Town of Warrenton – Water and Sewer System Capacity Evaluation Update

Town of Warrenton, VA

Work Order Number: 18672

Draft Report

12/06/2022

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1. Executive Summary

Whitman, Requardt & Associates (WRA) has updated the April 2015 Water and Sewer Capacity Evaluation to include new data and to determine the impact of potential new housing and commercial development in the Town and in the Town's water and wastewater service area. Data on potential development was provided by the Warrenton Community Development Department. WRA estimated water demand and wastewater loadings from new developments including impacts to water and wastewater system capacity from overall development over time through year 2040.

The current water system capacity is 2.68 MGD from 2 reservoirs and 3 groundwater production wells. The Town's Water Filtration Plant has a capacity of 3 MGD. Water from the reservoirs is treated at the Filtration Plant and well water is treated at the well head. Average water production from 2015 through 2021 is 1.16 MGD. The current wastewater system treatment capacity at the Town's Wastewater Treatment Plant is 2.5 MGD. The average daily wastewater loading from 2015 through 2021 is 1.86 MGD. The Town is planning on expanding the capacity of the Wastewater Treatment Plant to 3 MGD over the next 10 years.

The estimated water system demand from the combination of the developments analyzed by WRA is 1.31 MGD. The estimated buildout water demand plus the 2021 water demand of 1.11 MGD provides an estimate of 2.42 MGD of future water demand. The estimated wastewater loading demand from the combination of the developments is 1.18 MGD. The estimated buildout wastewater loading plus the 2021 wastewater loading of 1.72 MGD provides an estimate of 2.9 MGD of future wastewater loading.

Per this analysis the Town of Warrenton has adequate water supply capacity and wastewater treatment capacity to accommodate the new housing and commercial developments identified by the Community Development Department. Several assumptions and assertions are included in this conclusion:

- Water demand projections are conservative. Water demand and wastewater loading can be monitored as developments came online to project future demand with greater accuracy.
- Unaccounted for water or the difference between billed water and water production and billed water is approximately 10%. This compares favorably to other communities in Northern Virginia
- The Virginia Department of Health (VDH) requires that communities submit a plan for increasing or providing for additional water system capacity when demand reaches 80% of permitted capacity. For Warrenton, the 80% threshold limit will be reached when all the development included in this analysis is in place. Depending on the Town's service area growth rate, this threshold could be reached in the 2050 decade or beyond.
- Extraneous water entering the wastewater system, also referred to as infiltration and inflow (I&I) constitutes about 49% of the wastewater flow entering the wastewater treatment plant. This level of I&I, although high, is not unusually high for wastewater collection systems similar in age to Warrenton's. WRA recommends that the Town continue to investigate and remediate I&I problems in the service area.
- The Virginia Department of Environmental Quality (DEQ) recognizes flow loadings approaching 95% of the design capacity (or 2.85 MGD) as the threshold level for planning WWTP capacity management strategies and improvements. This threshold level will be reached when all the development included in this analysis is in place. Depending on the Town's service area growth rate, this threshold could be reached in 2045 or beyond.
- The Turkey Run Pump Station can be used to receive flows from Laurel Ridge Community College. Although flows from Laurel Ridge can be managed by the Turkey Run PS, a detailed analysis should be made of the pump station before any additional flows are added.
- The Taylor Run Pump Station cannot receive flows from the Arrington Development and the Turkey Run Pump Station without improvements to the existing pumping system including the wet well. A detailed analysis of the existing system with recommendations for improvements to handle additional flows should be conducted before any new flows are added to this system.

2. Purpose

The Town of Warrenton authorized Whitman Requardt and Associates (WRA) to update the Water and Sewer System Growth and Capacity Report prepared in April 2015. The 2015 Report considered existing and future sewer loadings and existing and future potable water demands for the Town's water and sewer service. In the 2015 Report future sewer loadings and water demands were calculated based on developable lots within the service area.

This Report Update will analyze current and future loadings and demands based on information provided by the Town's Community Development Department. This information includes data on new residential and commercial developments that have been approved by the Town or have been submitted to the Town for review and approval. In this report the following information was also included:

- Wastewater flow data from the Town's wastewater treatment plant since 2015
- Water production data from the Town's water treatment plant (WWTP) since 2015
- Water supply information for the Town's reservoirs and wells
- Water billing information
- Proposed capacity changes to treatment capacity at the Town's WWTP
- Capacity of the Turkey Run Pump Station (PS #9) and the Taylor Run Middle School Pump (PS #6) to convey future wastewater flows from new developments in their respective sewer sheds

3. Existing Water Capacity and Demands

3.1 Water Production, Distribution and Demand

Water supply for the Town of Warrenton is provided by 2 reservoirs, located on Cedar Run, and 3 groundwater wells. The Airlie reservoir (upstream) and the Warrenton reservoir (downstream), operate in series. The Airlie Reservoir provides a safe yield of 1.16 million gallons per day (MGD) and the Warrenton Reservoir provides a safe yield of 1.14 MGD for a total reservoir safe yield of 2.3 MGD. Reservoir safe yield is defined as the rate at which water can be withdrawn during a critical dry period without depleting the supply to such an extent that withdrawal of water is no longer economically feasible. Safe yield is determined by the Commonwealth of Virginia Department of Environmental Quality (DEQ). Water from the Airlie reservoir flows to the Warrenton reservoir further downstream on Cedar Run and is withdrawn from the Warrenton Reservoir for treatment at the Water Filtration Plant. The Water Filtration Plant has a capacity of 3 MGD. Water from the filtration plant is distribution throughout the Town and Town's water service area.

The Town also owns and operates 3 groundwater production wells. Well #5 and Well #6 provide 0.076 MGD of water directly to the Town's distribution system. Well #3 provides an additional 0.304 MGD of water supply and the Town's total groundwater capacity is 0.38 MGD. Similar to reservoir safe yield, wells are not operated at full capacity all of the time. However, for purposes of this analysis, groundwater well capacity of 0.38 MGD is used. Water from the Town's wells are treated at the wellhead before distribution.

The Town has an approximate total water supply capacity of 2.68 MGD (reservoir plus wells).

Figure 3.1 depicts average water production from the reservoir and groundwater systems for the years 2015 to 2021:

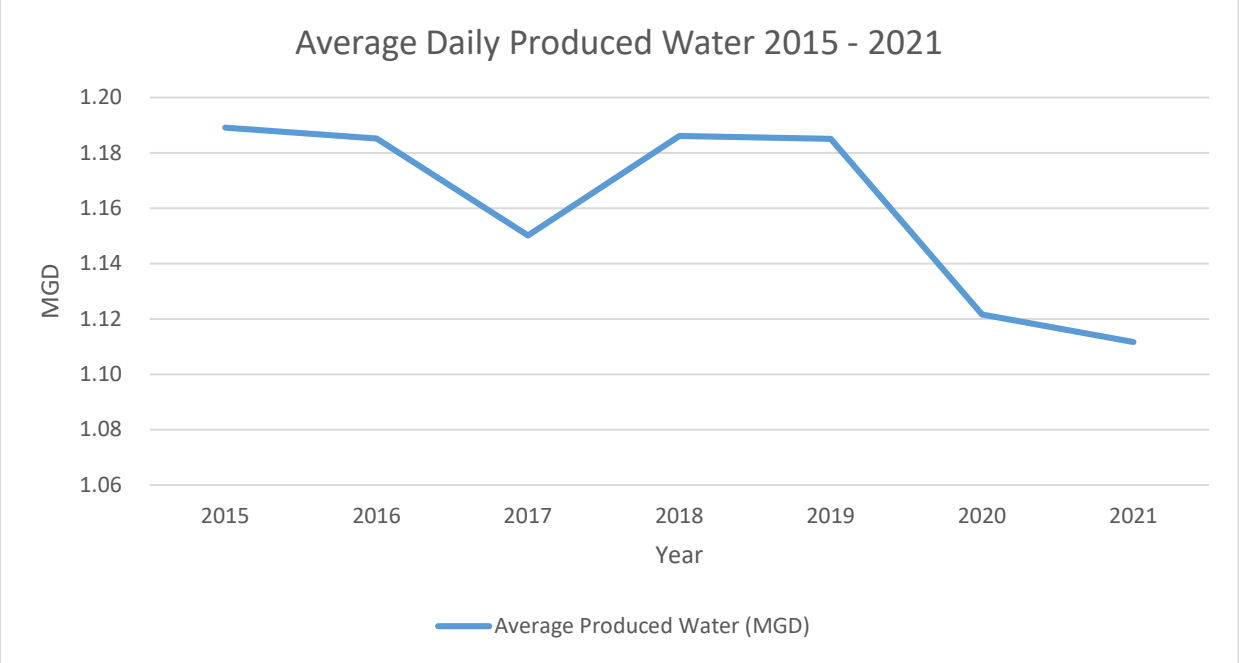

Figure 3.1: Average Daily Produced Water 2015 - 2021

The average water production for 2015 through 2021 is 1.16 MGD.

3.2 Water Production Data and Water Billing Data

WRA analyzed water production data and water billing data for the period 2015 through 2021. There are approximately 4,800 water accounts (residences and businesses) billed monthly. The billing data provided by the Town was adjusted for sale of water to construction contractors and other users not normally billed and for water lost through leaks. Water used to fight fires and to flush water mains is not accounted for. Water accounts are billed at the end of every month.

Water produced/distributed data was compared to billed water data on a month-to-month basis. Water volumes were converted to millions of gallons per day (MGD) and the difference between produced/distributed water and billed water was compared. The difference between these two values, is defined as unaccounted for water. Figure 3.2 depicts unaccounted for water for the period 2015 to 2021.

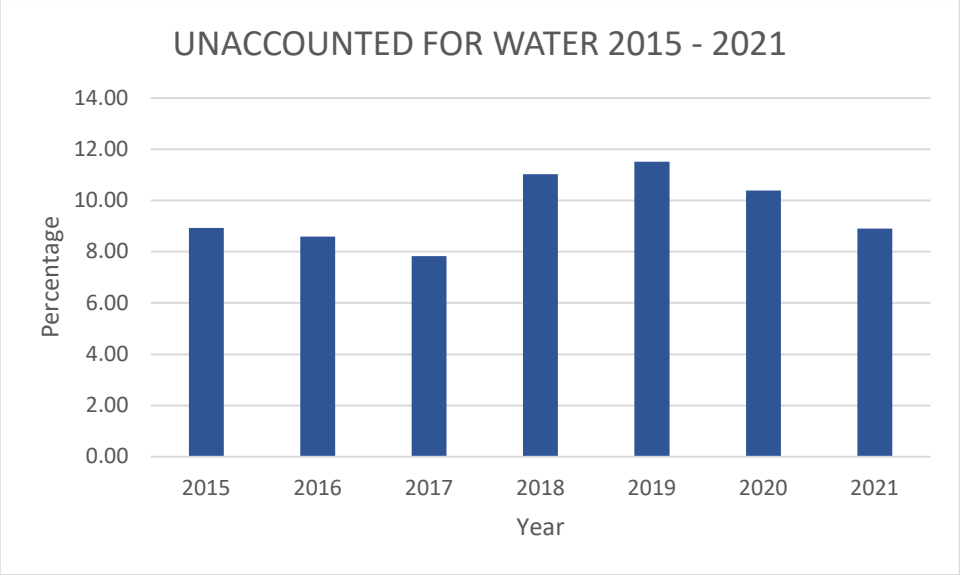

Figure 3.2: Unaccounted for Water 2015 - 2021

The average unaccounted for water in the most recent 7-year period is 9.6%. Unaccounted for water includes water lost through leaks in the distribution system, water used in firefighting, water taken illegally through fire hydrants and other sources and water used to flush mains and for other water system maintenance work.

The Town's 10% level of unaccounted for water compares favorable to other communities in Northern Virginia and does not indicate significant problems with the water distribution system or problems with the way the water system is managed.

4. Existing Wastewater Treatment Capacity

The Warrenton Wastewater Treatment Plant (WWTP) is permitted for treatment and discharge of 2.5 million gallons per day (MGD), average daily flow. Wastewater flows have averaged approximately 1.86 MGD over the past 7 years. The Town and WRA are currently conducting preliminary engineering for projects that will allow expansion of WWTP capacity to 3.0 MGD, average daily flow. Section 6 of this report describes how future wastewater flow projections will impact the proposed 3.0 MGD WWTP capacity.

4.1 Wastewater Flows

Daily wastewater flow data for the period 2015 – 2021 is shown in Figure 4.1.

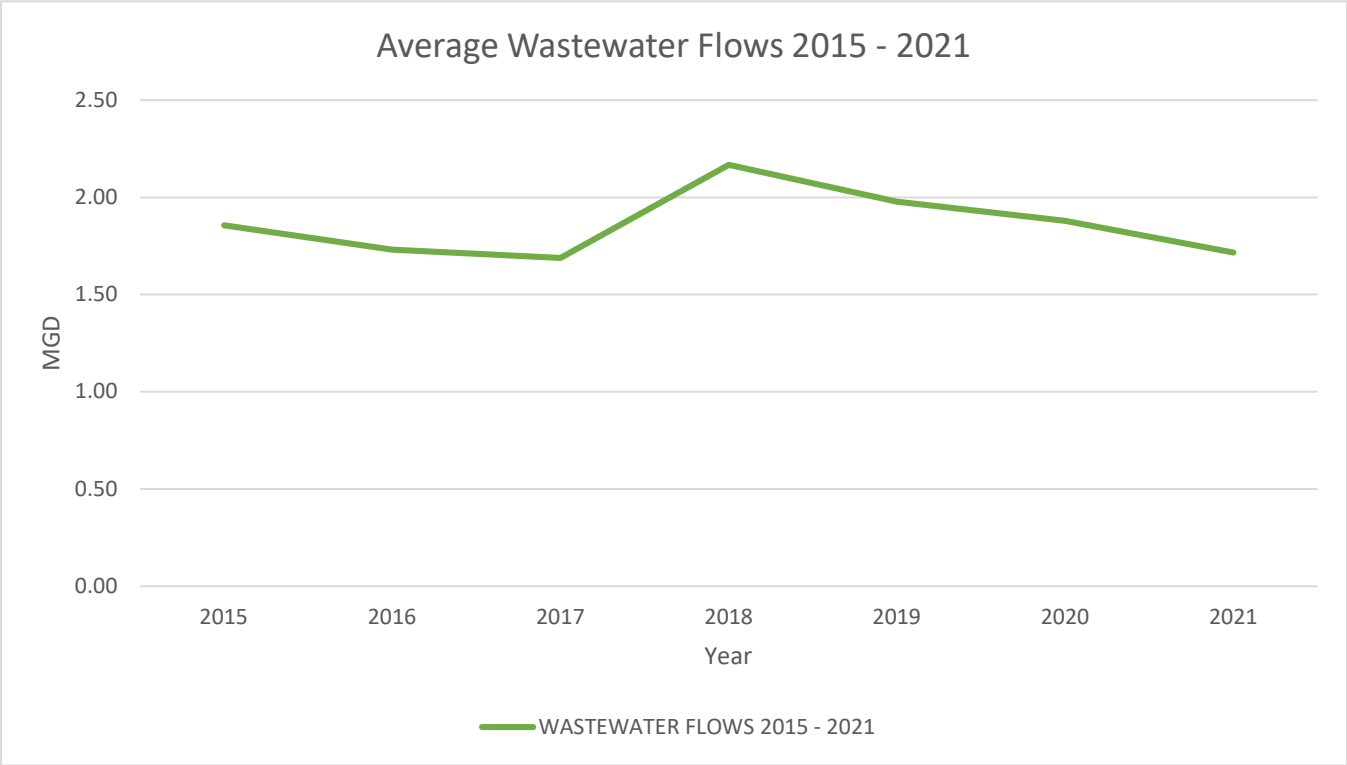

Figure 4.1: Average Wastewater Flows 2015 – 2021

Wastewater flows include sewage discharge from households and businesses and extraneous water that enters the collection pipeline system. Extraneous water sources include infiltration of groundwater through defection sewer pipe joints, manhole walls and other pipe defects in the collection system. Extraneous flows include Inflow of water discharged directly into the sewer system through basement and foundation drains, roof downspouts, manhole covers, cross connections with stormwater systems and other direct connections. Wastewater flows in municipal systems vary from year to year because infiltration and Inflow (I&I), varies depending on rainfall. I&I tends to be higher in years with excessive precipitation (rain and snow) such as occurred in 2018.

4.2 Wastewater System Extraneous Flows

WRA compared wastewater flow data and water billing data for period 2015-2021. Water billing data is the best measure of water consumed in municipalities. Figure 4.2 shows billed water versus wastewater loadings in the Town of Warrenton for the last 7 years.

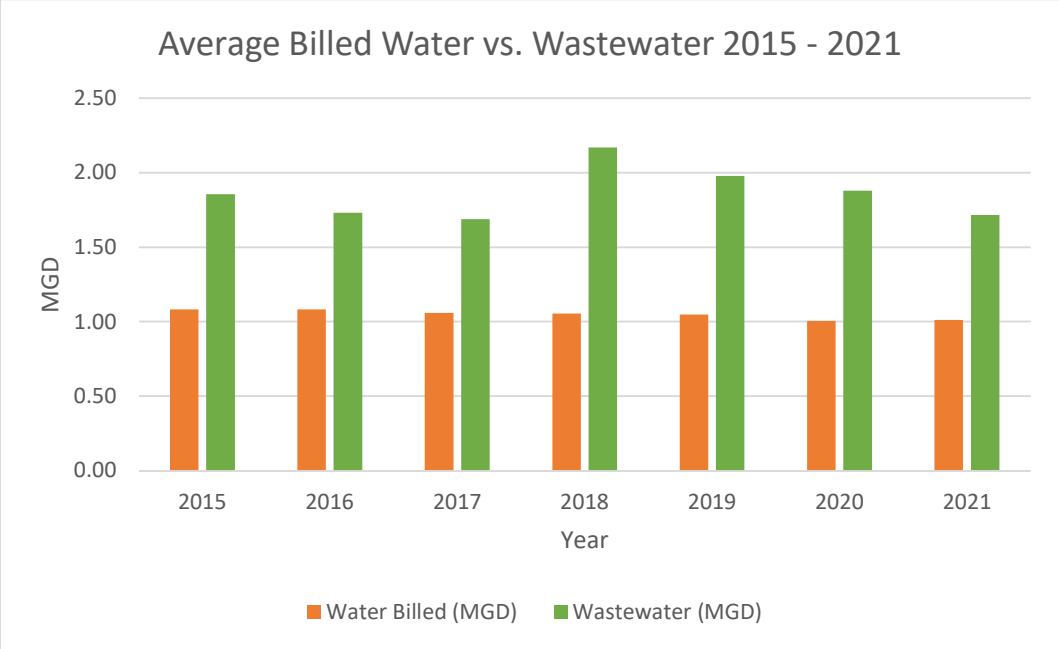

Figure 4.2: Average Billed Water vs. Wastewater 2015 – 2021

Billed water data used in this figure was discounted by 90% to account for customer water not returned to the wastewater system such as water used in landscape and lawn irrigation. Average annual I&I for the past seven years was calculated by subtracting wastewater flows as recorded at the WWTP from billed water (discounted). The difference is the measure of extraneous water or I&I entering the wastewater collection system.

Average I&I in the Warrenton system is calculated to be 0.92 MGD over the past years or 49% of total flows treated at the WWTP. This amount of I&I in the wastewater collection system is not unusual in municipalities with older wastewater collection infrastructure. The calculated 2015-2021 I&I flow component of 49% is approximately the same percentage as the I&I component calculated in the 2015 Water & Sewer System Capacity Evaluation.

5. Future Water Demand

5.1 Projected Water Demand from New Developments

The Town of Warrenton's Community Development Department provided WRA with data for proposed residential and commercial growth in the Town. Forty-two (42) projects were identified including residential and commercial developments. WRA also included Laurel Ridge Community College as a potential new consumer of Warrenton water and wastewater services. Laurel Ridge Community College is currently not served by the Town's.

The developments include new housing (Single-family homes, apartments, townhomes, hotels, senior care facilities) and commercial facilities (offices, medical facilities, retail, entertainment, industrial and academic facilities). Projects vary considerably in size from a few single-family houses to hundreds of apartment units. Project status varied also, with some developments approved by Community Development and other projects in review. WRA projected water demand and wastewater loadings for the developments based on the type of residential or commercial unit within the development. WRA used standard water demand (gallons per day) factor for each type of unit based on water demand factors used by the Town and/or by other utilities such as Prince William Service Authority and the Town of Leesburg. Information on the proposed developments, including the number of units, the and the total water demand and wastewater loading generated by the developments is included in Appendix A. The demand factors used to calculate water demand are included in Table 5.1.

Table 5.1: Residential Water Demands per Unit

Residential	Water Demand per Unit (GPD)
Single-Family (units)	300
Multifamily (units)	300
Apartment (units)	300
Townhouse (units)	300
Senior Home (units)	100
Hotel (rooms)	100

It should be noted that conservative demand values were chosen for residential units.

Commercial demand factors are included in Table 5.2.

Table 5.2: Commercial Water Demands per Square Foot

Commercial	Water Demand per Square Foot (GPD)
General (SF)	0.2
Entertainment (SF)	0.2
Academic (SF)	0.29
Office/Employment (SF)	0.29
Medical Offices (SF)	0.29
Industrial	Water Demand per Square Foot (GPD)
General (SF)	0.02

According to the U.S. Department of Education, Laurel Ridge Community College (LRCC) had a student population of 3,474 students in the 2018 – 2019 academic year. WRA used 15 gallons per day per student as the factor for calculating LRCC demand.

Additionally, there are some residences in Warrenton that are currently not connected to the Town's water system and/or the sewer system. The Town plans on incorporating these residences into the utility systems in the future and WRA included these units when calculating future water demand.

Table 5.3 summarizes the total number of residential units and commercial square footage and associated water demand for the proposed developments:

Table 5.3: Total Water Demand per Land Use Type

Land Use Type		Total Units	Total Water Demand (gal/day)
Residential	Single-Family (units)	1,479	469,500
	Multi-Family (units)	120	36,000
	Apartments (units)	1,420	426,000
	Townhouse (units)	296	88,800
	Senior Home (units)	60	6,000
	Hotel (rooms)	360	36,000
Commercial	General (SF)	200,711	40,142
	Entertainment (SF)	245,000	49,000
	Academic (SF)	220,000	63,800
	Office/Employment (SF)	40,000	11,600
	Medical Offices (SF)	50,000	14,500
Industrial	General (SF)	759,500	15,190
Community College	Students (unit)	3,474	52,110
		TOTAL	**1.31 MGD**

5.2 Future Water Demand and Water Supply Capacity

Total water demand for the target year 2040 was calculated to be 2.42 MGD, assuming all proposed developments are eventually constructed. This demand projection value includes the average water demand in 2021 (1.11 MGD) plus the total buildout demand (1.31 MGD).

Figure 5.1 displays cumulative water demand by addition of the demand created by the named developments. The order or chronology of the projects is not definitive; however, cumulative water demand will not change.

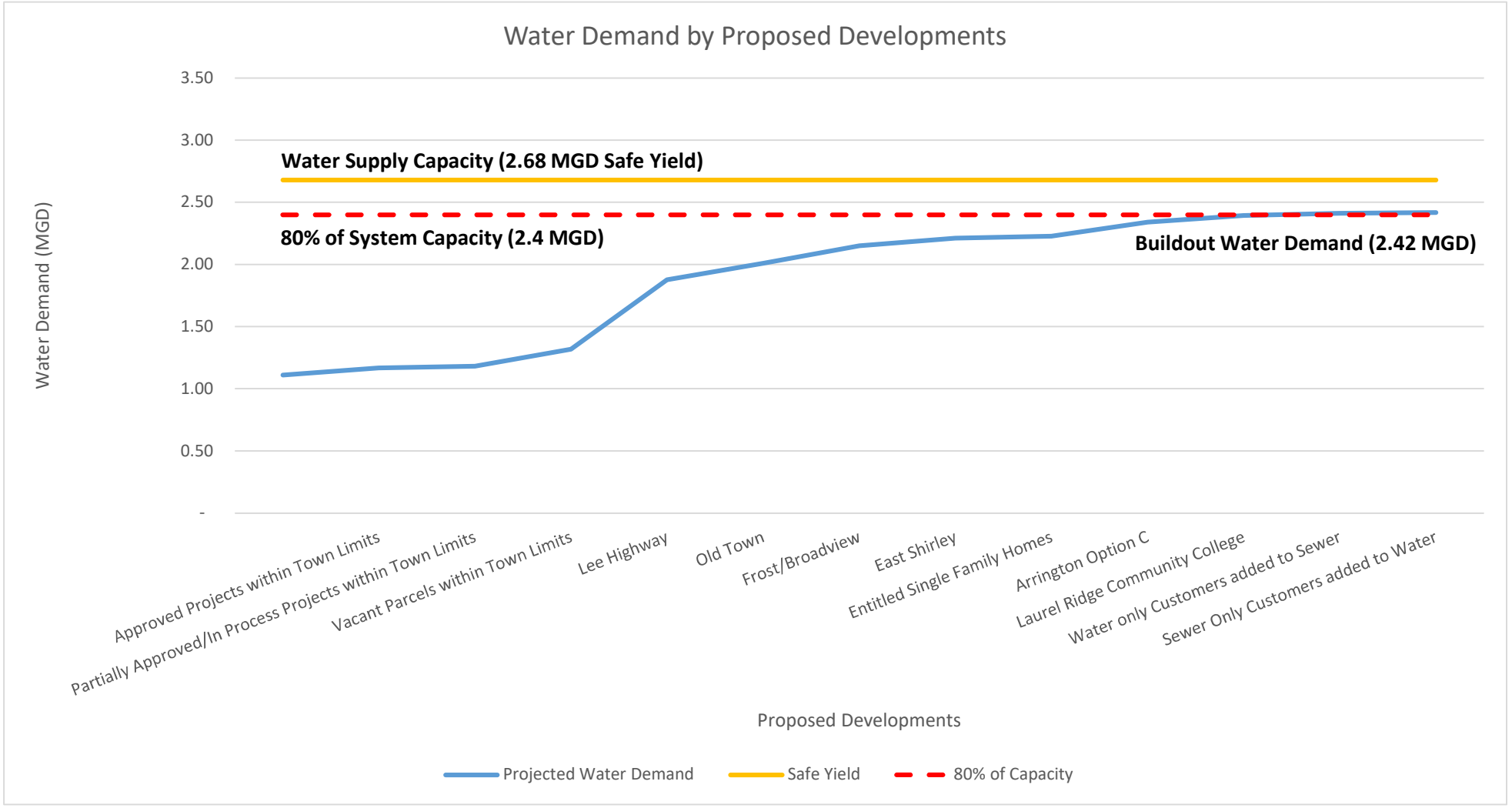

Figure 5.1: Water Demand by Proposed Developments

Buildout (all developments constructed) water demand is 2.42 MGD compared to water supply capacity of 2.65. Estimated demand is 91% of water supply capacity. Virginia Waterworks Regulation 12 VAC 5-590-520 requires municipalities to submit a written plan for developing adequate or additional water supply to the Virginia Department of Health, Office of Drinking Water, when water production exceeds 80% of the permitted design capacity for 3 consecutive months.

It should be noted that the estimated buildout water demand by development is conservative. Although the time frame for the progression of development construction through buildout is unknown, time-step analyses of water demand was also conducted.

An initial time step progression is shown in Figure 5.2. This linear growth time-step progression assumes that all development is completed by 2040, the target year for the current Warrenton Comprehensive Plan. The annual water demand growth rate is 7% for the linear growth model.

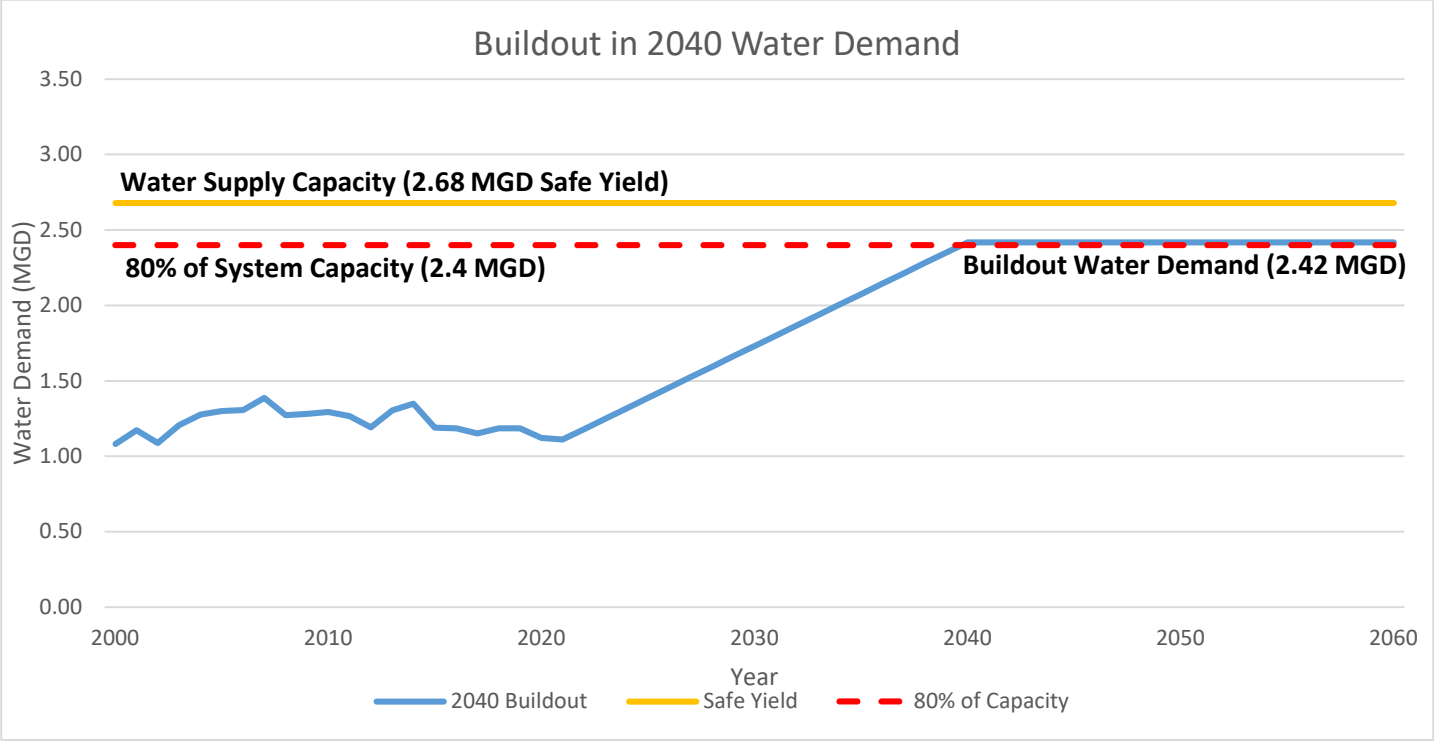

Figure 5.2: Buildout in 2040 Water Demand

Additional water demand growth models were analyzed by WRA. According to the U.S. Census Bureau, population growth in the Town of Warrenton and Fauquier County from 2010 to 2020 averaged 1% annually. Figure 5.3 depicts water demand assuming a 1% annual growth in water demand, similar to the most recent population growth pattern for The Town. For this growth model, 80% of system capacity is reached in 2099.

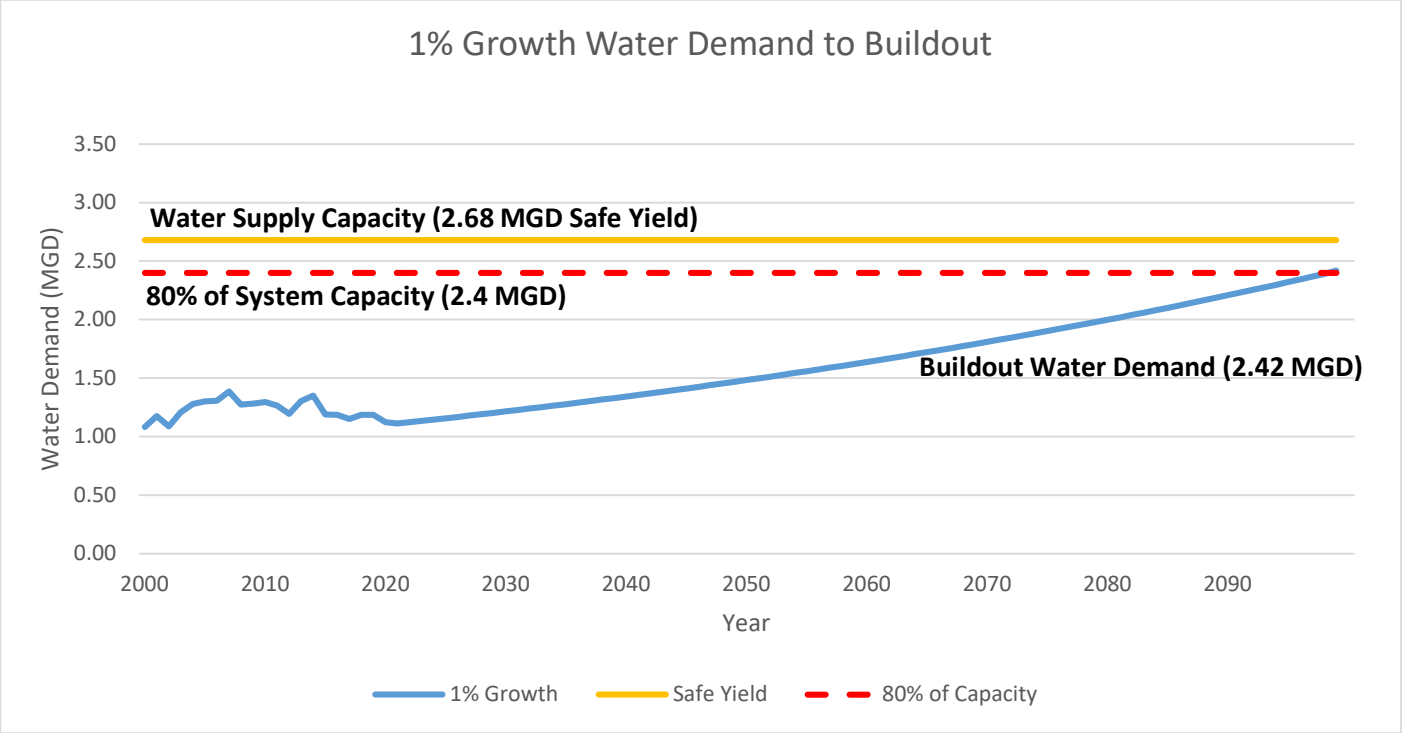

Figure 5.3: 1% Growth Water Demand to Buildout

Figure 5.4 shows a 2.5% annual increase in water demand. This model is more consistent with a more robust population and economic growth that could occur in Warrenton. In this case, 80% of capacity is reached in 2053.

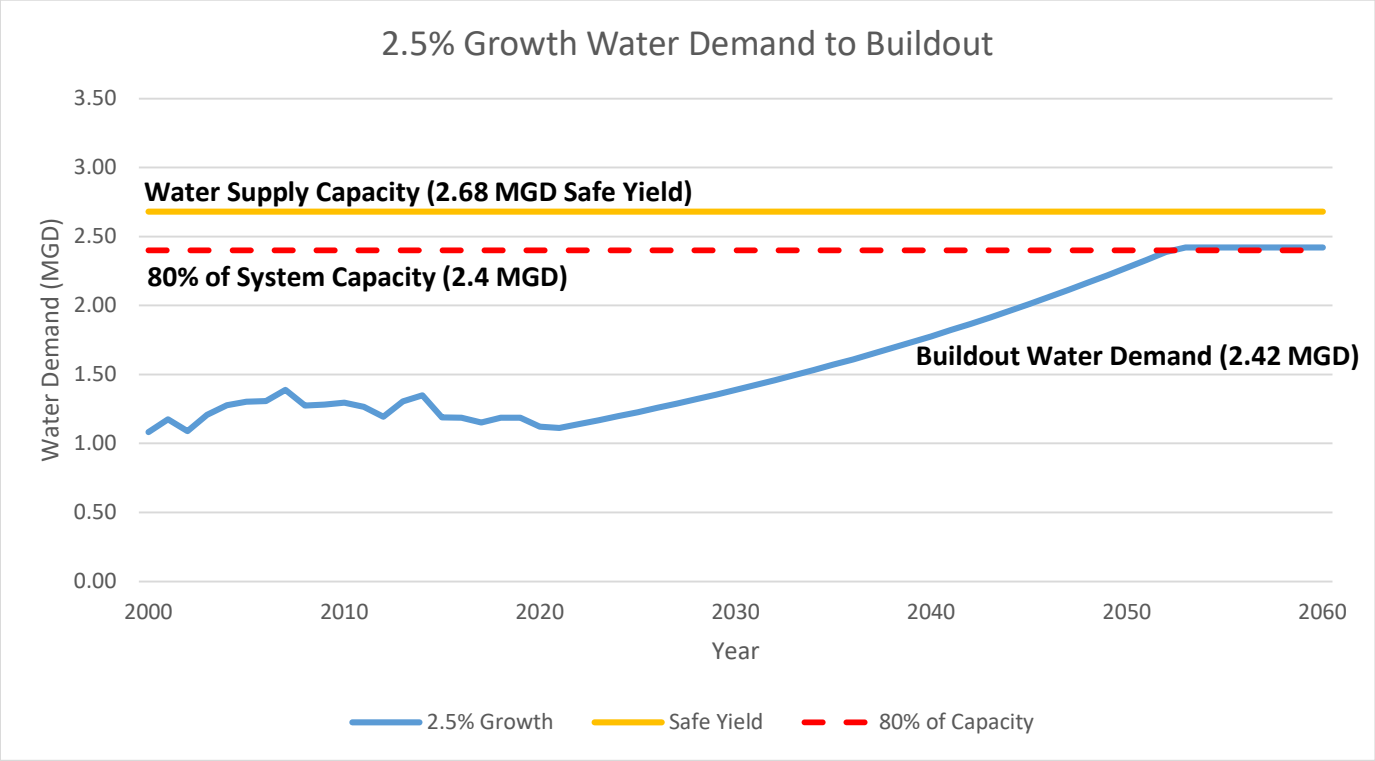

Figure 5.4: 2.5% Growth Water Demand to Buildout

6. Future Wastewater Loading

6.1 Wastewater Loading Projections

Future wastewater loadings are calculated based on an assumed 90% return of water consumed to the wastewater collection system. Water demand projections are described in Section 5 and included in Appendix A. Appendix A includes a compilation of expected wastewater loadings, based on water demand. The estimated total wastewater loading from all the developments described in Appendix A is 1.18 MGD (average daily flow basis).

Future total wastewater loading for Warrenton is estimated by adding the average wastewater flow in 2021 to the estimated buildout flow. The average daily wastewater flow in 2021 was 1.72 MGD and the additional flow from buildout is 1.18 MGD. Total future estimated wastewater loading is 2.90 MGD. It should be noted that the 2021 wastewater loading includes a significant extraneous water (I&I) component. I&I from the new developments is considered negligible in this analysis, although the base I&I in the beginning year of 2021 remains and is a component of overall wastewater loading.

6.2 Future Wastewater Loading and Capacity

Figure 6.1 depicts cumulative wastewater loading by addition of the demand created by the named developments. The order or chronology of the projects is not definitive; however, cumulative water demand will not change. As shown graphically, the capacity of the existing WWTP (2.5 MGD) is exceeded before all the proposed developments are completed. The Town is currently planning on increasing the capacity of the WWTP to 3.0 MGD within 10 years, approximately. Under this wastewater loading model, The Town's wastewater would be accommodated if the expansion of the WWTP is implemented as currently planned.

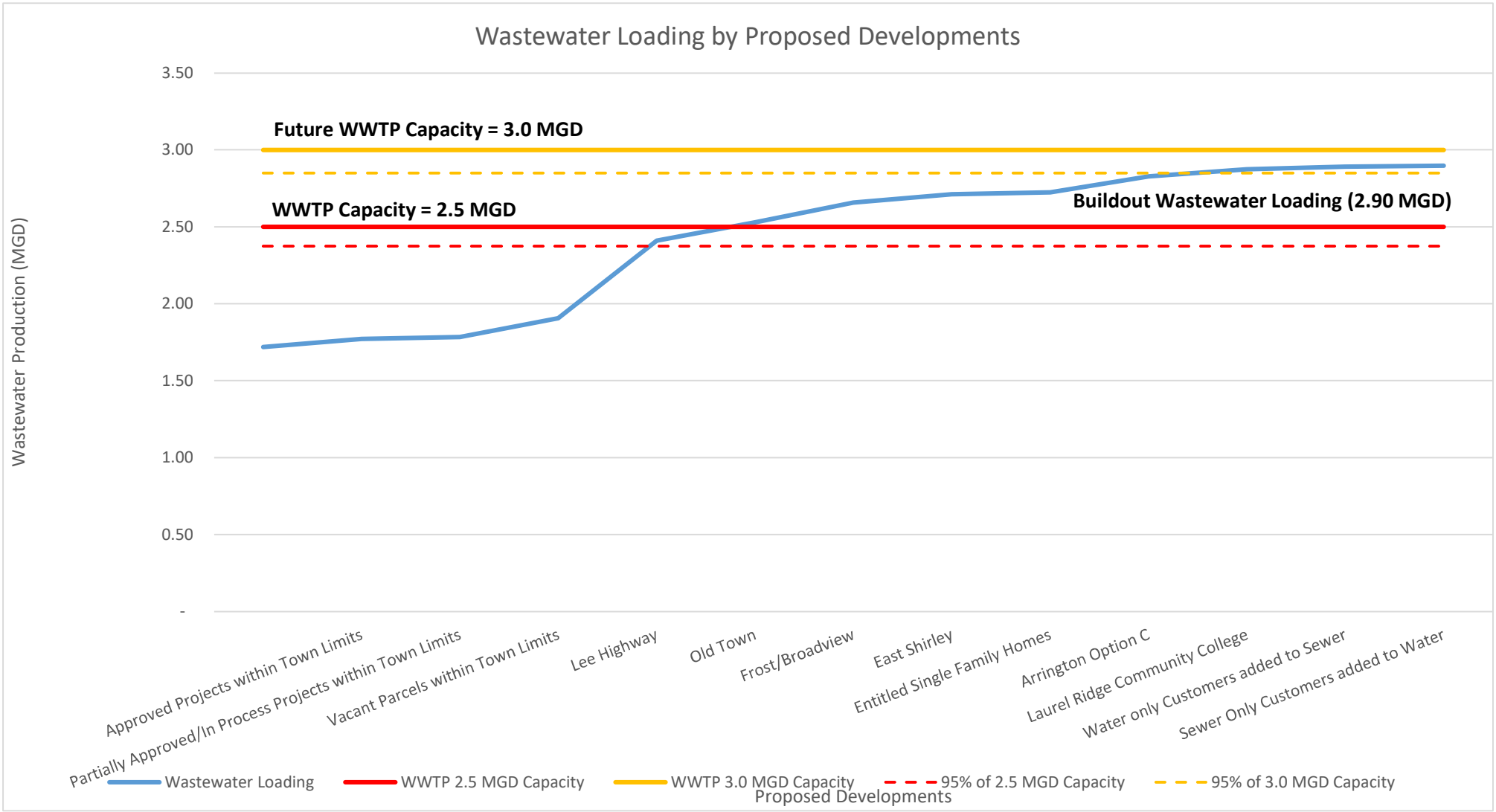

Figure 6.1: Wastewater Loading by Proposed Developments

Although the upsized WWTP will accommodate loadings from the proposed developments, additional WWTP capacity enhancements may be necessary as loadings approach 2.90 MGD. The Virginia Department of Environmental Quality (DEQ) recognizes flow loadings approaching 95% of the design capacity (or 2.85 MGD) as a trigger point for planning WWTP capacity management strategies and improvements.

An initial time step progression is shown in Figure 6.2. This linear growth time-step progression assumes that all development is completed by 2040, the target year for the current Warrenton Comprehensive Plan. The annual wastewater loading demand growth rate is the same as for water demand, 7%. With buildout by 2040, the current 2.5 MGD WWTP capacity is exceeded by 2034. With the proposed increased WWTP capacity, 95% of treatment capacity is reached in 2039.

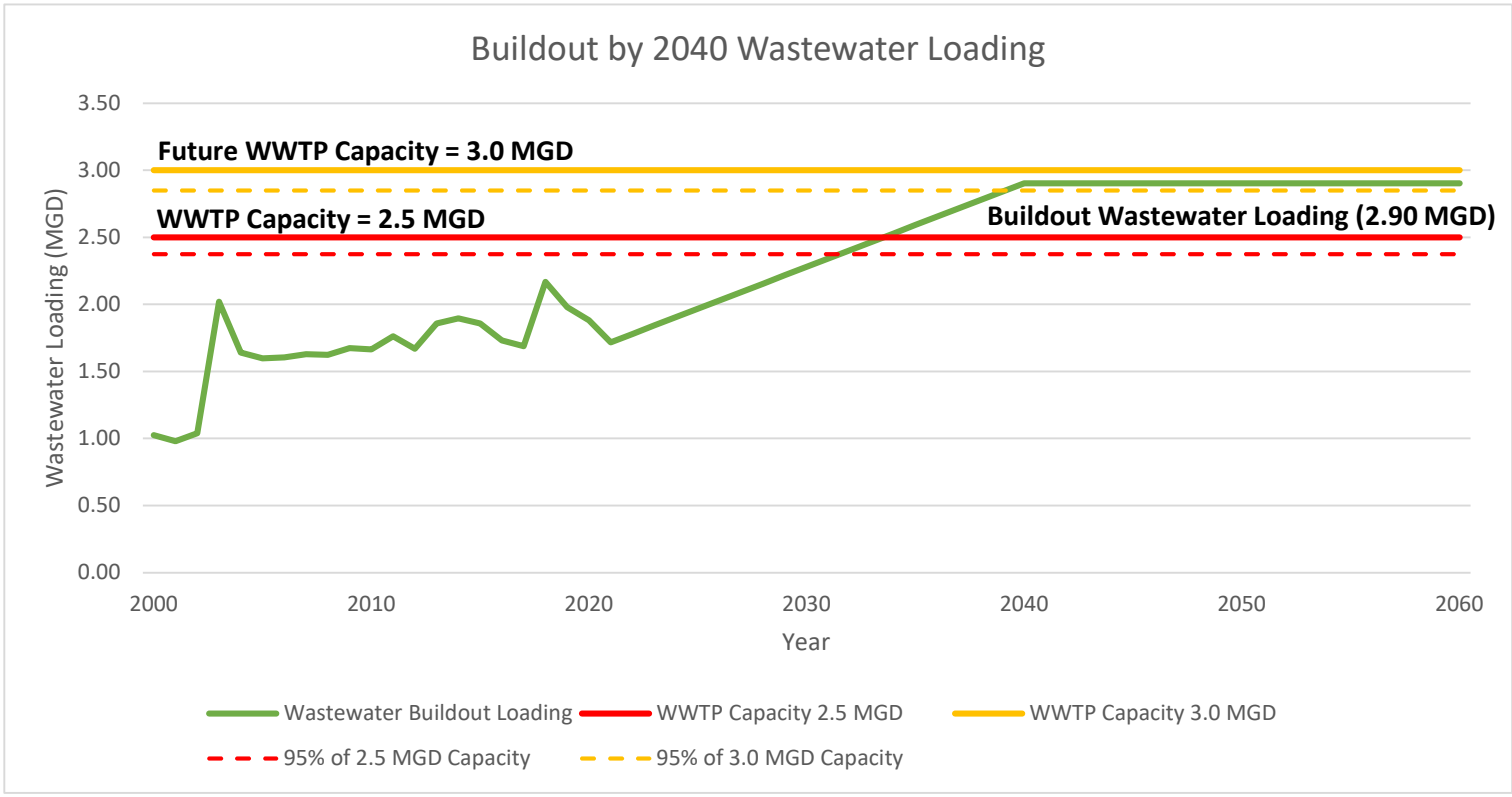

Figure 6.2: Buildout by 2040 Wastewater Loading

Similar to the water demand projection graphs, 6.3 depicts wastewater loadings at a 1% annual growth rate.

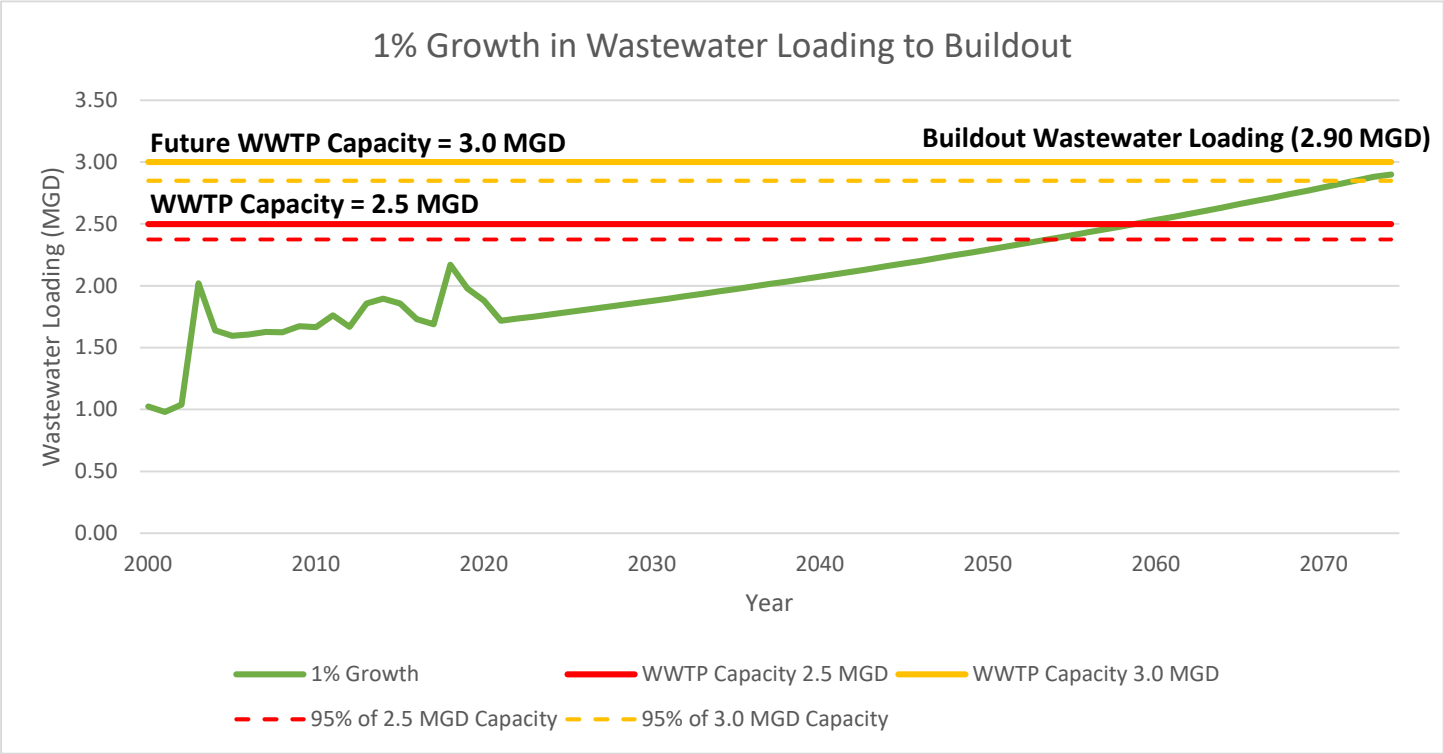

Figure 6.3: 1% Growth in Wastewater Loading to Buildout

In this case, wastewater loading would not reach the 3 MGD 95% threshold until 2071.

Figure 6.4 depicts a more robust 2.5% annual rate in wastewater loadings.

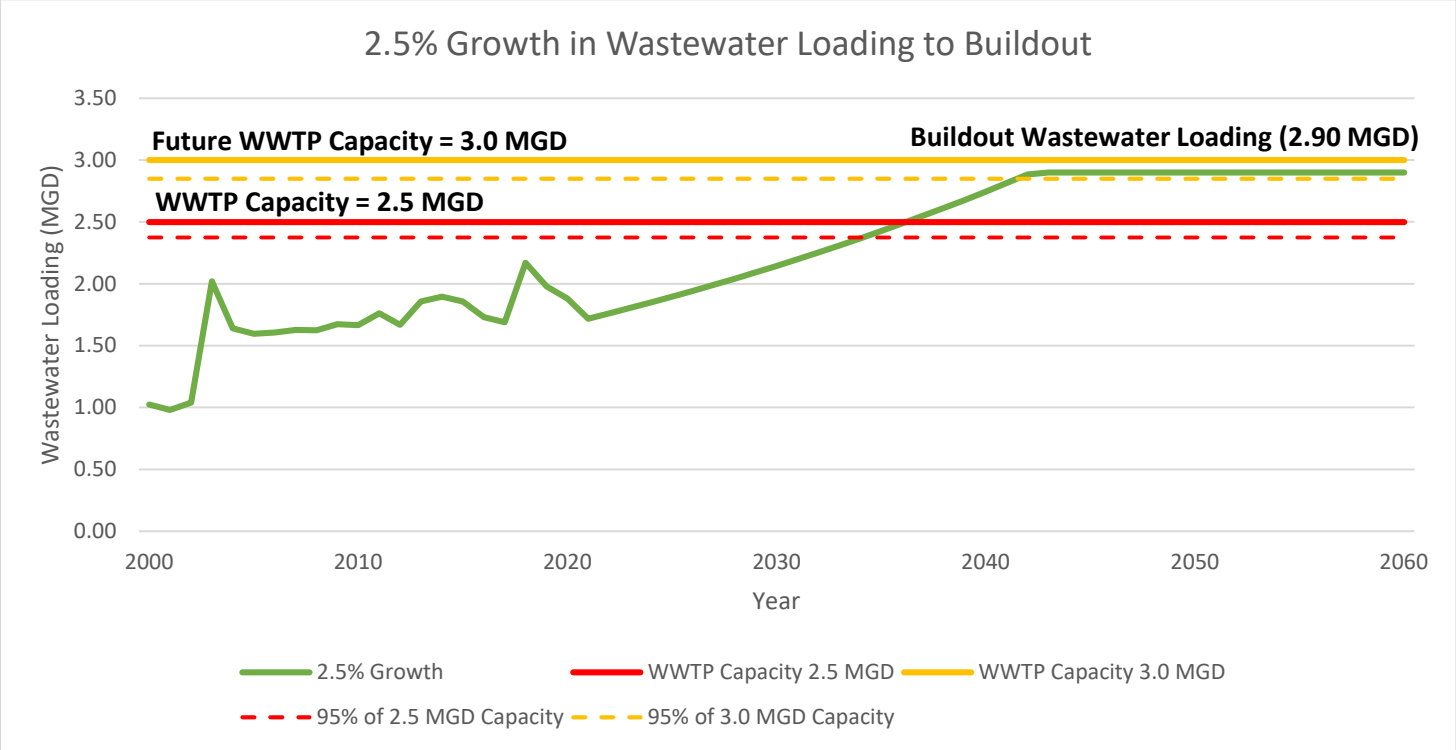

Figure 6.4: 2.5% Growth in Wastewater Loading to Buildout

In this scenario, wastewater loadings would not reach the 3 MGD 95% threshold until 2043.

7. Turkey Run and Taylor Run Wastewater Pumping Station Capacities

The Town of Warrenton owns and operates 11 wastewater lift stations (pump stations) that help convey wastewater generated in the outer reaches of the wastewater service area into the central part of the wastewater collection system for conveyance by gravity into the wastewater treatment plant.

Data for 2 of the pump stations Taylor Run (PS #6) and Turkey Run (PS #9) were analyzed to determine the impact of wastewater flows from new developments into the two stations. In the future wastewater, flows from Laurel Ridge Community College will flow into the Turkey Run Pump Station. Flows from the Turkey Run PS are then discharged to the Taylor Run PS. Taylor Run will also receive flows from the new Arrington development.

Laurel Ridge Community College is estimated to produce approximately 0.05 MGD of wastewater. Assuming a peak flow value of 4, the wastewater volume would increase to 0.2 MGD, or 139 gallons per minute (GPM). The proposed Arrington development is estimated to produce approximately 0.1 MGD of wastewater. A peak volume for this flow is 0.4 MGD, or 278 GPM.

WRA's analysis of the Turkey Run PS indicates that additional flows from Laurel Ridge Community College can be discharged into the Turkey Run PS using the existing pumps, wetwell and pump station appurtenances.

The Taylor Run PS will receive flows coming from the Turkey Run Pump Station and has a capacity of 600 GPM. Current wastewater flows into the Taylor Run PS are estimated to be 704 GPM. A pumping rate of 704 GPM is within the range of the new pumps installed in 2011. Adding peak flows from Laurel Ridge Community College and the proposed Arrington development would increase flows to the Taylor Run PS by 417 GPM (approximately 1121 GPM). This increase in flow would require larger horsepower motors and a different impeller if the same pumps are used. Taylor Run PS also currently experiences a large number of pump starts each day. This condition indicates that the wetwell may be too small for existing flows, even though the pumps are able to manage these flows.

The Turkey Run PS appears to be able to receive the future flows from Laurel Ridge Community College while the Taylor Run PS would probably need substantial modifications or replacement to serve the Arrington Development and the Turkey Run flows.

WRA recommends that a more detailed analysis be conducted for both stations before additional flows are discharged into them.

Appendix 1
Water & Wastewater Projection Allocation Summary

Totalized Units Based on Project Development		IN-TOWN								OUT OF TOWN				TOTALS
Land Use Type		Approved Projects within Town Limits	Partially Approved/In Process Projects within Town Limits	Vacant Parcels within Town Limits	Lee Highway	Old Town	Frost/Broadview	East Shirley	Entitled Single Family Homes	Arrington Option C	Laurel Ridge Community College	Water only Customers added to Sewer	Sewer only Customers added to Water	
Residential	Single-Family (units)	190	36	331	-	206	235	117	50	314	-	63	23	1,479
	Multi-Family (units)	-	-	-	-	-	120	-	-	-	-	-	-	120
	Apartment (units)	-	-	-	1,336	84	-	-	-	-	-	-	-	1,420
	Townhouse (units)	-	-	34	108	7	-	84	-	63	-	-	-	296
	Senior Home (units)	-	-	-	-	-	60	-	-	-	-	-	-	60
	Hotel (rooms)	-	-	-	115	115	115	-	-	15	-	-	-	360
Commercial	General (SF)	-	12,550	60,161	98,000	10,000	20,000	-	-	-	-	-	-	200,711
	Entertainment (SF)	-	-	-	100,000	145,000	-	-	-	-	-	-	-	245,000
	Academic (SF)	-	-	-	220,000	-	-	-	-	-	-	-	-	220,000
	Office/Employment (SF)	-	-	-	40,000	-	-	-	-	-	-	-	-	40,000
	Medical Offices (SF)	-	-	-	-	-	50,000	-	-	-	-	-	-	50,000
Industrial	General (sq ft)	-	-	759,500	-	-	-	-	-	-	-	-	-	759,500
Community College	Campus (units)	-	-	-	-	-	-	-	-	-	3,474	-	-	3,474

Additional Water Demand Based on Projected Development

Land Use Type		IN-TOWN								OUT OF TOWN				TOTAL (gal/day)
		Approved Projects within Town Limits	Partially Approved/In Process Projects within Town Limits	Vacant Parcels within Town Limits	Lee Highway	Old Town	Frost/Broadview	East Shirley	Entitled Single Family Homes	Arrington Option C	Laurel Ridge Community College	Water only Customers added to Sewer	Sewer Only Customers added to Water	
Residential	Single-Family (units)	57,000	10,800	99,300	-	61,800	70,500	35,100	15,000	94,200	-	18,900	6,900	469,500
	Multi-Family (units)	-	-	-	-	-	36,000	-	-	-	-	-	-	36,000
	Apartment (units)	-	-	-	400,800	25,200	-	-	-	-	-	-	-	426,000
	Townhouse (units)	-	-	10,200	32,400	2,100	-	25,200	-	18,900	-	-	-	88,800
	Senior Home (units)	-	-	-	-	-	6,000	-	-	-	-	-	-	6,000
	Hotel (rooms)	-	-	-	11,500	11,500	11,500	-	-	1,500	-	-	-	36,000
Commercial	General (SF)	-	2,510	12,032	19,600	2,000	4,000	-	-	-	-	-	-	40,142
	Entertainment (SF)	-	-	-	20,000	29,000	-	-	-	-	-	-	-	49,000
	Academic (SF)	-	-	-	63,800	-	-	-	-	-	-	-	-	63,800
	Office/Employment (SF)	-	-	-	11,600	-	-	-	-	-	-	-	-	11,600
	Medical Offices (SF)	-	-	-	-	-	14,500	-	-	-	-	-	-	14,500
Industrial	General (sq ft)	-	-	15,190	-	-	-	-	-	-	-	-	-	15,190
Community College	Students (units)	-	-	-	-	-	-	-	-	-	52,110	-	-	52,110
	Sub-Total Water (MGD)	0.06	0.01	0.14	0.56	0.13	0.14	0.06	0.02	0.11	0.05	0.02	0.01	**1.31**
	Sub-Total Wastewater (MGD)	0.05	0.01	0.12	0.50	0.12	0.13	0.05	0.01	0.10	0.05	0.02	0.01	**1.18**

Average Water Demand (MGD)

WRA Calculated Wastewater Demand (MGD)

Total Water and Wastewater Demand Including Projected and Existing

Existing 2021 + New Project Water Demand (MGD)	1.11	1.17	1.18	1.32	1.88	2.01	2.15	2.21	2.23	2.34	2.39	2.41	2.42	**2.42**	**Totalized Projected Water Demand (MGD)**
Existing 2021 + New Project Wastewater Demand (MGD)	1.72	1.77	1.78	1.91	2.41	2.53	2.66	2.71	2.72	2.83	2.87	2.89	2.90	**2.90**	**Totalized Projected Wastewater Demand (MGD)**