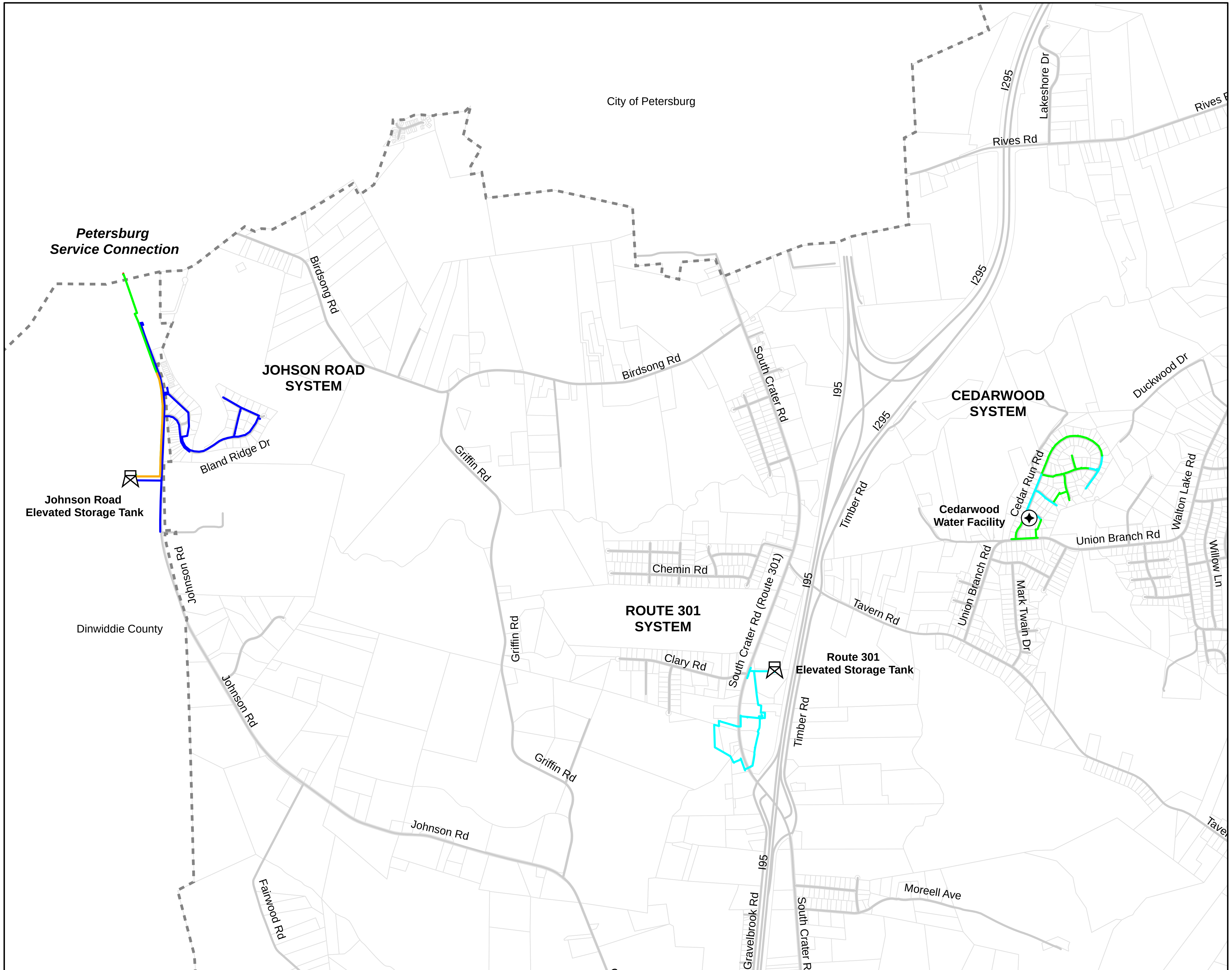
As shown in **Figure 6-8**, minimum domestic pressures under these conditions were approximately 38 psi, which is above the minimum 35 psi standard.

Residential fire flows were simulated in the Jordan on the James/Beechwood Manor water system and compared to the fire flow goals found in **Table 6-1**. As shown in **Figure 6-9**, the system does not meet the fire flow availability goals. The Lemonwood and Jordan on the James water supply facilities both have inadequate pumping capacity to supply 1,000 GPM for 2 hours. The water system is assumed to have a fire flow availability of 409 GPM equaling the firm pumping capacity of both facilities.

6.5.4 Jordan on the James/Beechwood Manor Water System Improvements

As discussed in the River's Edge system improvements section, the construction of an elevated storage tank within the Route 10 service area is anticipated within the planning period to meet fire flow availability goals. Refer to Chapter 9 for additional details. Existing waterlines within the Jordan on the James/Beechwood Manor system will also need to be upsized to meet fire flow availability goals.

Both the Jordan on the James and Lemonwood water facilities have extensive and costly deficiencies identified in the condition assessment, found in **Appendix B,** which will need to be improved to extend their service life. The Jordan on the James/Beechwood Manor water system is anticipated to be connected to a Route 10 water source from VAWC within the planning period. Therefore, it is recommended that the Jordan on the James and Lemonwood water facilities be decommissioned at that time and that only critical deficiencies are addressed as necessary to accommodate for operation through the service life of the facilities.



Legend

- Road Centerlines
- Tax Parcels
- Jurisdictional Boundaries
- Pump Station
- Water Supply Facility
- Elevated Storage Tank

Minimum Pressure

- Less Than 20 psi
- 20 - 35 psi
- 35 - 45 psi
- 45 - 60 psi
- Greater Than 60 psi

Key Plan

FIGURE NO. 6-1

TITLE JOHNSON ROAD/ROUTE 301 MINIMUM DOMESTIC PRESSURES

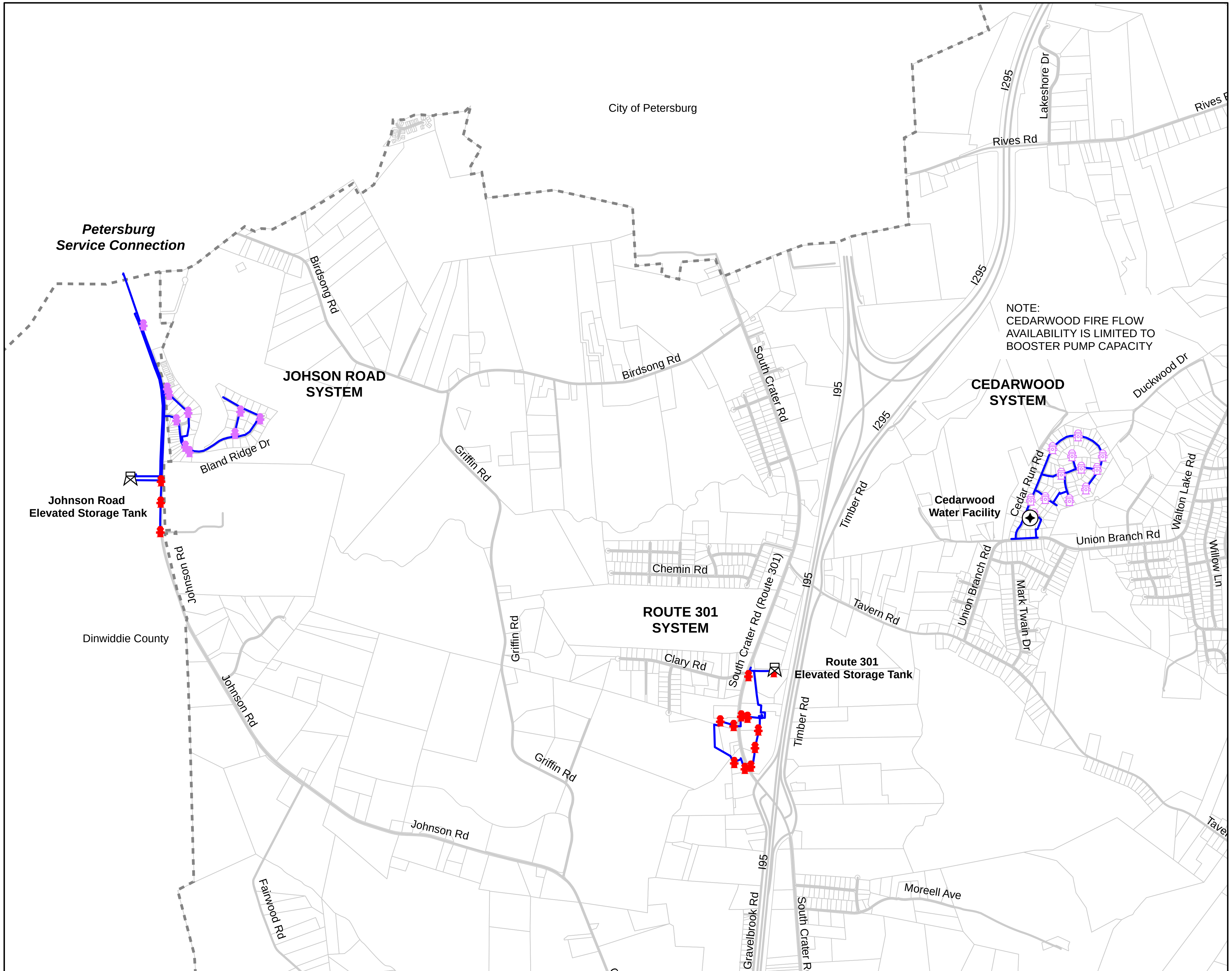
PROJECT WATER & WASTEWATER MASTER PLAN PRINCE GEORGE COUNTY, VA

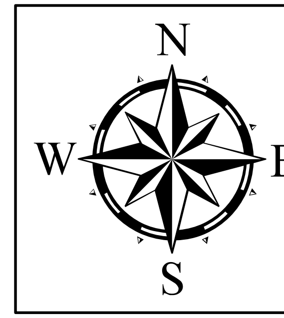
SCALE 1 inch = 2,000 feet

DATE 01/2016

PROJ. NO. 50068442

Dewberry
Dewberry Engineers Inc.
4805 LAKE BROOK DRIVE, SUITE 200
GLEN ALLEN, VIRGINIA 23060
PHONE: 804.290.7957
FAX: 804.290.7928





Legend

- Tax Parcels
- Road Centerlines
- Jurisdictional Boundaries

Fire Flow Goals

- Does Not Meet Goal
- Meets Goal

Fire Flow Type

- Residential
- Commercial
- Industrial
- Existing Waterlines
- Ground Storage Tanks
- Elevated Storage Tanks
- Water Supply Facility
- Booster Pump Station

Key Plan

FIGURE NO. 6-2

TITLE JOHNSON ROAD/ROUTE 301 FIRE FLOW AVAILABILITY

PROJECT WATER & WASTEWATER MASTER PLAN PRINCE GEORGE COUNTY, VA

SCALE 1 inch = 2,000 feet

DATE 01/2016

PROJ. NO. 50068442

Dewberry
Dewberry Engineers Inc.
4805 LAKE BROOK DRIVE, SUITE 200
GLEN ALLEN, VIRGINIA 23060
PHONE: 804.290.7957
FAX: 804.290.7928

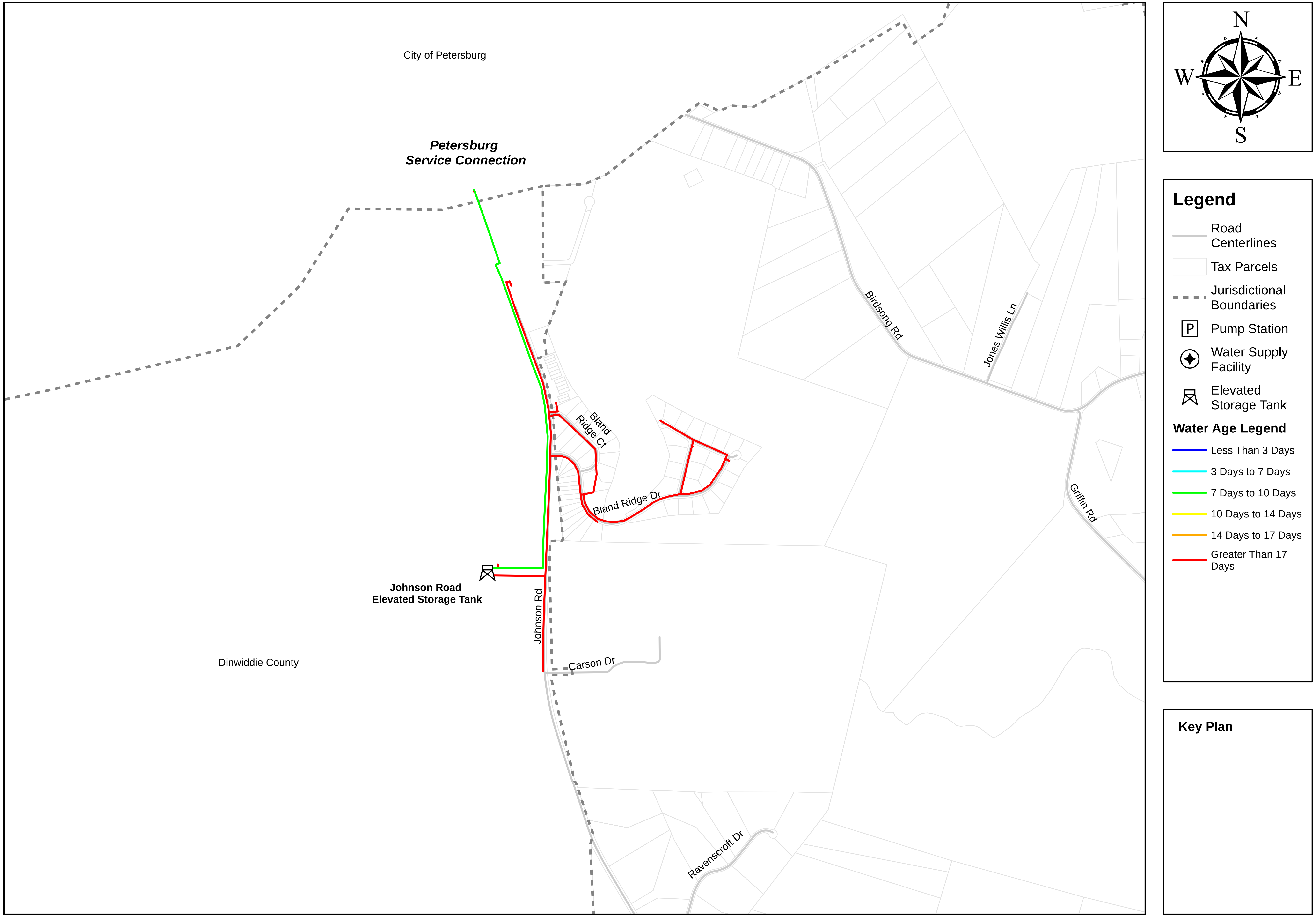


FIGURE NO. 6-3

TITLE JOHNSON ROAD SYSTEM WATER AGE

SCALE 1 inch = 1,000 feet

PROJECT WATER & WASTEWATER MASTER PLAN PRINCE GEORGE COUNTY, VA

DATE 01/2016

PROJ. NO. 50068442

Dewberry
Dewberry Engineers Inc.
4805 LAKE BROOK DRIVE, SUITE 200
GLEN ALLEN, VIRGINIA 23060
PHONE: 804.290.7957
FAX: 804.290.7928

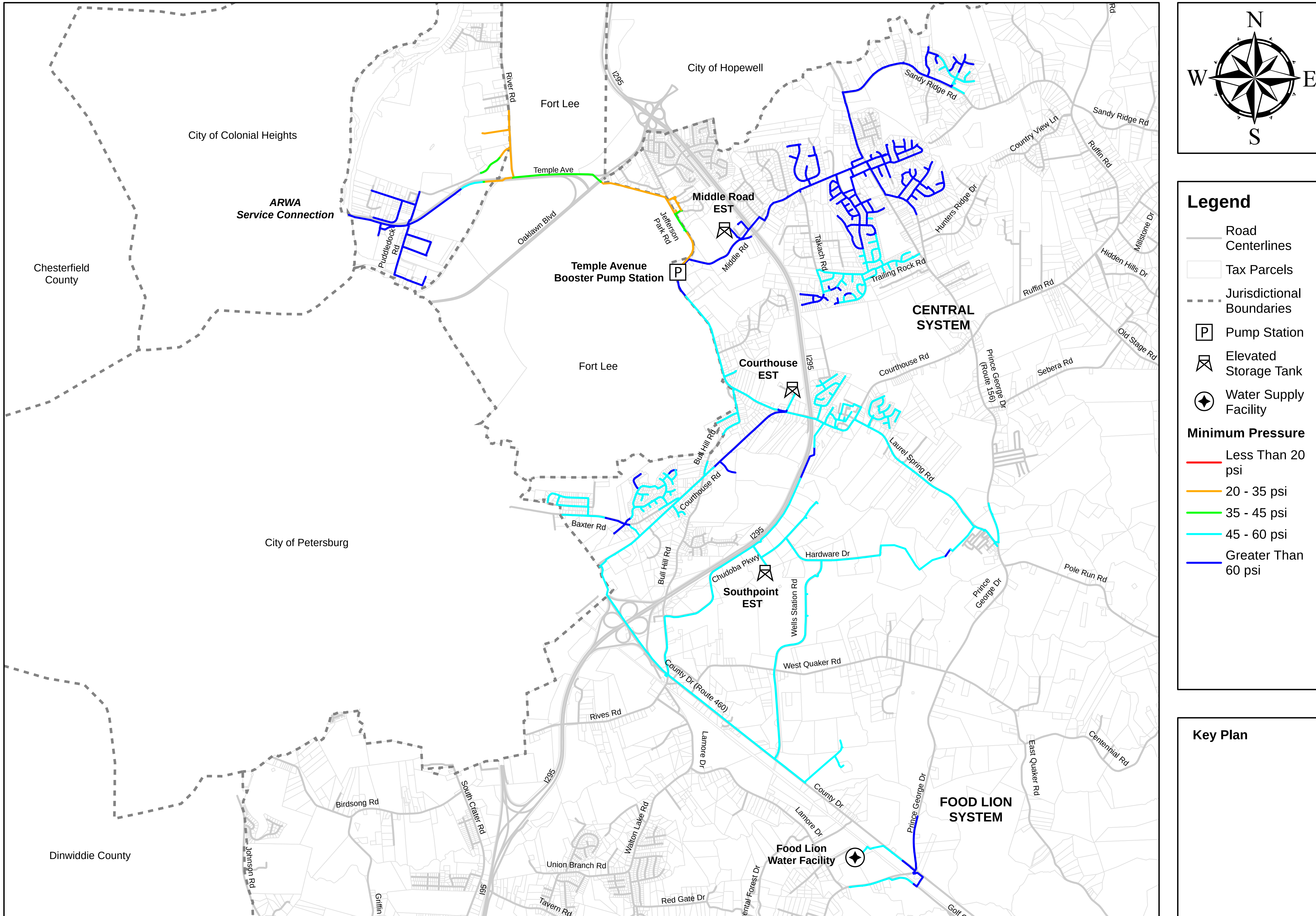


FIGURE NO. 6-4

TITLE
CENTRAL SERVICE AREA
MINIMUM DOMESTIC PRESSUERS

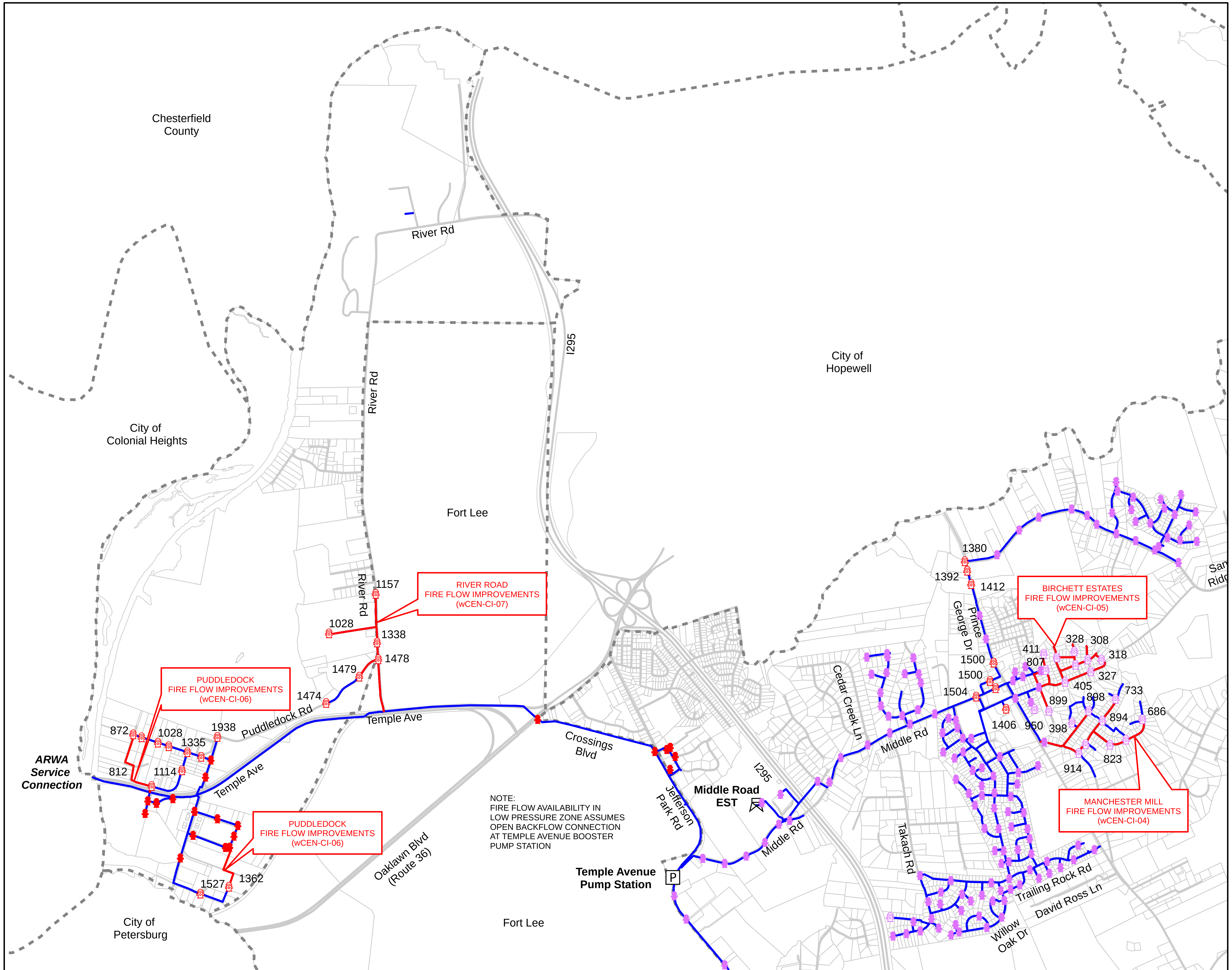
SCALE
1 inch = 5,000 feet

PROJECT
WATER & WASTEWATER MASTER PLAN
PRINCE GEORGE COUNTY, VA

DATE
01/2016

PROJ. NO.
50068442

Dewberry
Dewberry Engineers Inc.
4805 LAKE BROOK DRIVE, SUITE 200
GLEN ALLEN, VIRGINIA 23060
PHONE: 804.290.7957
FAX: 804.290.7928



N W E S

Legend

- Tax Parcels
- Road Centerlines
- Jurisdictional Boundaries

Fire Flow Goal

- Does Not Meet Goal
- Meets Goal

Fire Flow Type

- Residential
- Commercial
- Industrial
- Existing Waterlines
- Ground Storage Tanks
- Elevated Storage Tanks
- Water Supply Facility
- Booster Pump Station

Key Plan

FIGURE NO. 6-5

TITLE CENTRAL SERVICE AREA FIRE FLOW AVAILABILITY

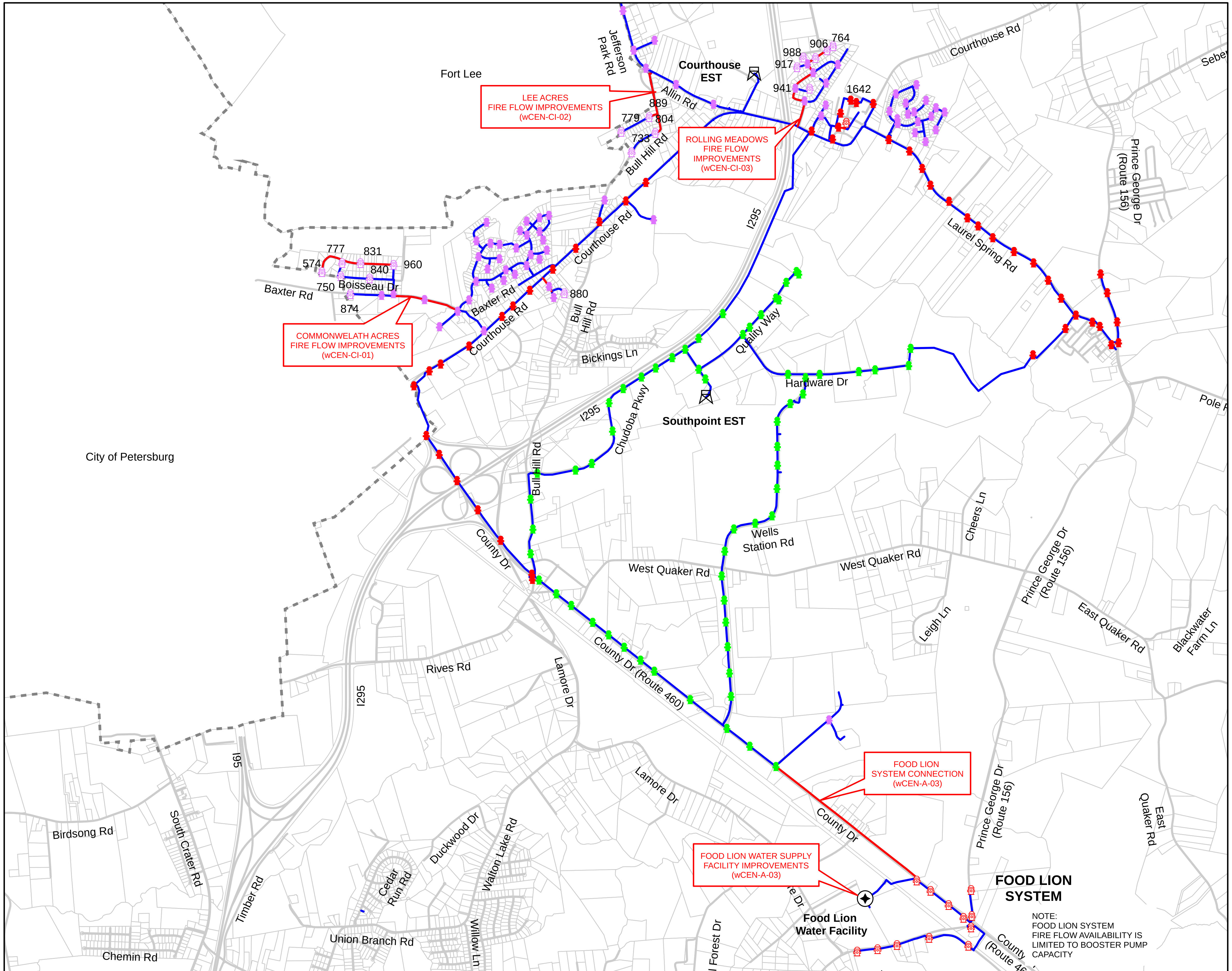
SCALE 1 inch = 3,000 feet

PROJECT WATER & WASTEWATER MASTER PLAN PRINCE GEORGE COUNTY, VA

DATE 01/2016

PROJ. NO. 50068442

Dewberry
Dewberry Engineers Inc.
4805 LAKE BROOK DRIVE, SUITE 200
GLEN ALLEN, VIRGINIA 23060
PHONE: 804.290.7957
FAX: 804.290.7928



N
W E
S

Legend

- Tax Parcels
- Road Centerlines
- Jurisdictional Boundaries

Fire Flow Goal

- Does Not Meet Goal
- Meets Goal

Fire Flow Type

- Residential
- Commercial
- Industrial
- Existing Waterlines
- Ground Storage Tanks
- Elevated Storage Tanks
- Water Supply Facility
- Booster Pump Station

Key Plan

FIGURE NO. 6-6

TITLE: CENTRAL SERVICE AREA FIRE FLOW AVAILABILITY

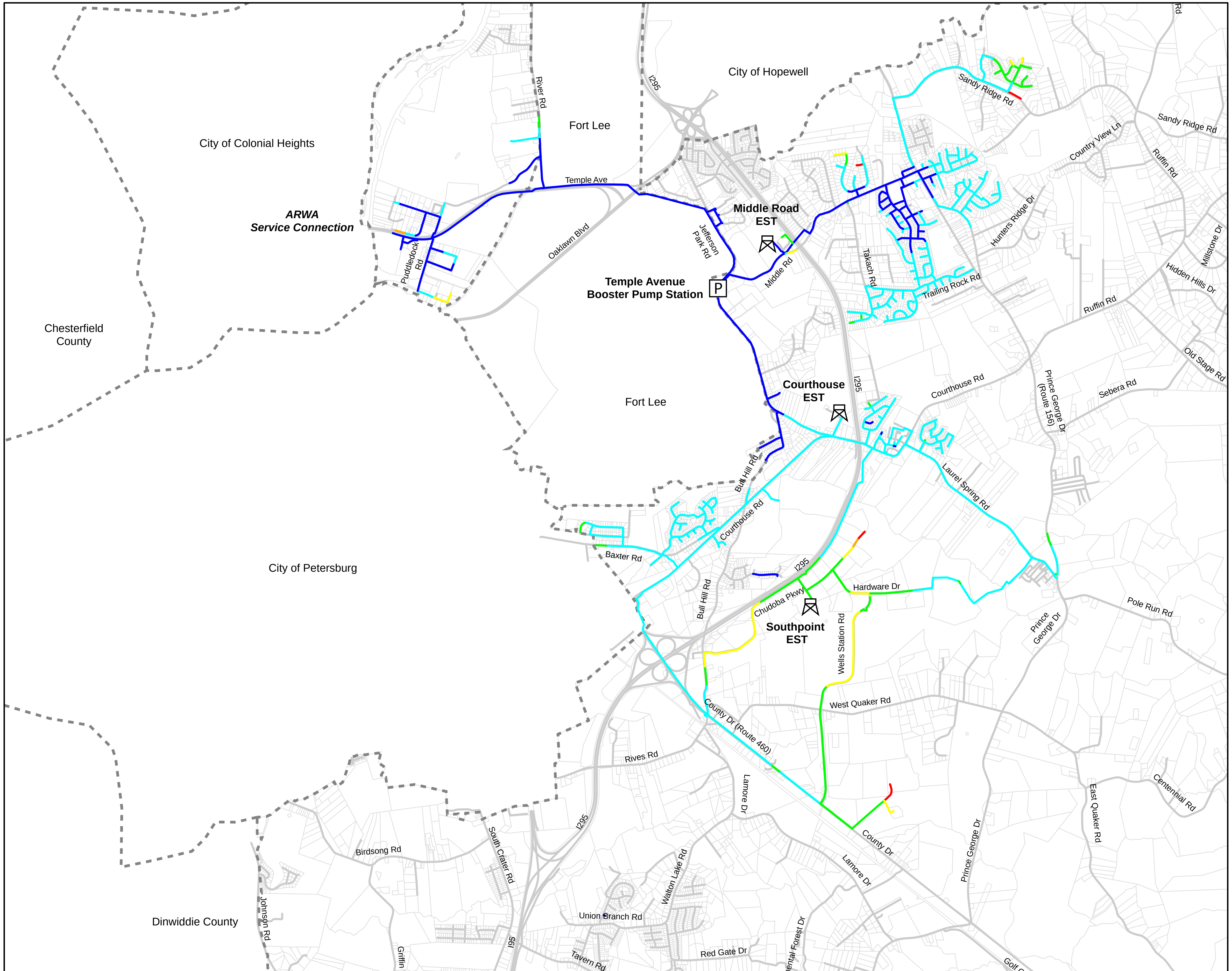
PROJECT: WATER & WASTEWATER MASTER PLAN PRINCE GEORGE COUNTY, VA

SCALE: 1 inch = 3,000 feet

DATE: 01/2016

PROJ. NO. 50068442

Dewberry
Dewberry Engineers Inc.
4805 LAKE BROOK DRIVE, SUITE 200
GLEN ALLEN, VIRGINIA 23060
PHONE: 804.290.7957
FAX: 804.290.7928



Legend

- Road Centerlines
- Tax Parcels
- Jurisdictional Boundaries

Water Age

- Less Than 3 Days
- 3 Days to 7 Days
- 7 Days to 10 Days
- 10 Days to 14 Days
- 14 Days to 17 Days
- Greater Than 17 Days
- P Pump Station
- Elevated Storage Tank

Key Plan

FIGURE NO. 6-7

TITLE: CENTRAL SYSTEM WATER AGE

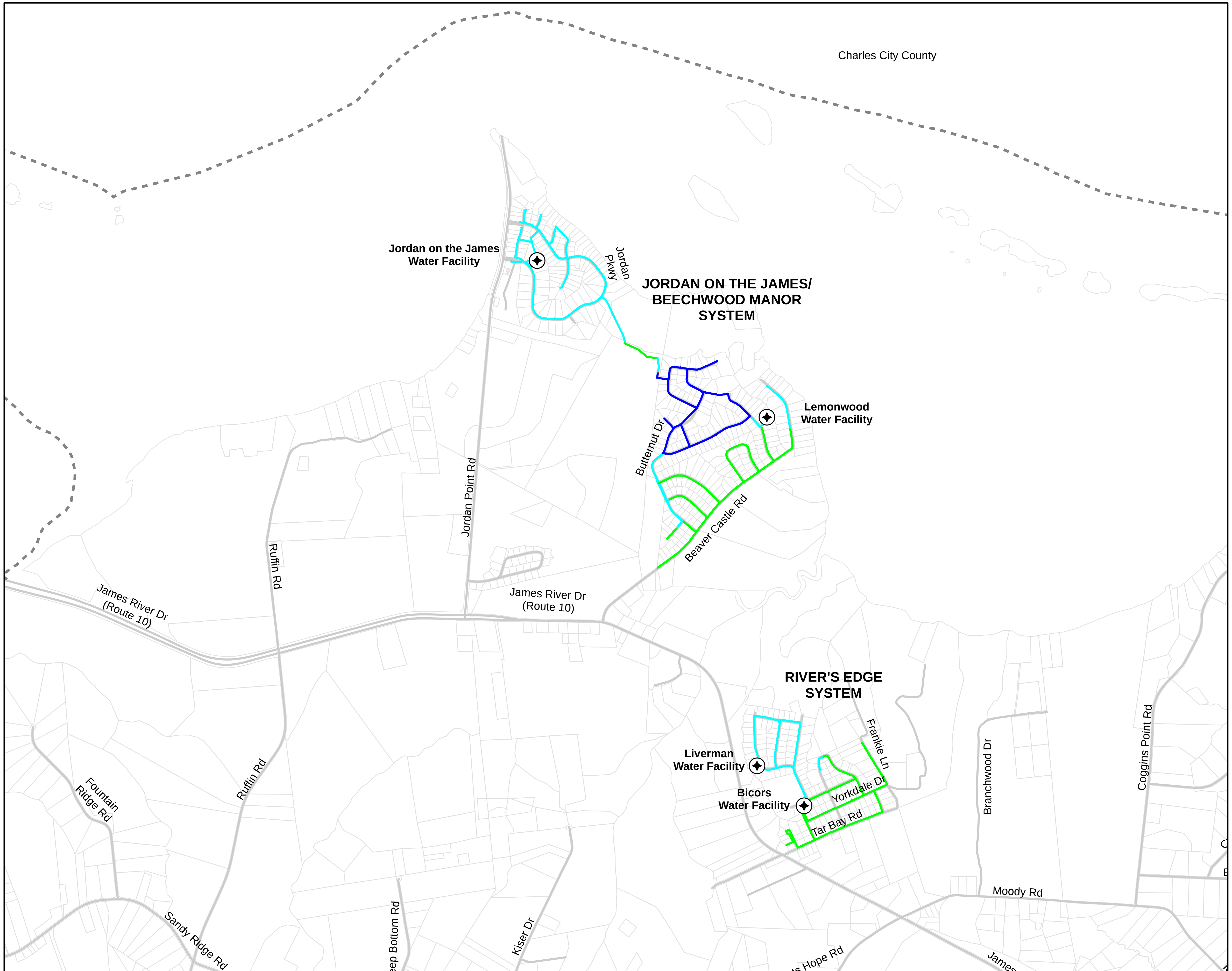
PROJECT: WATER & WASTEWATER MASTER PLAN PRINCE GEORGE COUNTY, VA

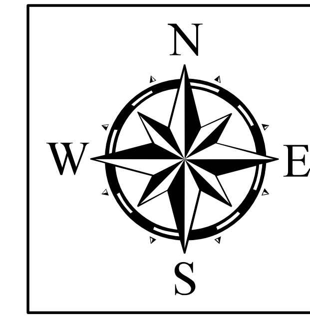
SCALE: 1 inch = 5,000 feet

DATE: 01/2016

PROJ. NO. 50068442

Dewberry
Dewberry Engineers Inc.
4805 LAKE BROOK DRIVE, SUITE 200
GLEN ALLEN, VIRGINIA 23060
PHONE: 804.290.7957
FAX: 804.290.7928





Legend

- Road Centerlines
- Tax Parcels
- Jurisdictional Boundaries
- Pump Station
- Water Supply Facility
- Elevated Storage Tank

Minimum Pressure

- Less Than 20 psi
- 20 - 35 psi
- 35 - 45 psi
- 45 - 60 psi
- Greater Than 60 psi

Key Plan

FIGURE NO. 6-8

TITLE ROUTE 10 SERVICE AREA MINIMUM DOMESTIC PRESSURES

SCALE 1 inch = 2,000 feet

PROJECT WATER & WASTEWATER MASTER PLAN PRINCE GEORGE COUNTY, VA

DATE 01/2016

PROJ. NO. 50068442

Dewberry

Dewberry Engineers Inc.
4805 LAKE BROOK DRIVE, SUITE 200
GLEN ALLEN, VIRGINIA 23060
PHONE: 804.290.7957
FAX: 804.290.7928

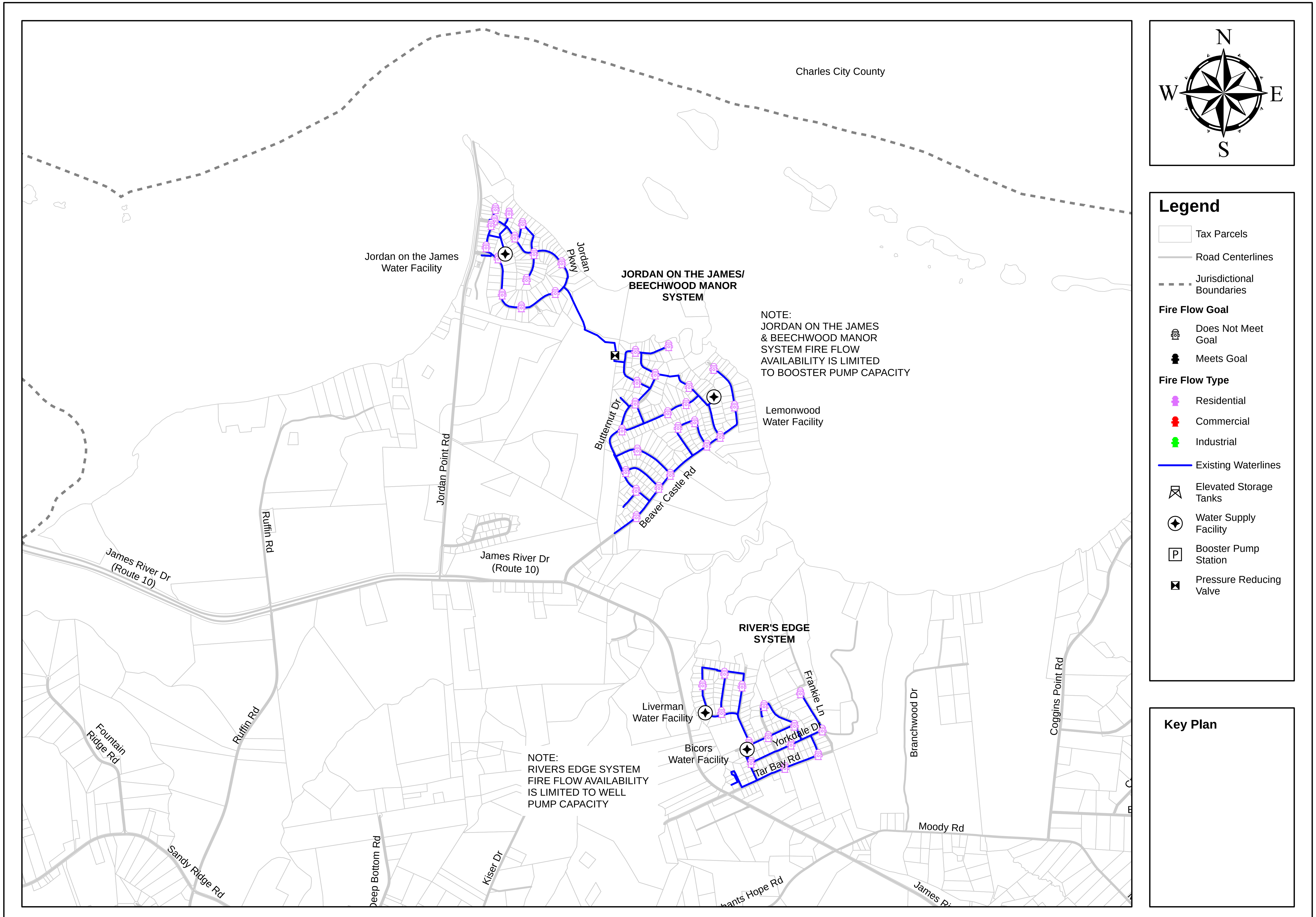


FIGURE NO. 6-9

TITLE
ROUTE 10 SERVICE AREA
FIRE FLOW AVAILABILITY

SCALE
1 inch = 2,000 feet

PROJECT
WATER & WASTEWATER MASTER PLAN
PRINCE GEORGE COUNTY, VA

DATE
01/2016

PROJ. NO.
50068442

Dewberry
Dewberry Engineers Inc.
4805 LAKE BROOK DRIVE, SUITE 200
GLEN ALLEN, VIRGINIA 23060
PHONE: 804.290.7957
FAX: 804.290.7928