# Chapter 7 Existing Wastewater System Evaluation

## 7.1 General

This chapter of the master plan evaluates the existing condition of each wastewater system and presents improvements to address any deficiencies.

## 7.1.1 Existing Wastewater System Evaluation

As discussed in Chapter 5 of this report, a model of the County's wastewater collection system was used to evaluate capacity of pump stations, force mains, and gravity sewer to assess the condition of the existing system. All scenarios were evaluated under a peak hourly demand scenario. It should be noted that additional remaining capacity is given in average day demands for easier comparison.

Pump station capacity was evaluated as a percentage by dividing the modeled pumping capacity of the pump station by the incoming peak hourly flow. The modeled capacity of each pump station was determined based on the wastewater system model results. For common force main systems, each pump station within the system was assumed to be pumping simultaneously with the largest pump out of service. The pump station's design capacity was based upon the pump station's original design capacity, which may be different from the modeled capacity based on actual system conditions. See **Table 7-2** at the end of this chapter for a summary of existing pump station capacity.

The capacity of pump stations, force mains, and gravity sewer was determined to be adequate if the peak hourly flow was less than 80% of the rated capacity. Note that force main capacity was evaluated as a function of the pump station capacity. The 80% capacity rule is a general rule of thumb to allow time for the planning, design, and construction of upgrades as needed for capacity improvements.

Based upon a comparison of billing data and metered discharge locations, it appears that certain wastewater systems may have I&I issues. As seen below in **Table 7-1**, the Route 301 and Route

460 systems experience higher flows at the metered discharge locations compared to the billing data (based on wastewater meter readings), which may indicate an external loading source to the system such as I&I, but could also indicate some metering inaccuracies.

Discharge	Metered Discharge Locations Average	Billing Data Average Daily	Unaccounted Wastewater	Unaccounted Wastewater			
Location	Daily Loadings <sup>1</sup> (GPD)	Loadings (GPD)	(GPD)	(%)			
Prince George Petersburg / SCWWA Service Area							
Johnson Road	27,000	25,300	1,700	6%			
Route 301	168,000	94,200	73,800	44%			
Route 460	507,000	392,900	114,100	23%			
Puddledock	18,800	23,600	-4,800	-26%			
Prince George HRWTF Service Area							
Route 36	57,400	53,200	4,200	7%			
Bailey's Creek	133,200	140,900	-7,700	-6%			
Manchester Run	310,200	289,700	20,500	7%			

Table 7-1 Comparison of Billing Data vs. Metered Discharge Locations

1. Per metered data collected from April 2012 to March 2013 at discharge locations.

#### 7.1.2 Existing Wastewater System Improvements

After evaluating and identifying system deficiencies based upon the above criteria, the wastewater model was utilized to model existing system improvements. Improvements are discussed in each wastewater system section below. In order for Prince George County to more accurately evaluate the flow discrepancies above, it is recommended that an in depth evaluation be conducted to identify areas of high I&I within the Route 301 and Route 460 service areas.

Wastewater 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 wastewater facility can be found in **Appendix B.** Each pump station was given a prioritization time frame based

upon age, safety conditions, reliability, service area, and operational issues which should be followed to address deficiencies.

#### 7.2 Petersburg Discharge Service Area

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

#### 7.2.1 Johnson Road Existing Wastewater System Evaluation

As shown in **Figure 7-1**, both the gravity sewer system and SPS-007 have adequate capacity for the collection and conveyance of existing wastewater flows to the City of Petersburg. SPS-007 is currently at 22% of its rated design and modeled capacity.

#### 7.2.2 Johnson Road Wastewater System Improvements

There are no system improvements necessary based upon the capacity of the existing gravity sewer and force mains within the Johnson Road wastewater system. It should also be noted that no future development is projected within the wastewater system during the planning period, therefore future system improvements will not be discussed for the Johnson Road system in Chapter 10.

SPS-007 is anticipated to continue to serve the Johnson Road service area for the duration of the planning period. Therefore, it is recommended that the County address all deficiencies for the pump station identified by the condition assessment found in **Appendix B** within 5- 10 years.

#### 7.2.3 Route 301 Existing Wastewater System Evaluation

As shown in **Figure 7-1**, the gravity sewer system and all pump stations, with the exception of SPS-016, within the Route 301 system have adequate capacity for the collection and conveyance of existing wastewater flows from this system to the City of Petersburg. SPS-006 has some additional capacity and is operating at approximately 60% of its rated capacity. SPS-008, which serves the Wildwood neighborhood, is estimated to be at operating 83% of capacity, however

this is considered acceptable since its service area is at full build-out. The 12-inch gravity trunk main south of SPS-006 along Route 301 has a maximum remaining capacity of approximately 41,000 GPD of average daily loading.

Based on modeled results, SPS-016, which serves the Cedarwood subdivision, is significantly over the modeled capacity (243%) but slightly under the design capacity (92%). The modeled scenario included an operating condition in which one pump was operating each at the Cedarwood pump station (SPS-016) and Wildwood pump station (SPS-008) and up to six (6) grinder pumps on within the Huckleberry Hills low pressure sewer system. All of these pumps were pumping into the common 6-inch force main along Union Branch Road. It appears that SPS-016 was designed without taking into account SPS-008 and the additional grinder pump stations pumping into the 6-inch common force main which conveys wastewater west towards Route 301. It is recommended that the County further investigate the operation of SPS-016 to determine if a capacity upgrade is required.

#### 7.2.4 Route 301 Wastewater System Improvements

As discussed above, all gravity sewer and force mains within the Route 301 system have adequate capacity to meet existing demands and do not require improvements to increase capacity at this time. However, critical deficiencies of the existing condition of pump station facilities within the Route 301 area have been identified by the condition assessment found in **Appendix B**. Both SPS-006 and SPS-016 contain critical deficiencies involving the exposure of the building and equipment within the pump station to sewer gases, not meeting the requirements for an explosion proof area. These deficiencies cause unsafe working environments and will need to be addressed. SPS-006 is anticipated to be in service for the duration of the planning period and SPS-016 is anticipated to be in service until late in the planning period. It is recommended that the pump stations are rehabilitated according to the actions outlined in the condition assessment. Minimal critical deficiencies have been identified for SPS-008 which require the immediate action of the County.

#### 7.2.5 Route 460 Existing Wastewater System Evaluation

As shown in **Figure 7-1**, the gravity sewer system and all pump stations within the Route 460 system have adequate capacity for the collection and conveyance of existing wastewater flows to the City of Petersburg. All pump stations within the system are under 50% of their rated capacity. Overall, the Route 460 system has adequate capacity for existing sewer loadings.

#### 7.2.5.1 Capacity Areas of Concern

#### Southpoint Business Park

Significant future industrial demands are projected within the Southpoint Business Park. In order to plan for capital investment within this area, the capacity of the existing infrastructure was determined. Currently, the existing wastewater system has a capacity which is limited by both the 12-inch gravity main located along Route 460 and pump stations SPS-021 and SPS-024. As shown in **Figure 7-1**, the 12-inch gravity main along Route 460 north of Rives Road is at 50% capacity and has an additional 94,000 GPD of average day loading before reaching 80% capacity. As shown in **Table 7-2**, SPS-021 and SPS-024 have significantly lower modeled pumping capacities than their design capacity. It is appears that this reduced modeled pumping capacity is due to changing head conditions from the originally designed pumping conditions from both pump stations pumping simultaneously into the common force main. Using the modeled capacity, SPS-021 is operating at approximately 37% capacity with an additional remaining average day capacity of approximately 57,500 GPD and SPS-024 is operating at approximately 44% capacity with additional remaining average day capacity of approximately 44,100 GPD.

#### 7.2.6 Route 460 Wastewater System Improvements

As discussed above, all gravity sewer, force mains, and pump stations have adequate capacity to meet existing demands and do not require improvements to increase capacity. The majority of pump stations within the service area contain minimal critical deficiencies identified in the condition assessment found in **Appendix B** including SPS-001, SPS-003, SPS-004, SPS-021, and SPS-024. It is recommended that critical deficiencies are addressed for these pump stations. Other pump stations such as SPS-009, SPS-010, SPS-015, and SPS-019 are in fair to poor condition and require pump replacements and new buildings as well as other critical improvements

outlined in the condition assessment. As outlined in the condition assessment, SPS-002 is one of the oldest pump stations in the County, in very poor condition, and requires the complete replacement with a duplex suction lift pump station. It is recommended that minimal improvements are conducted on SPS-002 to maintain operation until it is decommissioned with the construction of gravity sewer routed to the Blackwater Swamp interceptor discussed in Chapter 10. Similarly for other older pump stations within the Route 460 system such as SPS-002, SPS-003, SPS-009, SPS-010, and SPS-015 it is recommended that only critical deficiencies are addressed to maintain operation until their decommission.

#### 7.2.6 Puddledock Existing Wastewater System Evaluation

As shown in **Figure 7-2**, the gravity sewer system and SPS-014 within the Puddledock system have adequate existing capacity for current flows. While the system currently has adequate capacity, the existing system leaves limited additional capacity for future development within the collection system. Improvements to the Puddledock service area will be discussed in Chapter 10 for the future build out of the Puddledock system.

#### 7.2.7 Puddledock Wastewater System Improvements

As discussed above, future improvements are recommended for the Puddledock service area to increase capacity within the conveyance system. SPS-014 currently has critical deficiencies outlined in the condition assessment, found in **Appendix B.** It is recommended that minimal improvements are conducted on SPS-014 to maintain operation until the regional Puddledock pump station is constructed and SPS-014 is taken offline.

#### 7.2.8 Flank Road Wastewater System Improvements

The Flank Road wastewater system is very small with a short run of public gravity sewer and was not evaluated as part of this master plan.

## 7.3 Hopewell Discharge Service Area

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

## 7.3.1 Route 36 Existing Wastewater System Evaluation

As shown in **Figure 7-2** the Route 36 system has adequate capacity to meet existing flows with the exception of SPS-005. The pump station is currently operating above its design firm pumping capacity during estimated peak hourly flows. In order to meet peak demands, it is assumed that both pumps would have to operate simultaneously which eliminates pump redundancy. It is recommended that a study be conducted to verify actual pumping capacity and the flows entering the pump station during peak events to determine if pump upgrades are required.

## 7.3.2 Route 36 Wastewater System Improvements

Currently SPS-005 is located within the median which creates an unsafe working area. It is recommended that the pump station be improved according to the condition assessment found in **Appendix B**. Additional capacity should be added to the SPS-005 upon the relocation of the pump station from the median if determined to be required by the above referenced study. SPS-012 is identified in poor condition and should be improved as outlined in the condition assessment.

## 7.3.3 Bailey's Creek Existing Wastewater System Evaluation

As shown in **Figure 7-2**, the Bailey's Creek system has adequate capacity for current wastewater flows. There are no public pump stations within the system and all gravity sewer mains are currently below 50% of the rated capacity. Minimal future development is projected within the Bailey's Creek system and capacity within the system is adequate for projected future flows during the planning period. Therefore, the Bailey's Creek system will not be discussed in Chapter 10 for future system improvements.

#### 7.3.4 Bailey's Creek Wastewater System Improvements

As discussed above, there are no improvements needed to the Bailey's Creek system as all gravity sewer and force mains have adequate capacity to meet future flows projected during the planning period.

#### 7.3.5 Manchester Run Existing Wastewater System Evaluation

As shown in **Figure 7-2**, the Manchester Run system has adequate capacity for current wastewater flows. Pump Stations SPS-018 and SPS-022 within the Branchester Lakes subdivision are currently operating between 50 and 60 percent of their modeled capacity. Both pump stations serve isolated residential areas without projected future development and remaining capacity is adequate for existing flows.

#### Manchester Run Interceptor Capacity

All flow within the Manchester Run system is collected into the Manchester Run interceptor which runs along Manchester Run Creek. The interceptor currently has a significant amount of additional capacity with approximately 1.15 MGD of additional average day capacity within the 21-inch gravity interceptor before reaching 80% capacity.

#### Route 10 Capacity

All flow within the Route 10 service area is conveyed through a common force main system with 8-inch to 12-inch force mains which SPS-020, SPS-017, and SPS-025 pump into. These pump stations are the limiting factor for capacity within the Route 10 service area. With the recent addition of SPS-025 to the common force main system, SPS 017 and SPS-020 have slightly reduced capacities than previously, but there is still capacity available. Additional development allocated to the common force main system through the addition of another pump station will further reduce capacity of the existing pump stations and the addition of any new pump stations to the common force main should be studied carefully to ensure that the existing pump station operations would not be negatively affected. It should be noted that SPS-011 in Beechwood Manor and SPS-020 in River's Edge both have adequate capacity for the addition of wastewater loadings from the existing parts of their neighborhoods that are currently not served. Using the

modeled capacity, SPS-011 is operating at approximately 36% capacity with an additional remaining average day capacity of approximately 49,200 GPD and SPS-020 is operating at approximately 44% capacity with additional remaining average day capacity of approximately 45,800 GPD.

#### 7.3.6 Manchester Run Wastewater System Recommendations

All gravity sewer, force mains, and pump stations currently have adequate capacity and do not require improvements to increase capacity. The majority of pump stations within the service area contain minimal critical deficiencies identified in the condition assessment found in **Appendix B** including SPS-011, SPS-018, SPS-020, SPS-022, and SPS-023. SPS-017 contains critical deficiencies including the exposure of the building and equipment within the pump station to sewer gases creating an area which does not meet Occupational Safety and Health Administration (OSHA) explosion proof requirements and is an unsafe working environment. The pump station is also in overall poor condition and should be improved according to the condition assessment.

## 7.3.7 River Road Existing Wastewater System Evaluation

The River Road wastewater system was not evaluated as part of this master plan.

Sewer Pump Station (SPS)	Design Capacity** (GPM)	Modeled Capacity** (GPM)	Average Daily Flow <sup>(1)</sup> (GPD)	Peak Hour Factor <sup>(2)</sup>	Peak Hourly Flow (GPM)	Design Capacity	Modeled Capacity
001 <sup>3</sup>	350	543	85,176	3.84	227	65%	42%
002*3	200	200	10,022	4.24	30	15%	15%
003 <sup>3</sup>	555	461	83,087	3.85	222	40%	48%
0043	200	262	39,700	4.02	111	55%	42%
005*	138	138	57,436	3.94	157	114%	114%
006	660	678	168,103	3.64	425	64%	63%
007	350	344	26,530	4.10	76	22%	22%
0084	230	196	59,881	3.93	164	71%	83%
009	680	744	94,382	3.82	250	37%	34%
010	350	390	75,136	3.88	202	58%	52%
011*	200	200	25,483	4.11	73	36%	36%
012	233	236	6,018	4.30	18	8%	8%
013	150	120	24,246	4.12	69	46%	58%
014	120	153	23,636	4.12	68	56%	44%
015	235	230	42,127	4.01	117	50%	51%
0164	118	45	38,802	4.03	109	92%	243%
0175	450	369	48,393	3.98	134	30%	36%
018	95	113	22,458	4.13	64	68%	57%
019	156	158	23,089	4.12	66	42%	42%
0205	200	162	13,221	4.21	39	19%	24%
0216	350	248	32,094	4.07	91	26%	37%
022	85	116	22,203	4.13	64	75%	55%
023	274	352	16,767	4.17	49	18%	14%
0246	350	218	33,821	4.06	95	27%	44%
0255	102	97	24,653	4.11	70	69%	73%

**Table 7-2 Existing Pump Station Capacity** 

\*\* See section 7.1.1 for an explanation of the difference between Design Capacity and Modeled Capacity.

\* Modeled as a fixed capacity pump because pump performance curve was not available.

<sup>(1)</sup> Per 2013 Billing Data adjusted to account for metered flow data.

<sup>(2)</sup> Per Harmon Equation as discussed in Section 8.3

<sup>(3)</sup> Modeled pumping into common force main within the Route 460 system with one pump on

<sup>(4)</sup> Modeled pumping into common force main within the Route 301 service area with one pump on

<sup>(5)</sup> Modeled pumping into common force main within the Route 10 Service Area with one pump on

<sup>(6)</sup> Modeled pumping into common force main within the Southpoint Business Park with one pump on















# **Chapter 8 Future Demand Projections**

## 8.1 General

Future conditions in Prince George County were evaluated to identify water and wastewater system improvements required to meet future needs associated with the projected growth of population within the Prince George Planning Area (PGPA).

This Master Plan addresses future conditions and identifies required water and wastewater system improvements based on the development and geographic distribution of population and demand projections throughout the PGPA for the planning period, which is defined as the Years 2015 through 2045. Note that data from January 2013 to December 2013 was used as the baseline year for demand projections for Year 2015, since this time frame was the latest year that complete data was available when the demand projections were developed.

Proposed projects are based on projections and will need to be adjusted based on actual growth patterns within the PGPA. This is particularly true of any project more than 3 years in the future.

## 8.2 Development of Future Water Demands

Several workshops were held with Prince George County staff to develop the future development projections. During these workshops, areas of anticipated future growth were identified, such as residential neighborhoods, industrial parks, and commercial developments and timeframes as to when those areas would need water and sewer service. The percentage of development for each growth area at each time step was determined by Prince George County staff and is reflected in the future water demand projections. Each development area was assigned a development density based on anticipated future land use zoning. Additional resources including the I-295 and I-95 New Service Area Evaluation, and the Independence Village Plan were used as well for previously planned development areas.

## 8.2.1 Residential Water Demands

Several factors were utilized to calculate future residential water demands, including the useable area of each growth area, anticipated land use zoning density, and information contained in the 2012 Comprehensive Plan Update. For each anticipated development, an assumed percentage of developable area was applied to account for various features throughout the County, such as water bodies, wetlands, poor soils, or extreme elevation changes.

The residential areas were assumed to have a density between 1 to 2.5 units per acre based upon residential classifications found in the Prince George zoning ordinance, or the proposed number of units in the subdivision plans, if already prepared. The 2012 Comprehensive Plan Update used an assumed per capita rate of 3.12 people per unit, which was used to estimate the future population growth within the PGPA.

The Virginia Department of Health has capacity guidelines for water demands to use as a standard when designing waterlines and they recommend using 100 gpd per capita residential demand, which was used to estimate residential demand.

Using the size of each growth area, a percentage of developable land within the area, a density of units based on anticipated zoning, a capita rate per unit, and a daily water demand per capita, the total residential water demand was calculated for each targeted growth area or existing neighborhood.

## 8.2.2 Commercial/Industrial Water Demands

Future commercial and industrial demands were estimated based on guidelines included in the Chesterfield County Water and Sewer Design Standard Procedures (WSSP) and the Virginia Department of Health (VDH) Waterworks Regulations Section 12VAC5-590-690 Capacity of Waterworks.

Similarly to determining the residential water demand, for each anticipated commercial/industrial growth area, it was assumed that percent of the area would actually be developable based on the 2012 Comprehensive Plan Update, and this is due to various features throughout the county, such as streams, ponds, extreme elevation changes, etc.

The total commercial/industrial water demand was calculated for each parcel based on the size of each parcel, a percentage of developable land within the area, and a unit demand per acre estimate.

## 8.2.4 Water Demand Factors

A maximum day demand factor of 1.5 was assumed for planning purposes for all water systems within the PGPA. Standard diurnal patterns from the American Water Works Association (AWWA) as discussed in section 5.2.3 were utilized for future projected demands based on classification. These peak hour factors ranged between 0 and 3.0, with different patterns for residential, commercial, and industrial users.

## 8.2.5 Demand Calibration

To calibrate the projected water demands, it is essential to understand the anticipated growth within the County. Prince George County provided county-wide population census data was known for 2010, and County projections for the years 2020 and 2030 with an assumed average growth rate of 0.8% as part of the 2012 Comprehensive Plan Update. Since some of the time steps for this Master Plan fell in between and beyond the years of predicted populations, populations for odd years (2015 and 2025) and future phases (2035 and 2045) were predicted by interpolation between years with predicted populations.

The future projected population growth was compared with population growth estimates developed during the future demand projection planning. This was accomplished by taking the increase in new residential demand between each time step and dividing that by 100 gpd per capita. This resulted in an anticipated increase in number of people within the service area for each time step. The following table summarizes the predicted population based on information provided by Prince George County during development of the demand projections:

	<i>v</i> 1	0
Year	County-Wide Population <sup>(1)</sup>	County Population excluding Fort Lee and Prison <sup>(2)</sup>
2010	35,725	25,551
2015	37,177	26,590
2020	38,688	27,671
2025	40,261	28,795
2035	43,600	31,184
2045	47,216	33,770

**Table 8-1 County Wide Population Projections** 

(1) From Comprehensive Plan Page 29 (0.8% Annual Growth Rate)

(2) From Comprehensive Plan Table 4 (0.8% Annual Growth Rate)

The population increase for each time step is given below:

Time Step	Estimated County Wide Population Increase	Estimated County Only Population Increase <sup>1</sup>	Assumed Population Increase within the PGPA (Based on Demand Projections)
2015 - 2020	1,511	1,081	2,418
2020 - 2025	1,572	1,125	2,788
2025 - 2035	3,339	2,388	1,483
2035 - 2045	3.616	2,586	4.825

**Table 8-2 County Wide Population Increase** 

1. Excludes Fort Lee and Prisons

As shown in **Table 8-2**, the projected population increase based on demand projections was higher than the predicted County-wide population increase projection in 3 out of 4 planning time steps. This was discussed with County staff and it was decided that the demand projections developed as part of this Water and Wastewater Master Plan were more accurate than the previous county-wide population projections; therefore, no additional changes were made to the demand projections.

## 8.3 Wastewater Loading Projections

Wastewater demand projections were developed by assuming that 100% of the projected water usage at residential connections would enter the sewer collection system. For commercial/industrial wastewater demand projections, it was also assumed that 100% of projected water usage would enter the sewer collection system. Existing neighborhoods which were projected to receive sewer service in future phases were not included when evaluating population projection increases.

In addition to new development, the feasibility of providing sewer service to several existing neighborhoods who are not served currently and are located within close proximity to a County owned sewer system was evaluated. These neighborhoods include Rivers Edge and Beechwood Manor and service to these neighborhoods have been included in this Master Plan and the future sewer loading projections.

## 8.4 Demand Projections Summary

A summary of the system demand projections for the PGPA is shown on **Tables 8-3.** Refer to **Appendix A** for a detailed breakdown of demands.

 Table 8-3 Prince George Planning Area Water Demands and Sewer Loadings Estimates

 (GPD)

· · ·			-		
<b>Demand Category</b>	2013	2020	2025	2035	2045
Existing Demands	791,100	791,100	791,100	791,100	791,100
Residential Demands	-	241,800	520,600	668,900	1,151,400
Commercial Demands	-	180,500	764,600	1,547,900	2,533,900
Industrial Demands	-	1,191,700	1,342,800	1,342,800	1,626,900
Total	791,100	2,405,100	3,419,100	4,350,700	6,103,300

1. Per 2013 production water data (average day demands).

## **Chapter 9 Water System Improvements**

#### 9.1 General

This chapter of the Master Plan presents an overview of system improvements that are proposed 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. A brief overview of analysis results and improvements is provided in the following sections and are shown in **Figures 9-3 through 9-7**. More detailed descriptions of individual improvements are provided at the end of this chapter in the Water Improvement Program section. **Timing of the proposed projects will depend on the actual or desired rate of development within the County and available project funding**.

#### 9.2 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. **Graphs 9-1 to 9-3** provide a summary of existing water supply capacity for the County's water service vs. maximum day water demands through the end of the planning period for each service area. Note that future development is not projected within the Johnson Road service area, and River Road water system and is therefore not accounted for in the water supply analysis.

#### 9.2.1 Route 301 Service Area

Prince George County currently has a combined average day water capacity of approximately 90,100 GPD within the Route 301 service area. As seen below in **Graph 9-1**, the maximum day water supply will be exceeded by 2020 based upon demand projections within this service area. In order to provide water supply through the 30 year planning period, it is suggested that Prince George County receive additional water supply from the City of Petersburg. A capacity of approximately 0.82 MGD of maximum day water demand will be needed to supply the Route 301 service area through 2045.

In order to supply water from the City of Petersburg to the Route 301 system, a 12-inch water supply line will need to be constructed along Route 301 from the existing elevated storage tank to the City of Petersburg water system. An associated 0.75 MGD booster pump station located at the border to the City of Petersburg will need to be constructed to pump water from the City of Petersburg into the Route 301 water system to fill the elevated storage tank. A 0.5 MG ground storage tank will also need to be constructed at the booster pump station to provide a storage buffer with the Petersburg water system. Based on projected demands, this booster pump station will need to be upgraded in the 2045 planning period to a capacity of 1.5 MGD.



**Graph 9-1 Route 301 Service Area Water Demand Projections** 

In order to provide water supply for long term planning and redundancy, it is suggested that Prince George County consider connecting both the Route 301 system and the Cedarwood system into the Central system. As shown in **Figure 9-5**, The Cedarwood system could be con-

nected to the Route 301 system by a waterline running west along Tavern Road which will need to be constructed in the 2035 planning period. Both the Cedarwood and Route 301 systems could then be connected to the Central system in the 2045 planning period by constructing a waterline west along Union Branch Road and Walton Lake Road which would connect to a proposed waterline at the intersection of Rives Road. A 1.5 MGD booster pump station would need to be constructed along the new 12-inch waterline to allow a redundant feed from the Central system into the Route 301 system. This connection to the Central system would provide redundancy to the Route 301 system and increased fire flow availability for the Cedarwood system.

## 9.2.2 Central Service Area

Prince George County currently has plant allocation from ARWA to supply up to 2.69 MGD. However, transmission limitations within the ARWA transmission system limits the availability of water supply to approximately 1.5 MGD, based on the assumption that the Central System booster Station can pump a maximum duration of approximately 18 hours per day.



**Graph 9-2 Central Service Area Water Demand Projections** 

This assumption is based on the understanding that during peak flow periods of the day, ARWA cannot deliver pumping service to Prince George while simultaneously meeting the requirements of Colonial Heights and Chesterfield.

As seen above in **Graph 9-2**, demands are projected to exceed this supply capacity by the 2020 planning period. To meet the projected demands, Prince George County will be required to develop additional water supply sources within the County or secure additional water supply capacity from adjacent municipalities.

Groundwater supply within the County is limited due its location within the Virginia Groundwater Management Area. Permitting of any significant additional groundwater capacity would be difficult and the existing wells within the County do not have high yields. For those reasons, it is not recommended that a groundwater supply be used for future growth.

The County is bordered on the north by the Appomattox River and James River, which could be a source of surface water for a new County water treatment plant. It is estimated that a new surface water treatment plant would cost approximately \$5 to \$10 per gallon of capacity to construct, depending on type of treatment and size of plant. The major source of water demand growth is projected to be towards the southern portion of the water service area, which will require significant water supply infrastructure to transfer water from a water treatment plant to the distribution system. The construction of a new water treatment plant and transmission infrastructure is expected to be cost prohibitive to the County. Therefore, it is recommended that the County evaluate options for obtaining additional water supply from adjacent municipalities to reduce capital cost requirements.

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 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 with further detail discussed below. The alternative ARWA water supply option description can be found in **Appendix D**, at the end of the report.

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. See **Figure 9-1** for additional detail.

Projected to be needed in the 2020 planning period, 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 proposed booster pump station running east along Route 10 and south along Ruffin Road, Courthouse Road, and I-295 to the Southpoint elevated storage tank. 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 to meet demand projected to be needed in the 2020 planning period 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 to provide supplemental flow to the system to accommodate for additional demand projected to be needed within the 2025 planning period.

In order to provide water supply projected to be needed through the 2045 planning period, the 3.0 MGD booster pump station would be expanded to 6.0 MGD with an additional 1.0 MG ground storage tank in the 2035 planning period. Additionally, because water service is expected to be extended north along River Road, 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.

The estimated cost of the water supply option, described above, is approximately \$36,040,000 through the end of the planning period in 2045. A breakdown of estimated costs is provided, and shown below in **Table 9-1**.

	Total			
2020	2025	2035	2045	Totai
\$26,140,000	\$4,190,000	\$5,710,000	-	\$36,040,000

Table 9-1 Cost Estimate Summary for Central System Water Supply

It should be noted that there could be some short term water supply options available that could provide some additional water supply to the Central water system at a lower initial cost. Potential options include interconnections with the Fort Lee water system or with the Virginia American Water Hopewell water system near Crossings Boulevard where an existing 16-inch VAWC water main crosses the existing 16-inch Prince George water main. These options may be able to provide some additional short term water capacity if a need arises before the long term water supply project can be constructed.

#### 9.2.3 Route 10 Service Area

Currently, the Beechwood Manor/Jordan on the James water system within the Route 10 service area is supplied through groundwater wells with a combined DEQ groundwater withdrawal limit of 135,700 GPD. This withdrawal limit includes two additional wells which have been approved for Chappell Creek subdivision and have not been put into service. Additionally, the River's Edge system has a groundwater withdrawal capacity of 32,400 GPD. Based upon projected future demands, the service area will exceed is expected to exceed its groundwater withdrawal limitations. In order to provide a long term water supply solution to the Route 10 service area, a connection to VAWC along Route 10 is proposed.



**Graph 9-3 Route 10 Service Area Water Demand Projections** 

\*Route 10 Capacity based upon DEQ Groundwater Withdrawal Permit

As shown in **Figure 9-3**, water supply plans for the Route 10 service area consist of the following improvements:

- Construction of a 0.5 MG elevated storage tank located near the intersection of Ruffin Road and Route 10.
- Construction of a 12-inch water supply main parallel to Route 10 connecting the River's Edge and Jordan on the James/Beechwood Manor systems to the Virginia American water supply line in the City of Hopewell.
- Construction of a 0.75 MGD booster pump station located west of Ruffin Road along Route 10 to pump water into the Route 10 service area.
  - The booster pump station will be expandable to 1.5 MGD.

The approximate location of the proposed 0.5 MG elevated storage shown in **Figure 9-3** was selected based upon the highest elevation within the service area of approximately 135 feet. A previous elevated storage tank location was selected within the proposed Chappell Creek subdivision which is located at a relatively low elevation within the service area of approximately 85 feet due to the proximity to the James River. With the relocation of the elevated storage tank, the height necessary to achieve the same HGL will be reduced approximately 50 which will save capital costs in construction that can be reinvested into the waterline extension project to connect to VAWC.

With the connection to a surface water supply source, all existing water supply facilities within the Route 10 service area would either need to be converted to chloramines by installing an ammonia feed system or the facilities will be decommissioned. Due to high maintenance and rehabilitation costs that were identified as part of the condition assessment, see **Appendix B**, it is recommended that the existing water supply facilities be decommissioned rather than converted to chloramines to continue to provide water supply. The future 0.75 MGD pump station will be a combined facility with the Route 10 booster pump station, which will serve the Central service area. As seen in **Figure 9-3**, the pump stations will have a common suction waterline from the City of Hopewell and separate pumps will serve their respective service areas.

Although the River's Edge water system is projected to have adequate water supply capacity through the end of the planning period, the master plan shows the option of connecting the new water supply system to the River's Edge water system to provide an increase in storage and fire flow availability. In this scenario, the River's Edge well facilities would either have to be converted to chloramines or be decommissioned.





#### 9.3 Water Storage

As discussed in Chapter 6, equalization storage is needed to meet daily peak demands and should be equal to 30-40 percent of the maximum day demand over 24 hours. The increase in the storage requirement over time is a direct result of the increased equalization requirement due to the increase in system demand. Based upon the fire flow goals stated in Chapter 3, system storage required for fire flow is equal to 240,000 gallons, which is the volume of water needed for the County's design commercial/industrial standard of a 2,000 gpm, 2-hour duration fire event. The storage required through the end of the planning period is summarized below in **Table 9-2**.

	2013	2020	2025	2035	2045
Route 301 Service Area	260,000	294,000	304,400	327,200	458,800
Central Service Area	623,000	1,480,000	2,027,000	2,381,000	2,956,000
Route 10 Service Area	270,000	301,000	307,000	420,000	469,000

**Table 9-2 Water Storage Requirements** 

#### 9.3.1 Route 301 Service Area

As shown above in **Table 9-2**, the 0.5 MG gallon elevated storage tank in the Route 301 system provides adequate storage through the 30 year planning period. The water storage requirement table above includes the combined system demand of both the Cedarwood and Route 301 system for the Route 301 service area. The Cedarwood system currently has minimal storage at the existing water supply facility. As discussed in the water supply section, if the Cedarwood system is connected to the Route 301 system to meet projected demands needs by the 2035 planning period, this will provide adequate storage.

#### 9.3.2 Central Service Area

The Central service area 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, in 2045, an additional 1.0 MG elevated water storage tank at the Southpoint Business Park is also recommended to provide additional system redundancy. As shown in **Table 9-2**, the total proposed storage of 6.0 MG will meet the storage requirements of the Central system through the end of the planning period in 2045.

#### 9.3.3 Route 10 Service Area

Currently, the Route 10 service area has minimal water storage at each water supply facility and does not meet the existing water storage requirement. As discussed in the water supply section above, a 0.5 MG elevated storage tank is proposed to meet projected demands within the 2020 planning period. As shown in **Table 9-2** above, 0.5 MG of storage meets the requirement through 2045.

#### 9.4 Water Distribution System

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).

Water system improvements described above will include descriptions which explain the purpose of the improvements within the Water Improvement Program section below.

As shown in **Appendix A**, developments 55, 61, 63, and 65 are located along the City of Petersburg boundary. It is anticipated that these developments will be directly connected through an extension of the Petersburg water system. Developments 55 and 63 would require a bore under-

neath I-95 or I-295 which would be a costly expense for Prince George County to extend water service to limited development along the Petersburg boundary.

## 9.5 Water Improvement Program

A summary of the recommended water system improvements required for future development is provided on the following pages. Refer to **Figures 9-2 through 9-6** for the location of each proposed improvement.

Descriptions of the proposed water system improvements, organized by planning period, are provided on the following pages. The description lists the requirement for the improvement, the timing of the improvement, and a general description of the improvement.

The estimated timing of when projects are needed is based on the demand projections, which are based on best available information. However, the actual timing of projects will be dependent on the actual rate of growth and location of development and may be different than projected. In order to provide flexibility in planning, the future planning phases were designated as planning periods A, B, C, and D, which correspond to the 2020, 2025, 2035, and 2045 planning periods. **The planning periods generally indicate the order of when projects will be required; however, the timing of the construction of projects will be growth dependent and based on actual or desired rate of development within the County and available funding.** 

Additional details on costs associated with the water improvement program are provided in Chapter 11 of this Master Plan.























## Route 301 Service Area See Figure 9-5

## w301-A-01: Route 301 Water Supply Extension

This project would consist of the following improvements:

- 1. Construction of a 12-inch waterline to provide water supply and serve development north on Route 301 Approximately 9,000 linear feet.
- 2. Construction of a 0.75 MGD (expandable to 1.5 MGD) booster pump station with 0.5 MG ground storage tank located at the border of the City of Petersburg.

This project is identified for completion in planning period A.

#### w301-C-01: Cedarwood Service Extension

This project would consist of the following improvements:

1. Construction of a 12-inch waterline to provide water supply, increase fire flow availability, and increase storage within Cedarwood– Approximately 6,400 linear feet. This project includes a jack and bore under I-95.

This project is identified for completion in planning period C.

#### w301-D-01: Route 301 Service Extension

This project would consist of the following improvements:

1. Construction of a 12-inch waterline to serve development east of I-95 – approximately 3,000 linear feet. This project includes a jack and bore under I-95.

This project is identified for completion in planning period D.

#### w301-D-02: Route 301 Booster Pump Station Upgrade

This project would consist of the following improvements:

- 1. Add third pump and controls to increase capacity to 1.5 MGD.
- 2. Piping and valving modifications as needed for new pump installation.

This project is identified for completion in planning period D.

#### w301-D-03: Walton Lake Road Service Extension

This project would consist of the following improvements:

- 1. Construction of a 12-inch water main along Walton Lake Road to connect the Route 301 system to the Central system Approximately 14,700 linear feet.
- 2. Construction of a 1.5 MGD booster pump station north of Wildwood Farms.

This project is identified for completion in planning period D.

## <u>Central System Service Area</u> <u>See Figure 6-5 through 6-6 and Figure 9-2 through 9-6</u>

## wCEN-CI-01: Commonwealth Acres Fire Flow Improvements

This project would consist of the following improvements:

- 1. Replace existing 8-inch waterline along Baxter Road with 12-inch waterline Approximately 2,000 linear feet.
- 2. Replace existing 6-inch waterline along Lakeside Drive with 8-inch waterline Approximately 2,500 linear feet.

This project is necessary now to meet Community Fire Flow goals.

#### wCEN-CI-02: Lee Acres Fire Flow Improvements

This project would consist of the following improvements:

1. Replace existing 6-inch waterline along Bull Hill Road with 8-inch waterline – Approximately 2,200 linear feet.

This project is necessary now to meet Community Fire Flow goals.

#### wCEN-CI-03: Rolling Meadows and Hidden Oaks Fire Flow Improvements

This project would consist of the following improvements:

1. Replace existing 6-inch waterlines with 8-inch waterlines – Approximately 3,200 linear feet.

This project is necessary now to meet Community Fire Flow goals.

#### wCEN-CI-04: Manchester Mill Fire Flow Improvements

This project would consist of the following improvements:

1. Replace existing 6-inch waterlines with 8-inch waterlines – Approximately 5,600 linear feet.

This project is necessary now to meet Community Fire Flow goals.

#### wCEN-CI-05: Birchett Estates Fire Flow Improvements

This project would consist of the following improvements:

1. Replace existing 4-inch waterlines with 8-inch waterlines – Approximately 9,100 linear feet.

This project is necessary now to meet Community Fire Flow goals.

#### wCEN-CI-06: Puddledock Fire Flow Improvements

This project would consist of the following improvements:

- 1. 8-inch waterline loop south of Temple Ave. Approximately 1,450 linear feet.
- 2. 12-inch waterline loop connecting Riverdale Road to Temple Ave. Approximately 2,400 linear feet.

This project is necessary now to meet Community Fire Flow goals.

## wCEN-CI-07: River Road Fire Flow Improvements

This project would consist of the following improvements:

1. Replace existing 8-inch waterlines with 12-inch waterlines – Approximately 5,800 linear feet.

This project is necessary now to meet Community Fire Flow goals.

#### wCEN-CI-08: Scott Park Water Service Extension Phase 1

This project would consist of the following improvements:

- 1. Construction of a 12-inch water main west of Courthouse Road and east of Hollyberry Lane Approximately 2,700 linear feet.
- 2. Construction of an 8-inch water main to serve irrigation demands and concessions at Scott Park Approximately 1,400 linear feet.

This project is necessary now to extend service to Scott Park phase 1.

#### wCEN-CI-09: Scott Park Water Service Extension Phase 2

This project would consist of the following improvements:

1. Construction of a 12-inch water main to connect Scott Park phase 1 to Courthouse Road water main – approximately 3,400 linear feet

This project is necessary now to extend service to Scott Park phase 2.

#### wCEN-A-01: Central System Water Supply Project

This project would consist of the following improvements:

- 1. Construction of a 24-inch water main connecting the Southpoint Business Park to the Hopewell Route 10 connection– approximately 57,000 linear feet.
- 2. Construction of a 3.0 MGD booster pump station with 1.0 MG ground storage tank located at the Route 10 connection.
  - a. (Expandable to 6.0 MGD)

This project is identified for completion in planning period A.

#### wCEN-A-03: Food Lion Water Supply Facility Improvements

This project would consist of the following improvements:

- 1. Construction of a 12-inch waterline to connect the Food Lion water system with the Central water system along Route 460 approximately 5,400 linear feet.
- 2. Install two (2) 1,000 gpm pumps at existing water supply facility located at Food Lion Distribution Center.
- 3. Piping and valving modifications as necessary to accommodate new pumps.
- 4. Control modifications for 1.0 MG storage tank.
- 5. Take well offline or install Ammonia feed system

6. Generator and electrical upgrades

This project is identified for completion in planning period A.

#### wCEN-B-01: Route 156 Booster Pump Station and Water Service Extension

This project would consist of the following improvements:

- 1. Construction of a 1.5 MGD booster pump station to provide supplemental water supply to the Central service area.
- 2. Construction of a 12-inch water main loop between Branchester Lakes and Manchester Mill along Route 156 Approximately 9,000 linear feet.

This project is identified for completion in planning period B.

## wCEN-B-02: Route 156 Water Service Extension

This project would consist of the following improvements:

1. Construction of a 12-inch water main along Route 156 between Laurel Spring Road and Route 460 to serve proposed development – Approximately 17,800 linear feet.

This project is identified for completion in planning period B.

## wCEN-C-01: Central System Water Supply Booster Pump Station Upgrade (Option 2)

This project would consist of the following improvements:

- 1. Add additional pump to increase booster pump station capacity to 6.0 MGD.
- 2. Piping and valving modifications as needed for new pumps.
- 3. Construct a second 1.0 MGD ground storage tank.

This project is identified for completion in planning period C.

#### wCEN-C-02: Rives Road Water Service Extension

This project would consist of the following improvements:

1. Construction of a 12-inch water main along Rives Road to serve commercial developments – Approximately 6,000 linear feet. This will require a jack and bore under Route 460.

This project is identified for completion in planning period C.

## wCEN-C-03: River Road Water Service Extension

This project would consist of the following improvements:

- 1. Construction of a 12-inch water main along River Road to serve commercial developments – Approximately 6,200 linear feet.
- 2. The service of this area is dependent on the construction of the Puddledock booster pump station.

This project is identified for completion in planning period C.

## wCEN-C-04: Puddledock Booster Pump Station

This project would consist of the following improvements:

- 1. Decommission Central System booster pump station.
- 2. Construction of a 2.0 MGD booster pump station with 0.5 MG ground storage tank near the intersection of River Road and Temple Avenue.

This project is identified for completion in planning period C.

## wCEN-D-01: Route 156 Waterline Loop

This project would consist of the following improvements:

 Construction of a 12-inch water main along Route 156 to serve commercial developments along Route 156 between Courthouse Road and Laurel Spring Road – Approximately 5,300 linear feet.

This project is identified for completion in planning period D.

## wCEN-D-02: Sandy Ridge Road Waterline Extension

This project would consist of the following improvements:

1. Construction of a 12-inch water main extension along Sandy Ridge Road to connect to the future 24-inch water main on Ruffin Road – Approximately 7,000 linear feet.

This project is identified for completion in planning period D.

## wCEN-D-03: Southpoint Elevated Storage Tank

This project would consist of the following improvements:

1. New 1,000,000 gallon elevated storage tank located at Southpoint Business Park to provide additional storage redundancy.

This project is identified for completion in planning period D.

#### Route 10 Service Area See Figure 9-3

NOTE: Route 10 Fire Flow Improvements are dependent upon the water supply improvements project.

## w010-CI-01: Beechwood Manor Fire Flow Improvements

This project would consist of the following improvements:

1. Replace existing 4-inch waterlines with 8-inch waterlines – Approximately 6,100 linear feet.

This project is needed now and identified for completion following the Route 10 water supply improvements.

## w010-CI-02: Jordan on the James Fire Flow Improvements

This project would consist of the following improvements:

- 1. Construction of a 12-inch water main along Jordan Point Rd. Approximately 7,400 linear feet.
- 2. New 12-inch pressure reducing valve vault on Jordan Point Rd.

This project is needed now and identified for completion A following the Route 10 water supply improvements.

## w010-CI-03: Rivers Edge Fire Flow Improvements

This project would consist of the following improvements:

- 1. Construction of a 12-inch water main along Route 10 Approximately 6,800 linear feet.
- 2. Replace existing 4-inch waterlines with 8-inch waterlines Approximately 4,600 linear feet.
- 3. Replace existing 6-inch waterlines with 8-inch waterlines Approximately 4,600 linear feet.
- 4. Decommission Bicors, and Liveram water supply facilities.

This project is needed now and identified for completion following the Route 10 water supply improvements.

## w010-A-01: Route 10 Water Supply Improvements

This project would consist of the following improvements:

- 1. Construction of a 0.75 MGD booster pump station along Route 10 at the Hopewell border.
  - a. (Expandable to 1.5 MGD)
- 2. New 500,000 gallon elevated storage tank located near the intersection of Route 10 and Route 156.
- 3. Construction of a 12-inch waterline extension along Route 10 to connect the Beechwood Manor and Jordan on the James to the proposed Route 10 connection– approximately 12,600 linear feet.
- 4. New 12-inch pressure reducing valve vault along Beaver Castle Road.
- 5. Decommission Jordan on the James and Lemonwood water supply facilities.
- 6. It should be noted that this project cost would be expected be lower if it is constructed in unison with the Central System Route 10 Water Supply Project (**wCEN-A-01**).

This project is identified for completion in planning period A.

## w010-C-01: Route 10 Booster Pump Station Upgrade

This project would consist of the following improvements:

- 1. Add third pump to increase booster pump station capacity to 1.5 MGD.
- 2. Piping and valving modifications as needed for new pumps.

This project is identified for completion in planning period C.

## Chapter 10 Wastewater System Improvements

#### 10.1 General

This chapter of the Master Plan presents an overview of system improvements that are proposed to provide wastewater service within the County's planning area through the Year 2045. In general, the wastewater improvement program involves improvements to wastewater conveyance infrastructure including pump stations, force mains, and gravity sewer. The wastewater conveyance infrastructure needs will be driven by availability of wastewater treatment and disposal allocations with adjacent jurisdictions. A brief overview of analysis results and improvements is provided in the following sections and are shown in **Figures 10-2 through 10-6**. More detailed descriptions of individual improvements are provided at the end of this chapter in the Wastewater Improvement Program section. **Timing of the proposed projects will depend on the actual or desired rate of development within the County and available project funding**.

## **10.2** Wastewater Treatment and Disposal Capacity

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 in 2045. **Table 10-1** provides a summary of the existing wastewater discharge locations for the County's wastewater service areas and **Table 10-2** shows the projected maximum day wastewater loadings through the end of the planning period in 2045.

Service Area	<b>Discharge Location</b>	Allowable Allocation (MGD)
	Route 36	
$\mathbf{UD}\mathbf{W}$	Bailey's Creek	2.(1)
HKWIF	Manchester Run	
	River Road	
	Johnson Road	0.180 <sup>(3)</sup>
Petersburg /	Route 301	0.291 <sup>(3)</sup>
SCWWA <sup>(2)</sup>	Puddledock	0.025 <sup>(3)</sup>
	Route 460	1.0 <sup>(3)</sup>
Petersburg	Flank Road	0.004 <sup>(3)</sup>

#### Table 10-1 Existing Wastewater Average Day Discharge Capacities

1. Total allowable allocation of 2.0 MGD Peak Daily Flow for all Hopewell discharge points

2. Total treatment allocation at the South Central WWTP is 1.72 MGD average daily flow and 3.9 MGD peak daily flow rate.

3. Average daily maximum per conveyance agreement with Petersburg.

Service Area	Discharge Location	Discharge Allocation	2013	2020	2025	2035	2045
	Route 36	-	0.057	0.057	0.068	0.068	0.068
	Bailey's Creek	-	0.141	0.141	0.184	0.184	0.184
HKWIF	Manchester Run	-	0.310	0.492	0.701	0.984	1.106
	River Road	-	0.112	0.112	0.112	0.112	0.112
Total		2.000	0.620	0.803	1.065	1.348	1.470
	Johnson Road	0.180	0.027	0.027	0.027	0.027	0.027
Petersburg/	Route 301	0.291	0.168	0.253	0.279	0.336	0.665
SCWWA	Puddledock	0.025	0.024	0.102	0.301	0.639	0.639
	Route 460	1.000	0.505	1.726	2.157	2.410	3.367
Petersburg	Flank Road	0.004	N/A	N/A	N/A	N/A	N/A
	Total	1.50	0.723	2.107	2.763	3.412	4.698

 Table 10-2 Wastewater Loading Projections (Average Daily Demand)

1. Wastewater loading projections based upon future development discharge to existing system configuration

2. Loading Projections in MGD

#### 10.2.1 Prince George Petersburg / SCWWA Service Area

Prince George County currently holds two agreements for conveyance and treatment in the Prince George / SCWWA Service Area. The first agreements is for conveyance of wastewater

through the Petersburg sewer system, and second agreements is for treatment allocation at the South Central Wastewater Treatment Plant (SCWWA Treatment Plant). As seen above in **Table 10-1** and **Table 10-2**, wastewater loadings are projected to exceed conveyance and treatment capacity allocations within the 2020 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. The Route 301 and Route 460 discharge locations, which would receive the majority of the future projected flows, are located at the southern and eastern borders of Petersburg, approximately 10 miles away from the SCWWA Treatment Plant, which is located at the northeast side of the City. 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. Additional allocated treatment capacity at the SCWWA Treatment Plant would also have to be obtained, which may trigger the requirement for a costly expansion if capacity cannot be purchased from other members.

The Puddledock discharge location is projected to exceed conveyance capacity within the 2020 planning area. This discharge location is within close proximity of the SCWWA Treatment Plant which limits the conveyance upgrades that would be required for future projected loadings. Based on available information, it is anticipated that a force main from a Puddledock pump station could be extended to either the City of Colonial Heights gravity sewer interceptor along Temple Avenue or directly to the SCWWA Treatment Plant.

#### 10.2.2 Prince George HRWTF Service Area

Through an agreement with the City of Hopewell, Prince George County is currently allocated up to 2.0 MGD of total wastewater loading at all discharge locations combined for the conveyance and treatment of wastewater at the HRWTF. Based upon the projections of wastewater loadings to the existing system, as seen above in **Table 10-1** and **Table 10-2**, the County will not exceed its capacity. 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 HRWTF, in the vicinity of Route 10.

#### 10.3 Wastewater Collection, Conveyance, and Disposal

The wastewater collection and conveyance strategy for future projected wastewater loadings is largely driven by where the available wastewater treatment and disposal capacity will be located. Additionally, it was determined that it was preferable to develop a regionalized wastewater collection and conveyance concept in which larger gravity sewer interceptors and pump stations were constructed versus the current system configuration of many small pump station, which has significant upgrades costs and is operation and maintenance intensive. The majority of the projected wastewater loadings will occur in the Petersburg Service Area; therefore, based on shortest path to a discharge location, the existing wastewater infrastructure should be upgraded to convey wastewater to the discharge location. However, this concept would continue the current system configuration of many small pump stations and it would convey wastewater to Petersburg, which is anticipated to have inadequate capacity to convey and treat additional wastewater beyond the current allocation. 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.

Another option the County could consider is the construction of a new County owned wastewater treatment plant to treat future wastewater flows. This treatment plant should be constructed outside of the Chesapeake Bay watershed to avoid nutrient discharge limitations, which would require a discharge on the southern portion of the wastewater service area. It is estimated that the cost of a new wastewater treatment plant would be approximately \$10 to \$20 per gallon of treatment capacity, with the final cost depending on size and complexity. Typically, as the size of a treatment plant increases, the unit cost to build and operate the plant decreases. Since there are already two large wastewater treatment plants next to the County in Hopewell and Petersburg, it

is recommended that the County continue to convey wastewater to the existing regional treatment plants to take advantage of the lower treatment cost. If in the future, upgrades are required to these treatment plants, the County may consider constructing their own plant, if their share of the upgrade costs are significant.

The County currently has a large number of individual grinder pumps connected to long sewer transmission force mains. For future development, it is recommended that new grinder pump connections to the transmission force mains be avoided as they require significantly more maintenance for the County and they cause significant hydraulic variations in force mains. Additional grinder pump stations may be constructed in remote areas of the County such as Disputanta, where the construction of a centralized sewer system is cost prohibitive.

#### 10.3.1 Route 460 and Route 10 Wastewater Collection and Conveyance Evaluation

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. The recommended second option of constructing regional pump stations and centralized gravity interceptors is discussed below and the alternative option of maintaining the existing flow path can be found in **Appendix E** at the end of this report

# 10.3.1.1 Route 460 and Route 10 Wastewater Collection and Conveyance Recommended Option

This option would consist of modifying the flow path of the existing system to convey the majority of the future projected sewer loadings to a new Route 10 discharge location, as shown in **Table 10-3**, to the City of Hopewell wastewater system. This concept would include constructing gravity interceptors which would collect and convey sewer loadings to regional pump stations. As shown in **Figure 10-1**, existing gravity sewer, pump station, and force main improvements

would not be required due to the reduction of flow to the existing system as a result of the new regional gravity interceptors and regional pump stations. The extension of the new gravity interceptors would also allow the County to take a number of existing pump stations offline, which would reduce the operation and maintenance cost for the County.

Service Area	Discharge Location	Discharge Allocation	2013	2020	2025	2035	2045
	Route 36	-	0.057	0.057	0.068	0.068	0.068
	Bailey's Creek	-	0.141	0.141	0.184	0.184	0.184
HRWTF	Manchester Run	-	0.310	0.330	0.404	0.407	0.404
	River Road	-	0.112	0.112	0.112	0.112	0.112
	Route 10	-	-	1.191	1.907	2.880	3.927
	Total	2.0	0.620	1.831	2.675	3.650	4.695
	Johnson Road	0.180	0.027	0.027	0.027	0.027	0.027
Petersburg/	Route 301	0.291	0.168	0.253	0.279	0.238	0.567
SCWWA	Puddledock	0.025	0.024	0.102	0.301	0.639	0.639
	Route 460	1.000	0.505	0.697	0.548	0.208	0.243
	Flank Road	0.004	N/A	N/A	N/A	N/A	N/A
	Total	1.50	0.723	1.078	1.154	1.111	1.475

 Table 10-3 Recommended Option Wastewater Loading Projections (Average Daily Flow)

Wastewater loading projections based upon future development discharge to existing system configuration
 Loading Projections in MGD

As shown in **Figure 10-1**, the major 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 Business Park. The interceptor would also allow the 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 sta-

tion 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 project 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 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 at developments along Rives Road would also be collected by the Second Swamp interceptor project. By collecting projected loadings from this project, the 12-inch gravity interceptor along Route 460 would not need to be upgraded.

These improvements are projected to cost a total of \$53,670,000 within the Route 460 and Manchester Run wastewater systems through the 30 year planning period, see Table 10-4 for a breakdown of estimated costs by planning period.

Table 10-4 Cost Estimate Summary for Wastewater Collection and Di	sposal

2020	2025	2035	2045	Iotal
\$24,950,000	\$11,050,000	\$17,670,000	-	\$53,670,000

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. The County would need to negotiate with the City of Hopewell for additional capacity by the 2025 planning period.

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.

The recommended option would also reduce the projected wastewater loading to be treated by the SCWWA Treatment Plant to an estimated peak daily flow of approximately 3.87 MGD. This would be below the 3.9 MGD peak daily flow allocation, which would eliminate the need for the County to negotiate additional treatment capacity within the planning period.

# 10.3.2 Route 301 Wastewater Collection and Conveyance Evaluation and Recommendation

The existing Route 301 wastewater collection and conveyance system has adequate capacity to convey the projected wastewater loadings until the 2045 planning period. However, the existing SPS-006 is in poor condition and currently requires rehabilitation to address safety issues. This pump station improvements project should include the flexibility to add a third pump in the future (2045 planning period) to meet capacity needs through the end of the planning period. In order to serve projected wastewater loadings within the 2045 planning period, the gravity sewer interceptor along Route 301 will also have to be upsized and a sewer extension will be required south of the Route 95 ramp to serve future developments in that area.

To serve future development, it is recommended that a gravity sewer interceptor be constructed through Second Swamp in the 2035 planning period. Since this gravity sewer interceptor will pass the Cedarwood and Wildwood neighborhoods, it is recommended that the existing pump stations (SPS-008 and SPS-016) be taken offline and the sewer flows routed to the new gravity interceptor.

Based upon wastewater loading projections, the current Route 301 peak daily flow allocation of 0.77 MGD will be exceeded within the 2045 planning period. Additional conveyance capacity will need to be negotiated with the City of Petersburg to receive these projected wastewater flows.

# **10.3.3** Puddledock Wastewater Collection and Conveyance Evaluation and Recommendation

A regionalized wastewater collection and conveyance concept was developed for the Puddledock service area. When the existing Puddledock pump station (SPS-014) is projected to exceed capacity in the 2025 planning period, it is recommended that a 1.0 MGD (expandable to 2.0 MGD) Regional Puddledock Pump Station be constructed to serve the entire Puddledock service area. As the service area develops, gravity interceptors should be constructed running south and north to collect sewer loadings from the surrounding Puddledock area, including River Road. The new Regional Puddledock Pump Station will include a new 12-inch force main that will be routed to discharge to the Colonial Heights wastewater collection system on Temple Avenue or directly to the SCWWA Treatment Plant. A conveyance agreement with Colonial heights would have to be negotiated to discharge the additional projected wastewater flows.

#### 10.3.4 Route 10 Wastewater Collection and Conveyance Evaluation and Recommendation

In addition to serving future development, there are existing neighborhoods, Beechwood Manor and Rivers Edge, within the Route 10 service area that are not currently served by public sewer. Based on an initial evaluation, it appears that the Beechwood Manor section can be served by gravity sewer, which would connect into the existing Beechwood Manor collection system. The Rivers Edge section would require another pump station which would collect flow from gravity sewer and pump it into the adjacent Rivers Edge collection system. The construction of gravity sewer and a central pump station is recommended over a low pressure sewer system with individual grinder pumps as it would greatly reduce the maintenance required by the residents. With strong neighborhood participation, funding assistance for such projects can usually be obtained through state and local agencies in order to reduce the burden on the residents.

## **10.4** Wastewater Improvement Program

A summary of the recommended wastewater system improvements required for future development is provided on the following pages. Refer to **Figures 10-2 through 10-6** for the location of each proposed improvement.

Descriptions of the proposed wastewater system improvements, organized by planning period, are provided on the following pages. The description lists the requirement for the improvement, the timing of the improvement, and a general description of the improvement.

The estimated timing of when projects are needed is based on the demand projections, which are based on best available information. However, the actual timing of projects will be dependent on actual rate of growth and location of development and may be different than projected. In order to provide flexibility in planning, the future planning phases were designated as planning periods A, B, C, and D, which correspond to the 2020, 2025, 2035, and 2045 planning periods. The planning periods generally indicate the order of when projects will be required; however, the timing of the construction of projects will be growth dependent and based on actual or desired rate of development within the County and available funding.

Additional details on costs associated with the wastewater improvement program are provided in Chapter 11 of this Master Plan.















![](_page_55_Figure_0.jpeg)

![](_page_55_Figure_1.jpeg)

![](_page_56_Figure_0.jpeg)

![](_page_56_Figure_1.jpeg)

![](_page_56_Figure_2.jpeg)

## <u>Puddledock Service Area</u> <u>See Figure 10-2</u>

## sPUD-B-01: Puddledock Regional Pump Station

This project would consist of the following improvements:

- 1. Construction of 15-inch gravity sewer approximately 7,500 linear feet.
- 2. Construction of 12-inch forcemain approximately 5,100 linear feet assuming that force main can discharge to the existing 42-inch gravity interceptor in Colonial Heights
- 3. Construction of 2.0 MGD Puddledock Regional Pump Station.

This project is identified for completion in planning period B.

#### sPUD-C-01: River Road Service Extension

This project would consist of the following improvements:

- 1. Construction of 15-inch gravity interceptor approximately 5,800 linear feet.
- 2. Construction of 18-inch gravity interceptor approximately 11,700 linear feet.

This project is identified for completion in planning period C.

#### <u>Central Service Area</u> See Figures 10-3 through 10-7

#### sCEN-CI-01: Route 301 and Route 460 I&I Evaluation

This project would consist of the following improvements:

1. Development of an inflow and infiltration (I&I) evaluation letter report to identify areas of excessive I&I within the Route 460 and Route 301 wastewater systems.

This project is necessary now to identify I&I within the Route 460 and Route 301 systems.

#### sCEN-CI-02: Scott Park Service Extension (Phase 1)

This project would consist of the following improvements:

- 1. Construction of a duplex grinder pump station to serve concession stands.
- 2. Construction of a 3-inch force main approximately 1,600 linear feet.

This project is necessary now to extend service to Scott Park (Phase 1).

#### sCEN-A-01: Blackwater Regional Sewer Interceptor

This project would consist of the following improvements:

- 2. Construction of 30-inch gravity sewer approximately 11,000 linear feet (Blackwater Interceptor).
- 3. Construction of 36-inch gravity sewer approximately 6,000 linear feet (Route 10 Interceptor).
- 4. Construction of 20-inch forcemain approximately 31,900 linear feet.
- 5. Construction of 24-inch forcemain discharge upstream of Hopewell WWTP.

- 6. Construction of 3.25 MGD (expandable to 6.5 MGD) Blackwater Swamp Regional Pump Station.
- 7. Construction of 4.5 MGD (expandable to 9.0 MGD) Route 10 Regional Pump Station.
- 8. Reroute existing forcemain along Courthouse Road, south of Route 10, to discharge into Route 10 Interceptor.

This project is identified for completion in planning period A.

## sCEN-A-02: Decommission SPS-002

This project would consist of the following improvements:

- 1. Construction of 8-inch gravity sewer approximately 4,000 linear feet.
- 2. Take SPS-002 offline.

This project is identified for completion in planning period A.

## sCEN-B-01: Route 156 Service Extension

This project would consist of the following improvements:

1. Construction of 24-inch gravity sewer to serve development north of Quaker Road and receive flow from Second Swamp Regional Pump Station– approximately 2,500 linear feet.

This project is identified for completion in planning period B.

#### sCEN-B-02 Second Swamp Regional Interceptor and Pump Station (Phase 1)

This project would consist of the following improvements:

- 1. Construction of 21-inch gravity interceptor approximately 5,600 linear feet.
- 2. Construction of 12-inch gravity sewer approximately 11,900 linear feet.
- 3. Construction of 2.50 MGD duplex suction lift pump station.
- 4. Construction of 16-inch force main approximately 8,300 linear feet.
- 5. Decommission SPS-010.
- 6. Decommission SPS-009.
- 7. Decommission SPS-015.

This project is identified for completion by planning period B.

#### sCEN-B-03: Decommission SPS-003

This project would consist of the following improvements:

- 1. Construction of 12-inch gravity sewer approximately 1,850 linear feet.
- 2. Take SPS-003 offline.

This project is identified for completion in planning period B.

#### sCEN-B-04: 6.5 MGD Regional Blackwater Swamp Pump Station Upgrade

This project would consist of the following improvements:

1. Installation of a third pump to increase pumping capacity to 6.5 MGD.

- 2. Valve and piping modifications.
- 3. Electrical improvements.

This project is identified for completion in planning period B.

## sCEN-B-05: 9.0 MGD Route 10 Regional Pump Station Upgrade

This project would consist of the following improvements:

- 1. Installation of a third pump to increase pumping capacity to 9.0 MGD.
- 2. Valve and piping modifications.
- 3. Electrical improvements.

This project is identified for completion in planning period B.

## sCEN-C-01: Second Swamp Regional Interceptor (Phase 2)

This project would consist of the following improvements:

- 1. Construction of 18-inch gravity sewer approximately 4,800 linear feet.
- 2. Construction of 21-inch gravity sewer approximately 11,000 linear feet.

This project is identified for completion in planning period C.

## sCEN-C-02: Decommission SPS-001

This project would consist of the following improvements:

- 1. Construction of 15-inch gravity sewer approximately 3,250 linear feet.
- 2. Take SPS-001 Offline.

This project is identified for completion in planning period C.

## sCEN-C-03: Decommission SPS-008 and SPS-016

This project would consist of the following improvements:

- 1. Construction of 12-inch gravity sewer approximately 5,200 linear feet.
- 2. Take SPS-008 & SPS-016 Offline.

This project is identified for completion in planning period C.

## sCEN-C-04: Decommission SPS-021

This project would consist of the following improvements:

- 1. Construction of 18-inch gravity interceptor approximately 4,500 linear feet.
- 2. Reverse flow of force main from SPS-024 to discharge at SPS-021.
- 3. Take SPS-021 Offline.

This project is identified for completion in planning period C.

## sCEN-C-05: Rives Road Service Extension

This project would consist of the following improvements:

- 1. Construction of 1.0 MGD duplex suction lift pump station.
- 2. Construction of 10-inch force main to discharge into Second Swamp interceptor approximately 4,900 linear feet.

This project is identified for completion in planning period C.

## sCEN-D-01: Route 106 and Route 156 Service Extension

This project would consist of the following improvements:

- 1. Construction of 2.0 MGD duplex suction lift pump station to serve development along Prince George Drive near Courthouse Road.
- 2. Construction of 12-inch forcemain along Ruffin Road approximately 20,600 linear feet.

This project is identified for completion in planning period D.

## Route 10 Service Area See Figure 10-3

## s010-CI-01: Rivers Edge Service Extension

This project would consist of the following improvements:

- 1. Construction of 8-inch gravity sewer approximately 4,100 linear feet.
- 2. Construction of 3-inch force main approximately 1,800 linear feet.
- 3. Construction of 0.15 MGD duplex suction lift pump station.

This project is necessary now to extend sewer service in River's Edge subdivision.

#### s010-CI-02: Beechwood Manor Service Extension

This project would consist of the following improvements:

1. Construction of 8-inch gravity sewer - approximately 6,000 linear feet.

This project is necessary now to extend sewer service in Beechwood Manor subdivision.

## s010-C-01: Route 10 Service Extension

This project would consist of the following improvements:

- 1. Construction of 12-inch gravity sewer approximately 3,800 linear feet.
- 2. Construction of 15-inch gravity sewer approximately 8,300 linear feet.
- 3. Construction of 1.5 MGD duplex suction lift pump station.
- 4. Construction of 10-inch forcemain approximately 14,600 linear feet.

This project is identified for completion in planning period C.

#### Route 301 Service Area See Figure 10-5

#### s301-CI-01: SPS-006 Rehabilitation

This project would consist of the following improvements:

- 1. Rehabilitate existing pump station.
  - a. Rehabilitated pump station will meet current sewer loadings and add capacity for a third future pump.

This project is necessary now to extend service life of SPS-006.

#### s301-C-01: Decommission SPS-008 & SPS-016

This project would consist of the following improvements:

1. Construction of 12-inch gravity sewer – approximately 5,300 linear feet.

This project is identified for completion in planning period C.

## s301-D-01: Route 301 Service Extension

This project would consist of the following improvements:

- 1. Construction of 0.35 MGD duplex suction lift pump station
- 2. Construction of 6-inch force main to serve development east of I-95 approximately 3,000 linear feet.
- 3. Bore 6-inch force main under I-95 approximately 350 feet.

This project is identified for completion in planning period D.

## s301-D-02: Route 301 Sanitary Sewer Upgrades

This project would consist of the following improvements:

- 2. Upsize existing gravity sewer South of SPS-006 to 12-inch diameter pipe approximately 5,300 linear feet of.
- 3. Upsize existing gravity sewer North of SPS-006 to 15-inch diameter pipe approximately 3,100 linear feet of.
- 4. Install third pump at SPS-006 to increase capacity to 1.75 MGD.

This project is identified for completion in planning period D.