Issue Analysis Form

Date: April 12, 2022
Item: Report -Hydraulic Analysis of County Water & Wastewater System

Lead Department(s): Engineering & Utilities

Contact Person(s): Frank Haltom, Director

Description and Current Status

Dewberry Engineers were tasked to perform a Hydraulic Analysis of the County's water and wastewater systems to determine the available capacities for new developments.

Dan Villhauer, Vice President and Business Magnager with Dewberry, will present the results of the analysis to the Board. A copy of the report is attached.

Government Path

Does this require IDA action?	☐ Yes	☒ No
Does this require BZA action?	☐ Yes	☒ No
Does This require Planning Commission Action?	☐ Yes	☒ No
Does this require Board of Supervisors action?	☐ Yes	☒ No
Does this require a public hearing?	☐ Yes	☒ No

If so, before what date?

Fiscal Impact Statement

None

County Impact

None

Notes

None.

WATER AND WASTEWATER HYDRAULIC MODEL UPDATE

CAPACITY EVALUATION

Engineering and Utilities Department
Prince George County, Virginia

MARCH 2022

Dewberry

PREPARED FOR
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1. INTRODUCTION

The County of Prince George, Virginia (County) is experiencing growth, which has increased the water and wastewater customer base. There is concern regarding available water supply capacity and sewer flow capacity for continued growth. The purpose of this evaluation is to update and recalibrate the existing water and wastewater models, developed as part of the 2016 Water and Wastewater Master Plan, to assess the available water distribution and wastewater collection capacity of the County's systems accounting for proposed developments and new connections planned to occur in the near future.

The water model updates include the Route 10 waterline to the Jordan on the James and Beechwood Manor water systems, the Route 156 waterline, the Route 460 waterline connection to the Food Lion Water System, and upgrades to the Food Lion Booster Station and Tank. The wastewater model includes most of the County's wastewater systems, including the Route 301, Route 460, Puddledock, Route 36, Bailey's Creek, and Manchester Run systems.

2. WATER MODEL UPDATE

2.1. Water Model Overview and Update

The hydraulic model that was utilized by Dewberry, developed as part of the 2016 Water and Wastewater Master Plan, contains the major water distribution system assets (pumping stations, tanks, valves, and pipelines). For this capacity analysis, the Route 10 waterline (currently under design), the Route 156 waterline (currently under construction), the Route 460 waterline, and the Food Lion Booster Station and tank (currently under construction) were added to the model.

The County distribution system consists of the Central Pressure Zone (PZ), the Central Low PZ, and seven independent well fed systems. This capacity analysis includes the Central System, including the Food Lion, Jordan on the James, and Beechwood Manor well systems, since it was assumed that they are connected into the Central system. The wells were modeled as offline for each of the well systems. The Middle Road Booster Station (MRBS) supplies the Central PZ and is supplied by a connection to a 30" transmission main owned and operated by the Appomattox River Water Authority (ARWA). There is a portion of the County distribution system that is between the ARWA Central Service Connection and the suction side of the MRBS; this is referenced as the Central Low PZ in this analysis. The Central PZ has three elevated storage tanks, Middle Road Tank (MRT), Courthouse Tank (CHT), Southpoint Tank (SPT), and the Food Lion Ground Storage Tank (FLT). The FLT is filled by the Central PZ, and the Food Lion booster station (FLBS) pumps the water back into the Central PZ.

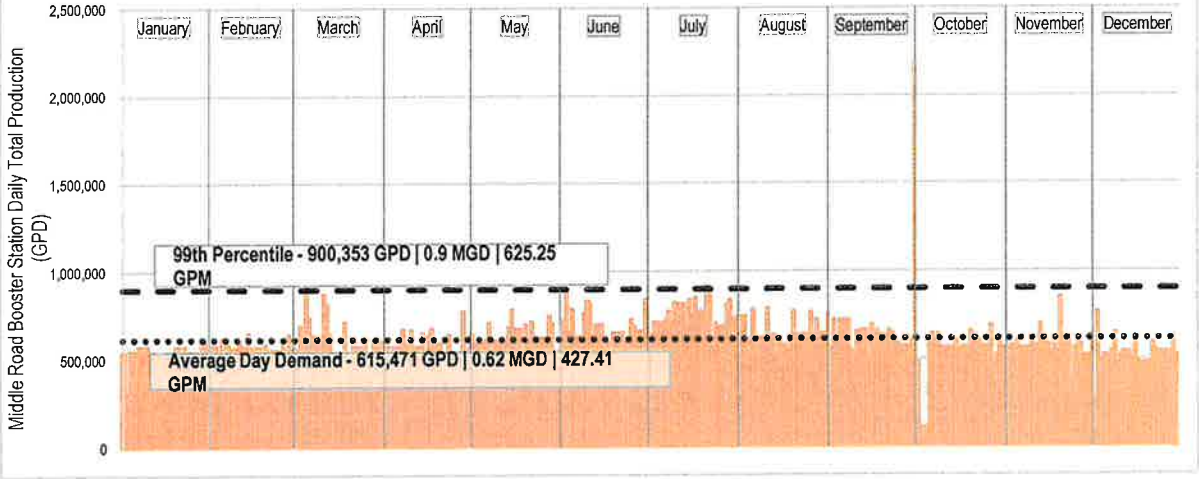
The Route 301 system, one of the County's independent well systems, is located just north of I-95 exit 45 on Route 301. The system is supplied by three wells, Days Inn, Hampton Inn, and Howard Johnson. The Howard Johnson is off-line with no plans of returning it to service. This system includes a single 500,000 gallon elevated storage tank.

Figure 2-1 shows a map of the distribution system with the locations of the ARWA Central Service Connection, the two Central System pumping stations, elevated storage tanks, and system piping, along with the Route 301 system.

2.2.Existing Demand Distribution

The existing average day demand (ADD), maximum day demand (MDD), and MDD:ADD factors were updated based on current billing and supply data. The County provided billing data for years 2016 through 2020 and MRBS daily pumping records. The billing data was utilized to determine the ADD by calculating the average of the 2020 daily totals as 615,471 GPD. The MDD was determined from the MRBS daily pumping records. **Figure 2-2** shows the daily pumping rate for the MRBS. The chart shows that there is an outlier occurring on October 1, 2020. Due to the outlier, the 99th percentile of the production data (900,353 GPD) was calculated and used as the MDD. The MDD:ADD factor was calculated to be 1.5 (900,353/615,471 = 1.5).

Figure 2-2 - Middle Road Booster Station Daily Flow Totals - 2020



The demand distribution was developed from the year 2020 consumption data, which contains the Tax Parel ID for each account in the system. The data was filtered to remove sewer-only, private, and metered sewer accounts. The Tax ID was then used to connect the usage data to the Tax Parcel layer providing a spatial distribution of the demand. The demand for each parcel was then assigned to the nearest model node.

Table 2-1 provides a summary of the existing ADD and MDD for the system pressure zones, and **Table 2-2** shows the proposed demands (reserve demands added).

Table 2-1: Existing Average and Maximum Day Demand

PRESSURE ZONE	ADD (GPM)	ADD (MGD)	MDD (GPM)	MDD (MGD)
Central	406	0.58	609	0.88
Central Low	72	0.10	106	0.15
Jordan on the James	24	0.04	36	0.05
Beechwood Manor	23	0.03	34	0.05
Route 301	30	0.04	44	0.06

Table 2-2: Proposed Average and Maximum Day Demand

PRESSURE ZONE	ADD (GPM)	ADD (MGD)	MDD (GPM)	MDD (MGD)
Central	745	1.07	999	1.44
Central Low	72	0.10	106	0.15
Jordan on the James	31	0.04	46	0.07
Beechwood Manor	31	0.04	46	0.07
Route 301	32	0.05	49	0.07

2.3.Calibration

The model was calibrated using data gathered from fire hydrant tests completed by the County, water meter records, and SCADA information. A calibrated model allows the County to simulate the water distribution system operation scenarios to optimize system operation, verify the capacity of the water distribution system to serve new development, or model proposed improvements. The hydrant test locations are shown in **Appendix A**. **Table 2-3** shows the results of the hydrant testing and model calibration.

Table 2-3: Hydrant Test Results

Test No.	Location	Test Date	Courthouse Tank HGL (ft)	Middle Rd Tank HGL (ft)	301 Tank HGL (ft)	Gauge Hydrant 1 Static (psi)	Gauge Hydrant 1 Residual (psi)	Gauge Hydrant 2 Static (psi)	Gauge Hydrant 2 Residual (psi)	Flow Hydrant 1 Static (psi)	Flow Hydrant 2 Static (psi)	Total Gallons Flowing	Flow Hydrant 1 (GPM)	Flow Hydrant 2 (GPM)
1	River Rd & Cleere Ave	2/18/2022	269	271	---	**45**	**32**	**51**	**43**	45	---	750	**750**	---
						43	27	54	43	39	---			
2	Middle Rd & Commerce Rd	2/18/2022	270	270	---	**72**	**63**	**70**	**60**	71	---	1,100	**1,100**	---
						67	56	66	54	67	---			
3	Courthouse Rd & Sawmill Rd	2/18/2022	270	273	---	**56**	**53**	**60**	**55**	69	69	2,299	**1,198**	**1,100**
						60	57	58	57	63	64			
4	End of Quality Way	2/18/2022	269	271	---	**70**	**55**	**68**	**56**	68	---	1,186	**1,186**	---
						64	52	59	48	68	---			
5	Laurel Springs & PGHS	2/18/2022	269	271	---	**61**	**55**	**63**	**55**	60	---	1,210	**1,210**	---
						60	47	63	51	60	---			
6	County Dr & Bull Hill Rd	2/18/2022	269	272	---	**55**	**48**	**50**	**35**	55	55	1,942	**993**	**949**
						51	35	51	34	51	51			
7	County Dr & Wells Station Rd	2/18/2022	270	273	---	**60**	**58**	**55**	**54**	68	---	444	**444**	---
						60	58	55	52	60	---			
8	County Dr & P.G. Dr	2/18/2022	269	272	---	**65**	**42**	**60**	**55**	72	---	1,186	**1,186**	---
						60	36	63	38	67	---			
9	Route 301	2/18/2022	---	---	298	**62**	**50**	**60**	**47**	62	---	1,061	**1,061**	---
						60	49	60	50	59	---			

2.4. Reserve Demand

The County has been growing and that growth is expected to continue. To ensure the distribution system has capacity for the existing demand and the development expected in the near future, this reserve demand for new connections is included in the model. **Table 2-4** shows the development demand that is expected to be online in the near future and/or capacity that has been allocated to future development parcels in the CPZ. The location of the reserve parcels is shown on **Figure 2-3**. In addition to the planned near-term connections, the County wants to hold an additional 10% system wide demand in reserve to allow for demand fluctuations and further improvements of existing business that may not be documented but will require additional demand over the next 2-3 years. The 10% system reserve demand was evenly divided among all of the water model junctions.

Table 2-4: Central Pressure Zone Reserve Demand

ID	CUSTOMER	ADD (GPM)	ADD (MGD)	MDD (GPM)	MDD (MGD)
1	Service Center Metals	104.17	0.1500	104.17	0.1500
2	VP-163	8.48	0.0122	8.48	0.0122
3	VP-145[1]	126.04	0.1815	126.04	0.1815
4	Meadows Section 3 – 66 homes	15.82	0.0228	23.73	0.0342
5	Davis Fast Food	3.29	0.0047	4.93	0.0071
6	Sandy Hill Subdivision – 11 homes	2.64	0.0038	3.96	0.0057
7	7-Eleven (Route 460)	0.31	0.0004	0.46	0.0007
8	7-Eleven Irrigation	0.59	0.0008	0.88	0.0013
9	Middle Road Elementary School	6.85	0.0099	10.27	0.0148
10	Route 156[2] – 17 Properties	4.08	0.0059	6.12	0.0088
11	Route 460[2] – 8 Properties	1.92	0.0028	2.88	0.0041
12	Jordan on the James	23.94	0.0345	35.91	0.0517
13	Beechwood Manor	22.77	0.0328	34.15	0.0492
14	System wide 10% Reserve[3]	82.31	0.1185	123.46	0.1778
	Reserve Demand Subtotal	**403.21**	**0.5806**	**485.44**	**0.6990**
	Central Pressure Zone[4]	***406.23***	***0.5850***	***609.34***	***0.8775***
	Total[5]	***809.44***	***1.1656***	***1,094.78***	***1.5765***

Notes:
1. Reserve allocation up to a total of 0.240 MGD upon completion of future water supply upgrades by the County.
2. Accounts for properties that received meter connections as part of easement negotiations for construction of the Route 156 and Route 460 waterlines.
3. Provides a system wide reserve of 10% of MDD for fluctuation and further improvements of existing business that may occur over the next 2-3 years in the Central System.
4. Central Pressure Zone Demands include the Central Pressure Zone, and Food Lion Systems (does not include Central Low Pressure Zone).
5. Total demand in the Central Pressure Zone used to evaluate the available capacity at Southpoint.

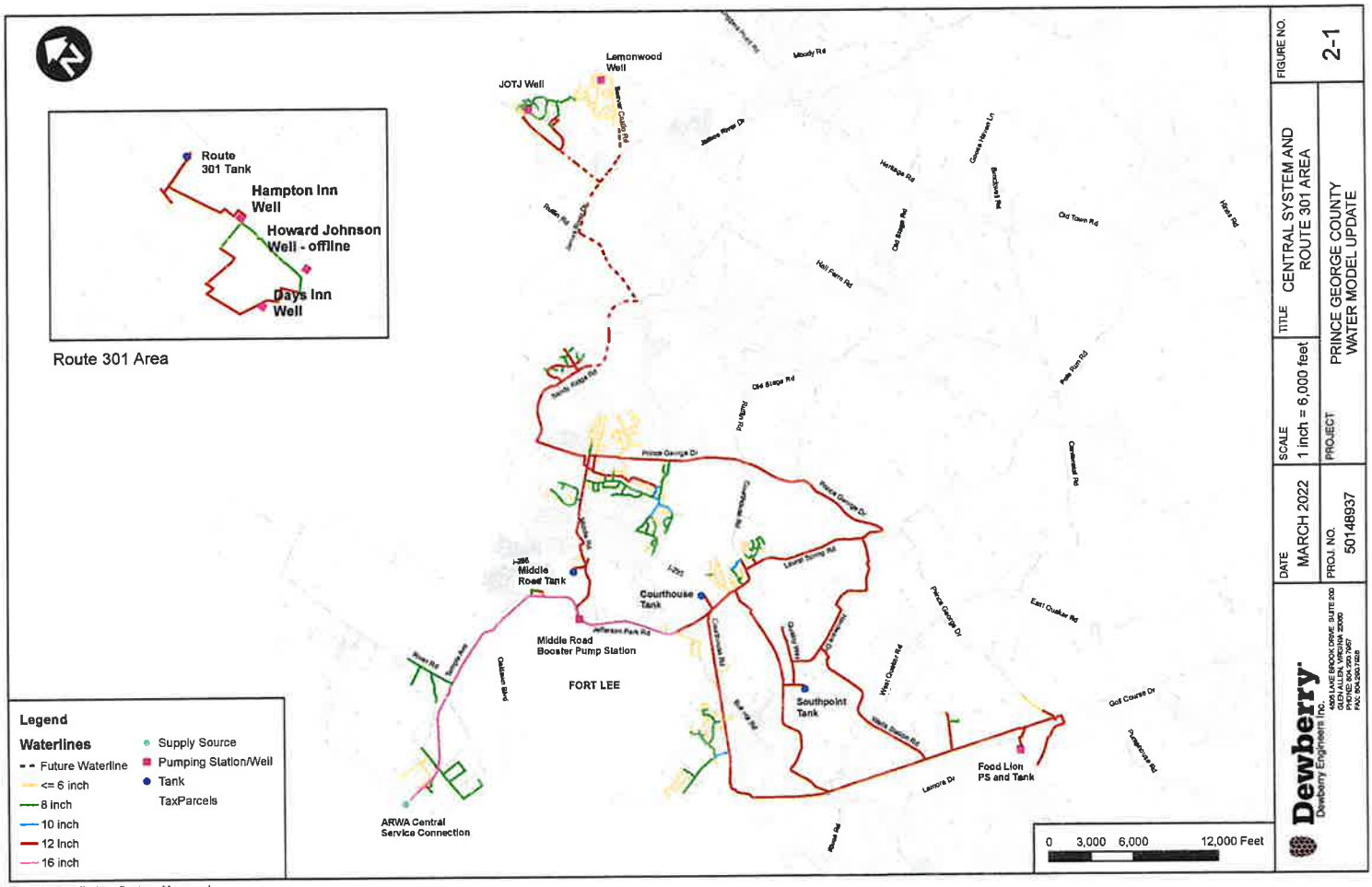
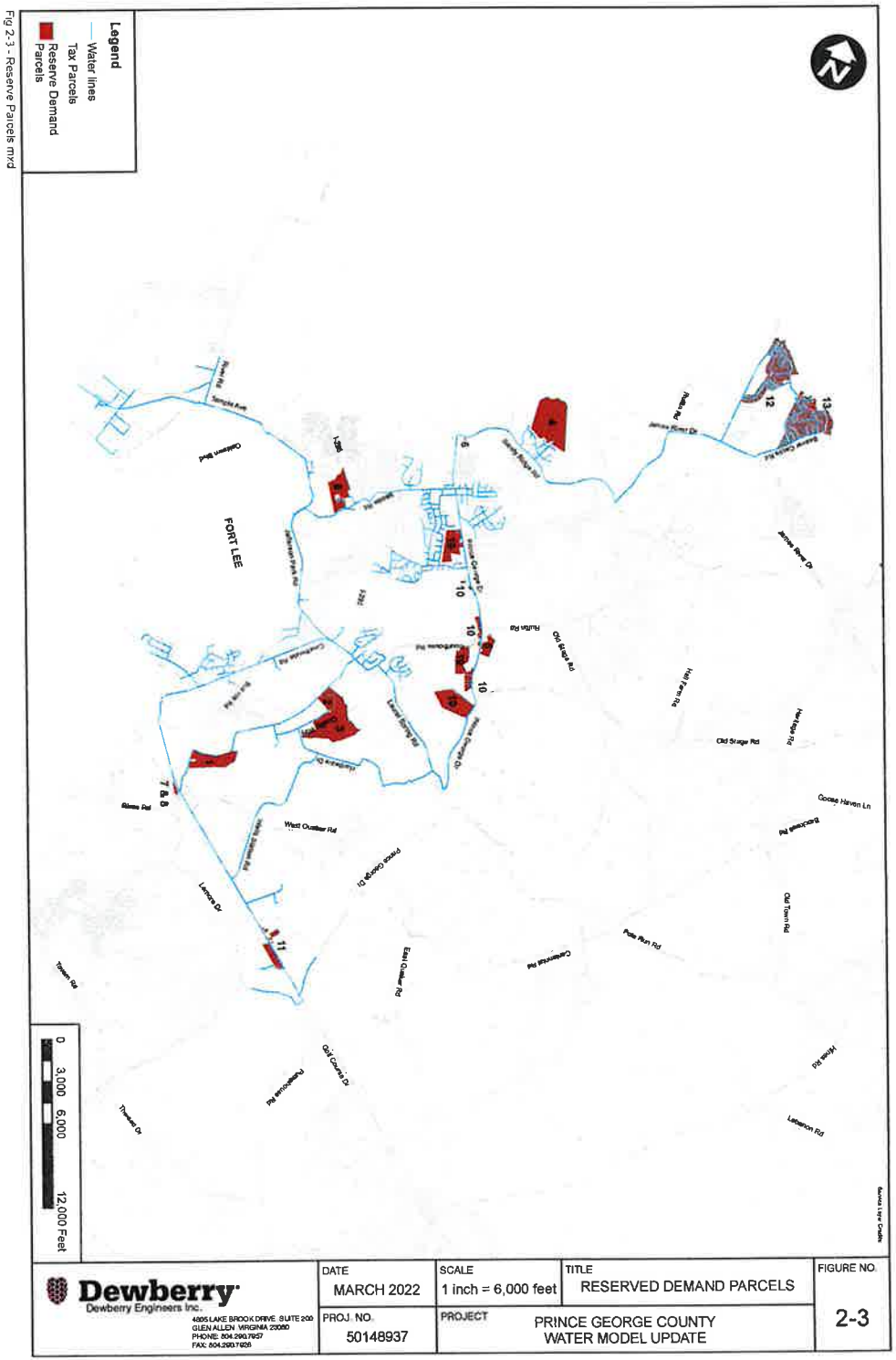


Fig 2-1 - Distribution System Map.mxd

Fig 2-3 - Reserve Parcels.mxd



Dewberry Dewberry Engineers Inc. 4805 LAKE BROOK DRIVE, SUITE 200 GLEN ALLEN, VIRGINIA 23060 PHONE: 804.290.7957 FAX: 804.290.7926	DATE MARCH 2022	SCALE 1 inch = 6,000 feet	TITLE RESERVED DEMAND PARCELS	FIGURE NO. 2-3
	PROJ. NO. 50148937	PROJECT PRINCE GEORGE COUNTY WATER MODEL UPDATE		

3. WATER CAPACITY EVALUATION

3.1. Overview

This analysis evaluated the available capacity of the Central System and the Route 301 System. The Central System consists of the Central Low PZ, the Central PZ, Food Lion Water System and the Route 10 area (Beechwood Manor and Jordan on the James subdivisions). The analysis also included the reserve demands shown in **Table 2-3**.

3.2. Assumptions and Design Constraints

The available capacity assumes the following, unless otherwise noted:

- MDD to ADD Factor: 1.5
- Food Lion Booster Pump Station and Tank are on-line
- Route 156 waterline extension is on-line
- Route 10 waterline extension is on-line
- Food Lion Well is offline
- Jordan on the James and Beechwood Manor wells are offline
- Minimum Pressure During Fire Flow Event: 20 psi
- Commercial Fire Flow: 2,000 GPM (2 hours from 9-11 AM)
- Tanks recover (return to an elevation at or above the initial level) during a 48-hour simulation

3.3. Central System Capacity Evaluation

The Central System consists of the Central Low PZ, the Central PZ, and Food Lion Water System. The County is anticipating new development in the Southpoint Business Park (Southpoint), and this analysis will focus on fire flow and increased demands in Southpoint.

3.3.1. Scenario 1 – Southpoint MDD Capacity – 2,000 GPM Fire Flow

Scenario 1 evaluated the capacity of the Central PZ with a 2,000 GPM 2-hour fire flow at Southpoint. See inset to the right for the location of the Southpoint added demand and fire flow. A 48-hour extended period simulation (EPS) was evaluated to determine the system response and available capacity with a fire flow from hours 9-11 AM.

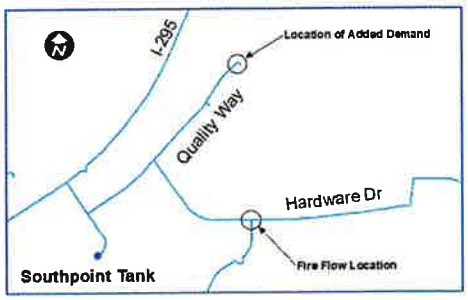
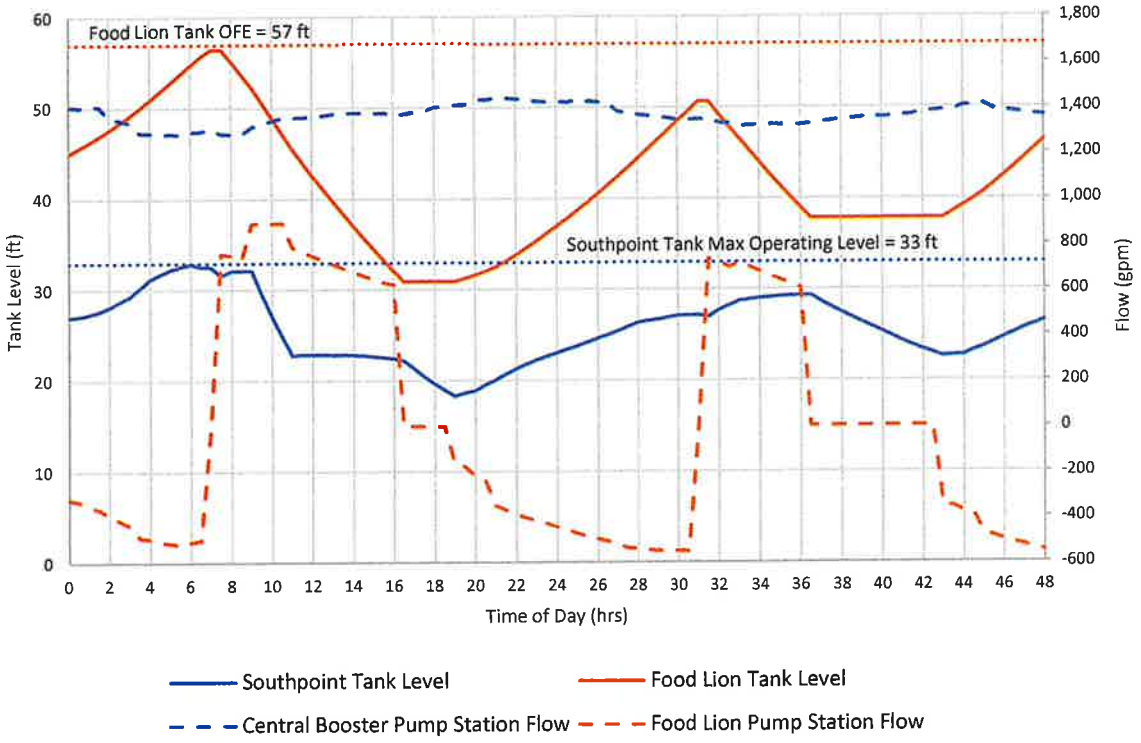


Figure 3-1 shows the system response with a Central PZ MDD of 1.58 MGD (1,095 GPM), MDD to ADD factor of 1.5, and a 2,000 GPM fire flow at the intersection of Hardware Drive and Wells Station Road. The figure shows pumping rates for the Middle Road Booster Pump Station, pumping rates for the Food Lion Booster Station, and water levels for Southpoint and Food Lion tanks. With the reserve demands and the addition of the Route 10 demands, the tanks levels were generally able to recover over the 48-hour simulation and all system nodes remained above 20 psi. Based on this analysis, with the reserve capacity and the addition of the Route 10 area demands, the system has capacity for the existing maximum day demands plus the maximum day demands held in reserve.

Figure 3-1 - Central System Capacity Evaluation
MDD = 1.58 MGD | MDD:ADD Factor = 1.5



3.3.2. Scenario 2 – Route 10 Waterline Extension

The County is in the process of designing a 12" waterline extension along Ruffin Rd from the intersection of Prince George Drive and Courthouse Road to Route 10, and along Route 10 to connect to the Jordan on the James and Beechwood Manor subdivisions.

The model indicated that the system can supply the subdivisions during an MDD scenario with no pressure issues. A fire flow evaluation, with a 2-hour fire flow at the intersection of Ruffin Road and Route 10, shows that a 960 GPM fire flow is the maximum the system can provide to the area. The fire flow is limited by a high point ground elevation of approximately 134 ft along Ruffin Road, approximately 0.3 miles south of Route 10.

3.3.3. Central Pressure Zone Water Supply Capacity Summary

The results of the hydraulic analysis indicate the current water supply system has approximately 1.5 MGD of maximum day capacity, limited by the pumping rate of the Middle Road Water Booster Station. This capacity assumes that the average pumping rate of the station is approximately 1,400 GPM for a maximum duration of 18 hours per day. Based on this, the Central system does not have available capacity beyond the current and reserved demands. The maximum day allocation from the ARWA supply is 2.69 MGD; therefore, the Central system would have additional capacity if the water transmission capacity was increased.

3.3.4. Central Pressure Zone Storage Evaluation

The Central PZ has a total storage volume of 2.5 million gallons (MG). The required storage volume, per VDH regulations of ½ of MDD, is 0.88 MG. This provides an available storage capacity of 1.62 MG, allowing for an additional 3.24 MGD of maximum day demand before additional storage is required. **Table 3-1** summarizes the tank storage volume and capacity.

Table 3-1: Central Pressure Zone Storage Capacity

NAME	VOLUME
Southpoint	500,000 Gal
Middle Road	500,000 Gal
Courthouse	500,000 Gal
Food Lion	1,000,000 Gal
Total	2,5000,000 Gal
VDH Required Volume	880,000 Gal
Remaining Capacity	1,620,000 Gal

3.4.Route 301 Capacity Evaluation

The Route 301 PZ is supplied by two wells, Hampton Inn and Days Inn, that pump into the distribution system, which includes a 500,000 gallon elevated storage tank.

The Days Inn water well consists of one well, a softening system, sodium hypochlorite feed system, two offline booster pumps. The well has a yield of 145 GPM and is equipped with a submersible pump with a limiting pumping capacity of 110 GPM.

The Hampton Inn water well facility consists of one well, a 125,000 gallon bolted steel atmospheric ground storage tank, softening system, sodium hypochlorite system, and two booster pumps. The well is equipped with a submersible pump with a pumping capacity of 30 GPM and has a limiting well yield of 29 GPM.

The zone has a third well facility at Howard Johnson, which is currently off-line, with no plans for bringing the facility back on-line.

The total supply capacity for Route 301 based on the DEQ Groundwater Withdrawal Permit (GWP) is 140 GPM (201,600 GPD). The 500,000 gallon tank, per VDH regulations, is sufficient for a system MDD of 1 MGD. The tank is sufficient for an additional 0.92 MGD of maximum day capacity and therefore is not a limiting factor to the zones supply capacity. The current ADD demand is 21 GPM (30,935 GPD) and the MDD is 49 GPM (70,900 GPD). With a total well supply capacity of 140 GPM, the system has an available maximum day capacity of 91 GPM (130,709 GPD).

4. SEWER MODEL UPDATE

4.1. Sewer Model Overview and Update

The sewer model that was utilized by Dewberry, developed as part of the 2016 Water and Wastewater Master Plan, contains all major existing sewer assets (pumping stations, treatment plants, valves, and pipelines). For this model update and capacity analysis, model geometry remained the same from the previous model.

The County sewer collection system consists of nine (9) wastewater basins. Each wastewater basin is divided into a service area based on which wastewater treatment plant the system discharges to. The Johnson Road, Route 301, Route 460, Puddledock, and Flank Road wastewater basins ultimately flow to the South Central Wastewater Authority (SCWWA) wastewater treatment plant. The Route 301, Route 460, and Puddledock wastewater basins that discharge flow to the SCWWA are evaluated in this report. The Route 36, Bailey's Creek, Manchester Run, and River Road wastewater basins ultimately flow to the Hopewell Regional Wastewater Treatment Facility (HRWTF). All HRWTF wastewater basins except for the River Road system are evaluated in this report.

The existing County wastewater systems and pump stations are shown in **Figure 4-1** and an outline of the sewer service areas is shown **Figure 4-2**.

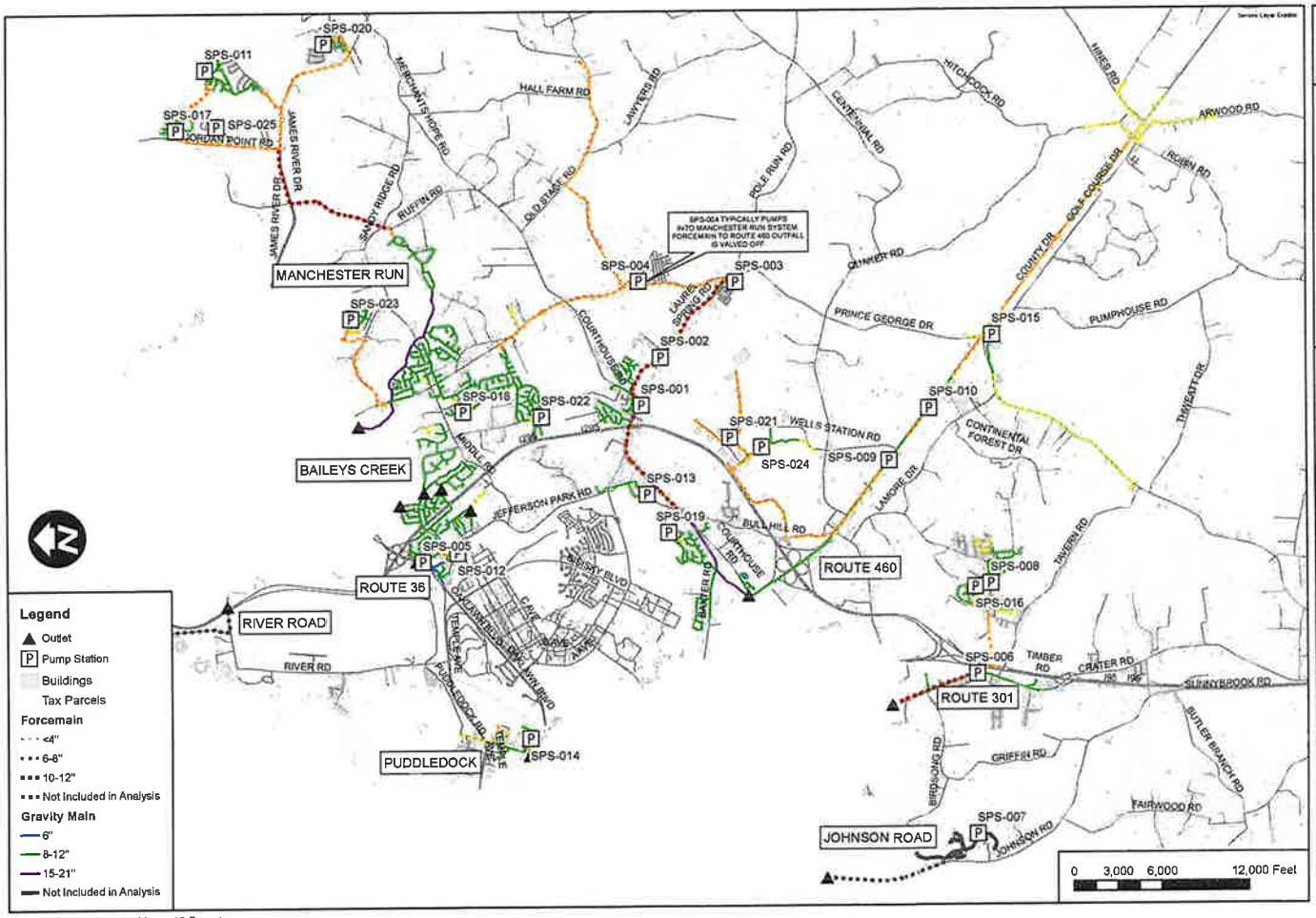


FIGURE NO. 4-1

TITLE EXISTING SEWER SYSTEM

SCALE 1 inch = 6,000 feet

PROJECT PRINCE GEORGE COUNTY WASTEWATER MODEL UPDATE

DATE MARCH 2022

PROJ NO. 50148937

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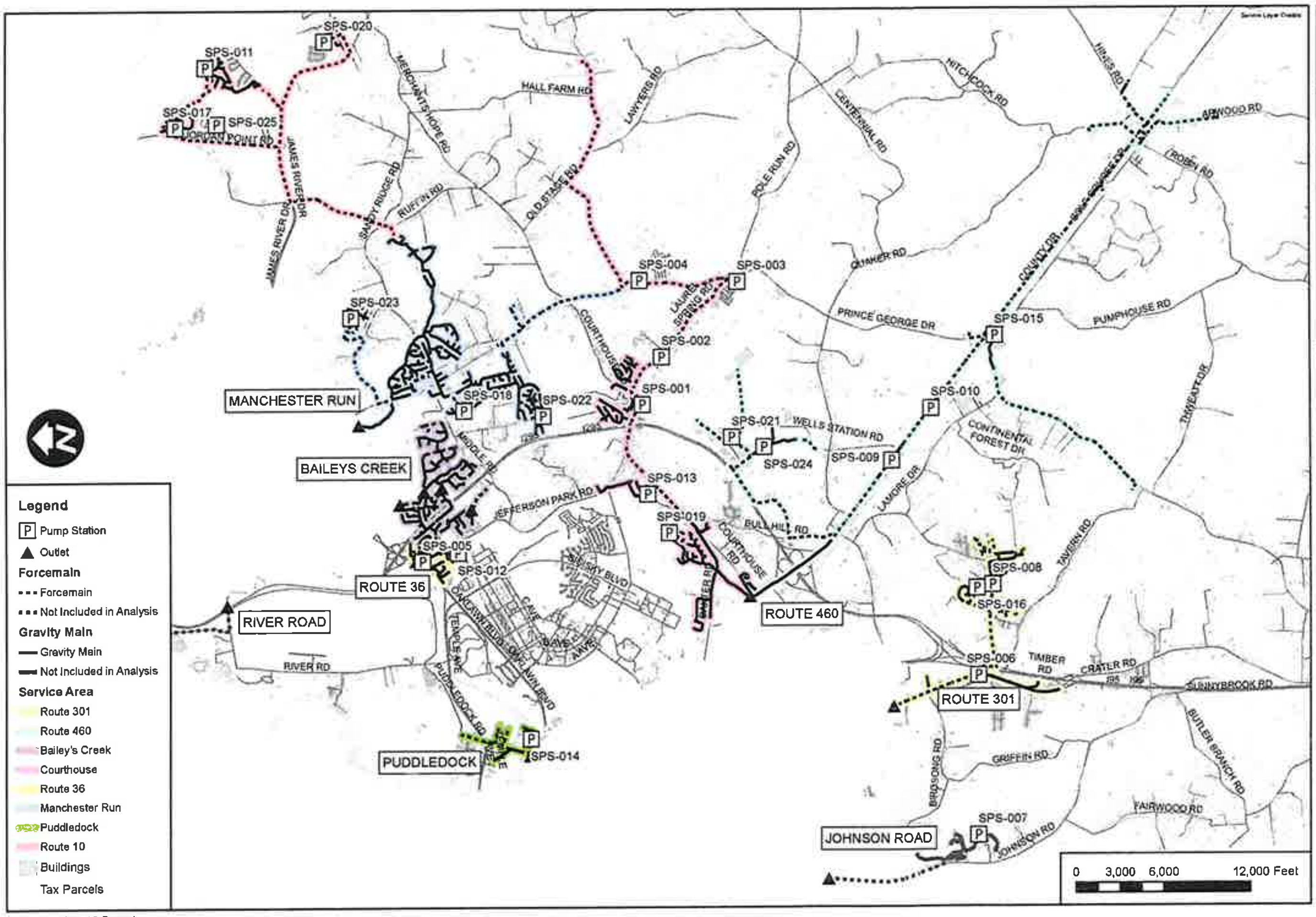
Existing Sewer System Map - 10 7.mxd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SPS-017
SPS-025
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JAMES RIVER DR
MERCHANTS HOPE RD
HALL FARM RD
LAWYERS RD
SANDY RIDGE RD
RUFFIN RD
OLD STAGE RD
POLE RUN RD
CENTENNIAL RD
HITCHCOCK RD
HINES RD
ARWOOD RD
ROBEY RD
QUAKER RD
COUNTY DR
SPS-004
SPS-003
LAUREL SPRING RD
SPS-023
COURTHOUSE RD
SPS-002
PRINCE GEORGE DR
SPS-015
PUMPHOUSE RD
SPS-018
SPS-022
SPS-001
MANCHESTER RUN
SPS-010
SPS-021
WELLS STATION RD
SPS-024
SPS-009
CONTINENTAL FOREST DR
THWEATT DR
BAILEYS CREEK
MIDDLE RD
JEFFERSON PARK RD
SPS-013
LAMORE DR
SPS-019
BULL HILL RD
TAVERN RD
SPS-005
SPS-012
ROUTE 36
SPS-008
ROUTE 460
SPS-016
RIVER ROAD
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TEMPLE AVE
OAKLAWN BLVD
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SPS-006
TIMBER RD
CRATER RD
SUNNYBROOK RD
ROUTE 301
BUTLER BRANCH RD
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PUDDLEDOCK
BRISONS RD
GRIFFIN RD
FAIRWOOD RD
SPS-007
JOHNSON ROAD
JOHNSON RD
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Outlet
Forcemain
Forcemain
Not Included in Analysis
Gravity Main
Gravity Main
Not Included in Analysis
Service Area
Route 301
Route 460
Bailey's Creek
Courthouse
Route 36
Manchester Run
Puddledock
Route 10
Buildings
Tax Parcels

FIGURE NO.	4-2
TITLE	EXISTING SEWER SERIVEC AREAS
PROJECT	PRINCE GEORGE COUNTY WASTEWATER MODEL UPDATE
SCALE	1 inch = 6,000 feet
DATE	MARCH 2022
PROJ. NO.	50148937

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4.2. Sewer Loading Distribution

The sewer loading in the model was updated based on using existing average daily flows (ADF) calculated from County billing data and the sewer loading held in reserve as summarized in Section 4.3. Using the Harmon Peaking Factor equation, the peak hour flow (PHF) for each wastewater basin was calculated based on the ADF. The Harmon equation is defined as follows:

$$Peak\ Factor = 1 + \frac{14}{4 + \sqrt{P}}$$

Where P is population in thousands

Peak factor from the Harmon Equation can be applied to an ADF to calculate the peak hour flow.

Table 4-1 and **Table 4-2** show the ADF and PHF for each of the County's wastewater basins based on consumption data and reserve data provided by the County. The Route 460 wastewater basin is the County's largest wastewater basin and includes flow from most of the Southpoint Business Park. The Manchester Run and Bailey's Creek wastewater basins account for the majority of the remainder of the County's sewer flows and serve primarily residential areas.

Table 4-1: SCWWA Average Daily and Peak Hour Flows (Current and Reserve)

Service Area	Sewer Basin	ADF (GPM)	ADF (GPD)	Peak Hour Flow (GPM)	Peak Hour Flow (MGD)	Average Daily Conveyance Agreement Capacity (MGD)	Peak Conveyance Agreement Capacity (MGD)
SCWWA	Johnson Road	19	27,029	77	0.111	0.18	0.460
	Route 301	65	93,571	248	0.357	0.291	0.728
	Route 460	395	568,800	1,260	1.81	1.0	2.565
	Puddledock	34	48,744	135	0.194	0.10	N/A
	Flank Road	N/A*	N/A*	N/A*	N/A*	0.004	N/A

** No Data*

Table 4-2: HRWTF Average Daily and Peak Hour Flows (Current and Reserve)

Service Area	Sewer Basin	ADF (GPM)	ADF (GPD)	Peak Hour Flow (GPM)	Peak Hour Flow (MGD)	Maximum Daily Conveyance Agreement Capacity (GPD)
HRWTF	Route 36	29	41,746	116	0.168	2,000,000
	Bailey's Creek	116	167,501	424	0.610	
	Manchester Run	199	286,906	689	0.992	

4.3. Reserve Flows

The County has been experiencing growth in the Route 460 service area and this is expected to continue. To ensure the wastewater system has sufficient capacity, reserve flows for future connections were included in the model. **Table 4-3** shows the ADF and peak hour flows for each reserve flow provided by the County.

Table 4-3: Route 460 Wastewater System Reserve Flows

Sewer System	ADF (GPM)	ADF (GPD)	Peak Hour (GPM)	Peak Hour Source
Service Center Metals (SCM)	57	82,000	120	Determined Based on Remaining Capacity
VP-163	8.6	12,375	36	Harmon Equation
VP-145	5.7	8,225	24	Harmon Equation
Meadows Section 3 – 66 homes	16	23,100	66	Harmon Equation
Davis Fast Food	3.3	4,800	32	Provided by County
Sandy Hill Subdivision – 11 homes	2.6	3,800	11	Harmon Equation
7-Eleven (Route 460)	0.3	450	1.4	Harmon Equation
7-Eleven Irrigation	0.6	850	2.6	Harmon Equation
Middle Road Elementary School	6.9	10,000	55	Provided by County
Total Reserve Flows	**101**	**145,600**	**349**	

4.4. Calibration

The sewer model was calibrated by comparing the distributed consumption data included in the model to the data collected by the Hach flow meters located near the Route 460 outfall.

Pump stations in the model were calibrated using data gathered from drawdown tests conducted by the County over the past several years. Drawdown tests provide a more realistic estimation of the pumping capacity of a pump station than the design point of a pump station, as they consider real-world effects on a pump such as pipe degradation, and pump wear and tear. Drawdown tests were not provided for all pump stations. Pump stations tests were prioritized for pump stations that feed the Route 460 gravity main and the largest pump stations in the County. All County-owned pump stations are listed with design capacities, and where applicable, drawdown test results in **Table 4-4**. Design capacities are based on the original design point of each pump station.

Table 4-4: Pump Station Design Capacity and Drawdown Test Results

Pump Station	Name	Wastewater system	Design Flow (GPM)	Drawdown Flow (GPM)
SPS-01	Courthouse Road	Route 460	350	
SPS-02	Laurel Spring Road	Route 460	200	
SPS-03	PG Road at Laurel Spring	Route 460	555	458
SPS-04	PG Road at Sebera Road	Route 460	200	
SPS-05	Jefferson Park	Route 36	138	
SPS-06	Route 301 Trunk Sewer	Route 301	660	266
SPS-07	Johnson Road Trunk Sewer	Johnson Road	350	
SPS-08	Second Swamp Trunk Sewer	Route 301	230	
SPS-09	Route 460 PS 1	Route 460	680	640
SPS-10	Route 460 PS 2	Route 460	350	350
SPS-11	Beechwood Manor	Manchester Run	200	
SPS-12	Jefferson Park at Crossings Blvd	Route 36	233	
SPS-13	Lee Acres	Route 460	155	
SPS-14	Puddledock	Puddledock	120	168
SPS-15	Route 460 at Route 156	Route 460	235	63
SPS-16	Cedarwood	Route 301	118	
SPS-17	Jordan on the James	Manchester Run	450	
SPS-18	Branchester Lakes Section 12	Manchester Run	95	
SPS-19	Baxter Ridge	Route 460	156	
SPS-20	Rivers Edge	Manchester Run	200	
SPS-21	I-295 Industrial	Route 460	350	306
SPS-22	Branchester Lakes Section 14	Manchester Run	85	
SPS-23	The Meadows	Manchester Run	274	153
SPS-24	Crosspointe	Route 460	350	309
SPS-25	Eagle Preserve	Manchester Run	102	

Drawdown tests for SPS-21 and SPS-24 show the capacity to be 306 GPM and 309 GPM, respectively, however the force mains for each station manifold into the Southpoint Force main, therefore decreasing capacity when both pump stations are operating simultaneously. A reserve pumping rate into the force main from Service Center Metals further reduces the simultaneous pumping capacity of each station. The various operating points of SPS-21 and SPS-24 are shown in **Table 4-5**.

Table 4-5: Southpoint Pump Station Capacities

Pump Station	Name	Capacity when Single Station is Active (GPM)	Capacity when Both Stations are Active (GPM)	Capacity when Both Stations and are Active with Reserve PS (GPM)
SPS-21	I-295 Industrial	306	182	166
SPS-24	Crosspointe	309	178	160

5. SEWER CAPACITY EVALUATION

5.1. Overview

This analysis evaluated the available capacity of the sewer collection system including pump stations and gravity mains.

5.2. Assumptions and Design Constraints

The following assumptions were made during the development of this model:

- All pump stations are active
- Pump station firm capacity assumes largest pump out of service
- Peak flows are based on Harmon Peak Factors
- Unless otherwise specified, flow data is based on water consumption
- Steady state analysis

5.3. Gravity Main Capacity Evaluation

The capacity of all gravity mains in the County's wastewater systems was evaluated using a steady state model. This analysis focused primarily on the Route 460 Gravity Main that is fed by the Route 460 corridor and the Southpoint Business Park, where future development is anticipated by the County; however, data from other areas were included in the analysis.

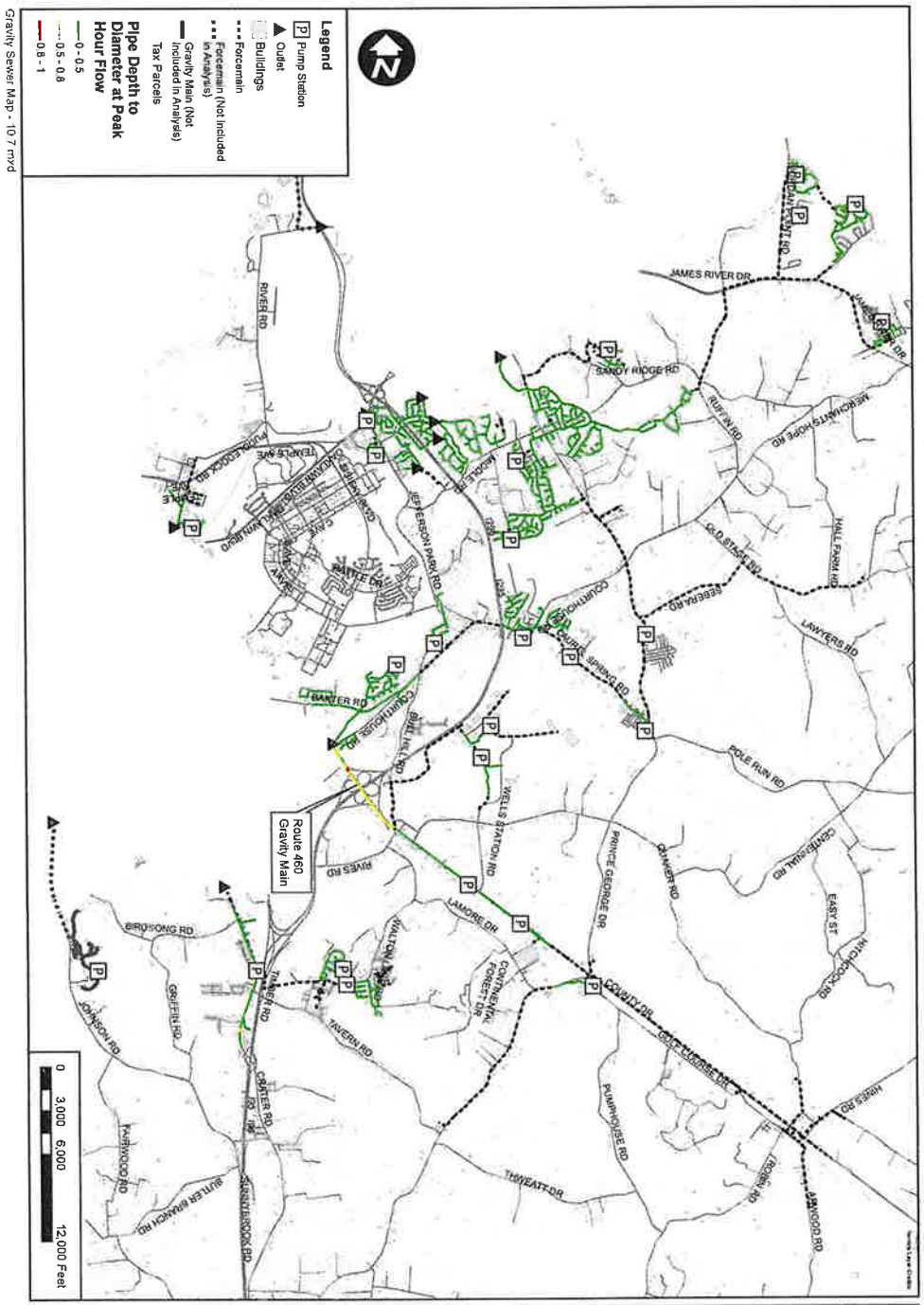
Based on the analysis, the majority of the County's gravity mains are below 50% capacity (a d/D value of less than 0.5). The only area above 50% capacity in the Route 460 wastewater system is on the Route 460 Gravity Main from the discharge point of the Southpoint Force Main to the Route 460 Outfall. Including the reserve flows in the Route 460 corridor and Southpoint Business Park, the Route 460 Gravity Main does not have capacity to handle additional flows beyond the existing and reserve flows.

The Route 301 system also has a small area of gravity main with a d/D of greater than 0.5. This gravity main runs along South Crater Road and is estimated to have a remaining ADF capacity of approximately 14,000 GPD.

Figure 5-1 shows all gravity main in the County's wastewater systems with any pipes with current peak flows of greater than 50% of capacity highlighted and **Table 4-5** summarizes the remaining capacity at the gravity sewer outfall for each sewer basin both hydraulically and based on current conveyance agreements.

Table 4-5: Remaining Gravity Sewer Capacity at Sewer Basin Outfalls

Sewer Basin	Remaining ADF Hydraulic Capacity at Outfall (MGD)	Remaining ADF Agreement Capacity at Outfall (MGD)	Remaining PHF Hydraulic Capacity at Outfall (MGD)	Remaining PHF Agreement Capacity at Outfall (MGD)
Route 460	No Capacity	0.431	No Capacity	0.755
Courthouse	0.768		2.356	
Route 301	0.014	0.197	0.059	0.371
Route 10	0.028	0.503	0.115	N/A
Manchester Run	0.092		0.352	
Route 36	0.080		0.309	
Baileys	0.081		0.313	
Puddledock	0.087	0.051	0.334	N/A



Gravity Sewer Map - 10.7.mxd

Dewberry Engineers Inc.	DATE	SCALE	TITLE	FIGURE NO.
4805 LAKE BROOK DRIVE, SUITE 200 GLEN ALLEN, VIRGINIA 23060 PHONE: 804.290.7957 FAX: 804.290.7978	MARCH 2022	1 inch = 6,000 feet	GRAVITY MAIN CAPACITY ANALYSIS	5-1
	PROJ. NO. 50148937	PROJECT PRINCE GEORGE COUNTY WASTEWATER MODEL UPDATE		

5.4. Pump Station Capacity Evaluation

Pump stations throughout the County's wastewater systems were evaluated using a steady state model to ensure the pumps can pump the peak hour inflow at each pump station. Using the Harmon Peak Factor equation, the ADF inflows to each pump station were converted to peak hour flows, which were compared to the design flow rates, or where available, the drawdown test results of each pump station. Note that SPS-21 and SPS-24 were excluded from this section of the report and are discussed in more detail in **Section 5.5**. SPS-07 is also absent from this section as the Johnson Road wastewater system is not included in this analysis.

Table 5-1 shows the capacity and the modeled peak hour flow of each pump station owned by the County. Drawdown tests results are used where available, otherwise design capacity is used for this comparison.

Table 5-1: Pump Station Peak Hour Flows

Pump Station	Sewer Basin	Capacity (GPM)	Peak Hour Flow (GPM)
SPS-01	Route 460	350	123
SPS-02	Route 460	200	1
SPS-03	Route 460	458	279
SPS-04	Route 460	200	147
SPS-05	Route 36	138	384
SPS-06	Route 301	265	248
SPS-08	Route 301	230	65
SPS-09	Route 460	230	249
SPS-10	Route 460	640	199
SPS-11	Manchester Run	350	63
SPS-12	Route 36	200	11
SPS-13	Route 460	233	34
SPS-14	Puddledock	155	135
SPS-15	Route 460	168	121
SPS-16	Route 301	63	44
SPS-17	Manchester Run	118	129
SPS-18	Manchester Run	450	86
SPS-19	Route 460	95	38
SPS-20	Manchester Run	156	25
SPS-21	Route 460	*	*
SPS-22	Manchester Run	182	62
SPS-23	Manchester Run	85	126
SPS-24	Route 460	*	*
SPS-25	Manchester Run	178	29

*see discussion in Section 5.5

Most County-owned pump stations operate within the design or drawdown capacity; however, several pump stations are over capacity or are close enough to the capacity that they should be monitored. SPS-15, in the Route 460 system, is over capacity based on peak hour flows for the service area. SPS-15 is shown to be currently over capacity based on the results of its drawdown test, which indicates that SPS-15 is operating significantly below the design point. The cause of this low operating point should be investigated, and if necessary, the pump station should be rehabilitated or upgraded to bring the station back to the design capacity.

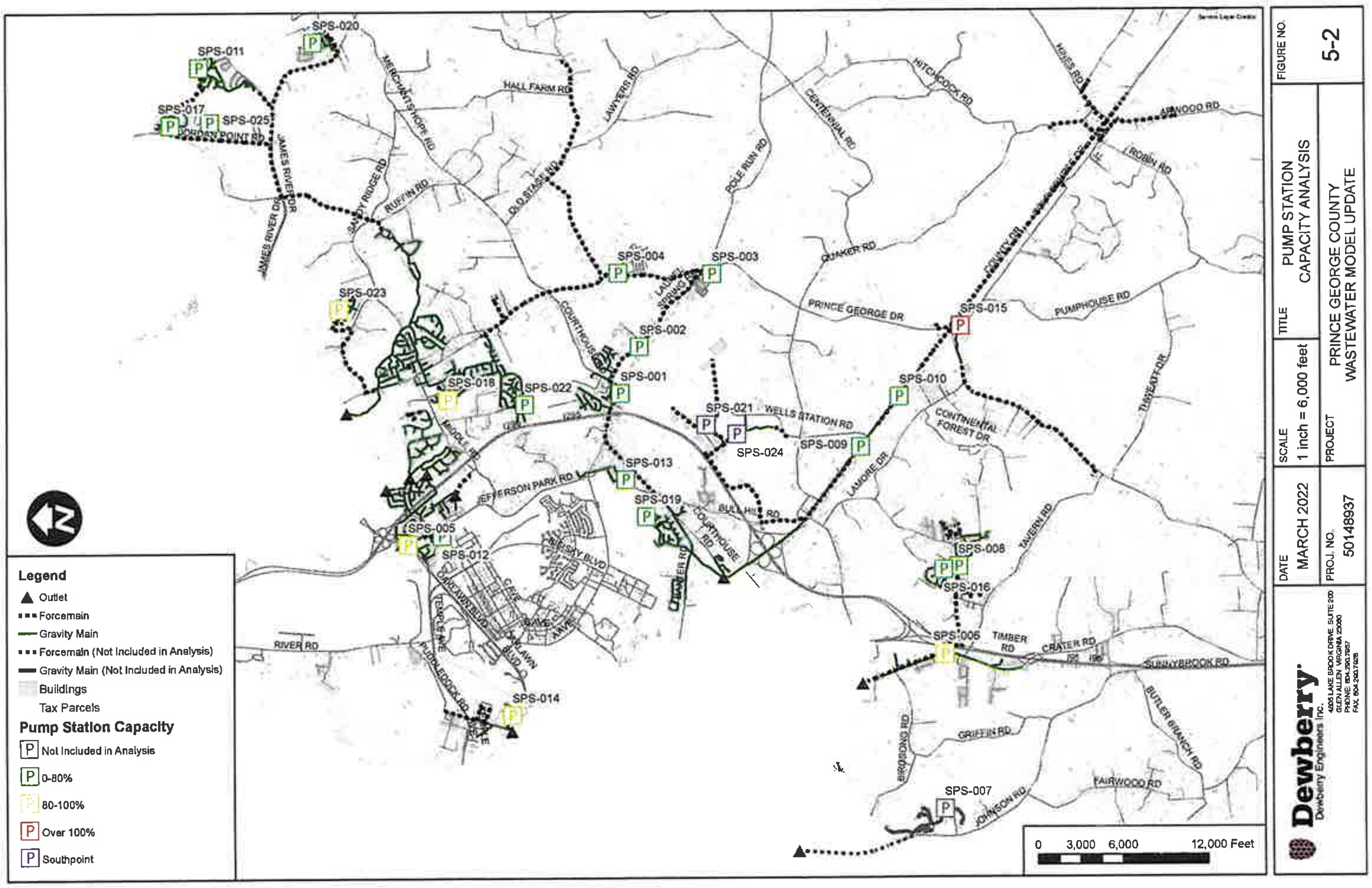
During a peak hour flow, SPS-05, SPS-06, SPS-14, SPS-18, and SPS-23 are operating at or above 80% of the maximum capacity. These pump stations should be monitored, and a capacity upgrade should be considered if additional flows are expected in the future. SPS-06 is operating significantly below the design pumping rate and it is recommended that the cause of this should be investigated. Additionally, SPS-14 would be over capacity at its design point; however, the drawdown test shows that it can operate at a higher pumping rate than the design point.

Figure 5-2 shows all pump stations with those between 80% and 100% highlighted in yellow and any stations over capacity in red.

Table 5-2 lists the pump stations with peak inflows over or near the station capacity.

Table 5-2: Pump Stations with Peak Flow Above 80% Capacity

Pump Station	Name	Wastewater system	Capacity (GPM)	Peak Hour Flow (GPM)	Percent of Capacity
SPS-05	Jefferson Park	Route 36	138	116	84
SPS-06	Route 301 Trunk Sewer	Route 301	265	248	94
SPS-14	Puddledock	Puddledock	168	135	80
SPS-15	Route 460 at Route 156	Route 460	63	121	192
SPS-18	Branchester Lakes Section 12	Manchester Run	95	86	90
SPS-23	The Meadows	Manchester Run	153	126	82


SPS-020
SPS-011
SPS-017
SPS-025
SPS-023
SPS-004
SPS-003
SPS-002
SPS-001
SPS-018
SPS-022
SPS-021
SPS-024
SPS-013
SPS-019
SPS-005
SPS-012
SPS-014
SPS-015
SPS-010
SPS-009
SPS-008
SPS-016
SPS-006
SPS-007
HALL FARM RD
MERCHANTS HOPE RD
LAWYERS RD
OLD STAGE RD
RUFFIN RD
SANDY RIDGE RD
JAMES RIVER DR
BRANDON POINT RD
POLE RUN RD
CENTENNIAL RD
HITCHCOCK RD
HINES RD
ARWOOD RD
ROBIN RD
COUNTY DR
QUAKER RD
PRINCE GEORGE DR
PUMPHOUSE RD
THREAT DR
WELLS STATION RD
CONTINENTAL FOREST DR
LAMORE DR
COURTHOUSE RD
JEFFERSON PARK RD
BULL HILL RD
TAVERN RD
TIMBER RD
CRATER RD
SUNNYBROOK RD
BUTLER BRANCH RD
GRIFFIN RD
BIRDSONG RD
FAIRWOOD RD
JOHNSON RD
RIVER RD
PUDDLEDOCK RD
TEMPLE AVE
OAKLAWN BLVD
Legend
Outlet
Forcemain
Gravity Main
Forcemain (Not Included in Analysis)
Gravity Main (Not Included in Analysis)
Buildings
Tax Parcels
Pump Station Capacity
Not Included in Analysis
0-80%
80-100%
Over 100%
Southpoint
0 3,000 6,000 12,000 Feet
Dewberry
Dewberry Engineers Inc.
DATE
MARCH 2022
SCALE
1 inch = 6,000 feet
TITLE
PUMP STATION CAPACITY ANALYSIS
FIGURE NO.
5-2
PROJ. NO.
50148937
PROJECT
PRINCE GEORGE COUNTY WASTEWATER MODEL UPDATE

5.5. Southpoint Capacity Evaluation

Since the Southpoint Business Park is identified as an area of high growth, and due to the complexity of the operating conditions of the Southpoint Force Main, particular attention was given to SPS-21 and SPS-24. In addition to an analysis based on the consumption data provided by the County as completed on all other pump stations, an analysis was conducted on the pump runtimes of both pump stations to identify any deviations in influent flows. As noted in **Section 4.4**, the SPS-21 and SPS-24 have several operating points, presented again in **Table 5-3**.

Table 5-3: Southpoint Pump Station Capacities

Pump Station	Name	Capacity when Single Station is Active (GPM)	Capacity when Both Stations are Active (GPM)	Capacity when Both Stations and are Active with Reserve PS (GPM)
SPS-21	I-295 Industrial	306	182	166
SPS-24	Crosspointe	309	178	160

According to consumption data allocated to the model, including reserve flows, the average daily flow to SPS-21 was estimated to be 82 GPM, with a peak hour flow of 306 GPM. This represents an increase over the 60 GPM ADF and PHF of 230 GPM that was estimated based on runtime data. Even with the addition of reserve flows to the calculated runtime flows, the ADF is 74 GPM, with a PHF of 280 GPM.

SPS-24 shows a similar trend. According to consumption data, the average daily flow to the pump station is 47 GPM, with a peak hour flow of 182 GPM. Using runtime data, the ADF to the pump station is 10 GPM, with a PHF of 42 GPM. Flow data for SPS-21 and SPS-24 is presented in **Table 5-4**.

Table 5-4: Southpoint Pump Stations Flow Data

Pump Station	Name	Runtime Data ADF (GPM)	Runtime Data PHF (GPM)	Consumption Data ADF (GPM)	Consumption Data PHF (GPM)
SPS-21	I-295 Industrial	74	280	82	306
SPS-24	Crosspointe	10	42	47	182

Using the runtime calculated flow (with reserve flows added), both SPS-21 and SPS-24 have sufficient capacity to meet peak hour flow requirements. Using water consumption data flow values, SPS-21 will have just enough capacity to handle existing and reserve flow when operating independently. SPS-24 will also have sufficient capacity when operating independently.

Due to the difference in flows calculated from the different data sets, it is likely that the actual flows at each of these pump stations is between the consumption and runtime data. Based on this, both pump stations are operating under capacity when operating independently; however, when both are active at the same time and both experiencing peak hour flows, capacity would become a concern.

It is unlikely that both pump stations would be active at the same time for an extended period. Runtime data from each pump station shows that on average, SPS-21 is active for 5 hours per day and SPS-24 is active for 1 hour per day. If for any reason SPS-24 operates more frequently, it may cause capacity issues for SPS-21. This area should be closely monitored for any deviation in flow pattern that cause a reduction in flow capacity in SPS-21.

Additional consideration should be given to the effect of the future reserve flow tie-in to the Southpoint Force Main on SPS-21 and SPS-24 capacity. If both pump stations and the reserve capacity pump station are operating at the same time, the capacity of SPS-21 and SPS-24 will decrease to 160 GPM and 166 GPM, respectively. SPS-21 is over capacity when both pump stations and the tie-in are online whether using runtime

data or consumption data. In that scenario, SPS-24 is over capacity according to consumption data. When the tie-in comes online, the operation of SPS-21 and SPS-24 should continue to be monitored closely and action should be taken to increase pump station capacity if necessary.

It should be noted that the capacity within the Southpoint Business Park is limited based on the capacities of SPS-021 and SPS-024 and the gravity sewer along Route 460. The capacity agreement with the City of Petersburg at the Route 460 outfall does have remaining capacity, which could be used for the Southpoint Business Park if the Southpoint Force Main was rerouted to bypass the Route 460 gravity sewer and SPS-021 and 024 were upgraded.

6. CONCLUSIONS

6.1. Water Capacity Analysis

The County's water model was updated and calibrated to include the Route 156 waterline, the Route 460 waterline, the Route 10 waterline extension, and the Food Lion Booster Station. Based on the hydraulic analysis, the Food Lion Booster Station and Tank provides needed system storage to allow the system to deliver the 2,000 GPM fire flow, recover, and return to normal operation by the end of the following day during an MDD scenario. However, based on current water supply capacity, which is limited to approximately 1.5 MGD, the Central Pressure Zone does not have additional water supply available beyond the existing and reserve demands that were identified in this report. Water transmission upgrades would be required to increase this capacity to allow the County to use the full 2.69 MGD maximum day water supply allocation from ARWA.

The Route 10 corridor has a limited fire flow capacity of 960 GPM due to high ground elevations along Ruffing Road. The Route 301 area has an available maximum day capacity of 91 GPM (0.13 MGD), limited by the well supply capacity.

6.2. Sewer Capacity Analysis

The County's wastewater model was updated and calibrated using consumption data and pump station drawdown tests. A system-wide hydraulic model was completed to evaluate the available capacities of the County's gravity mains and pump stations in the Route 460 wastewater system. At current sewer peak flows, all gravity sewer in the County's sewer basins has available capacity. Considering the flows reserved by the County along the Route 460 corridor and in the Southpoint Business park, the Route 460 gravity main is at capacity. During peak hour flows, several of the County's pump stations are above or nearing the capacity, including SPS-15 in the Route 460 system. Pump stations that have peak hour inflow over station capacity should be prioritized for upgrades, and pump stations nearing capacity should be monitored, especially if new development is planned in the service area.

SPS-21 and SPS-24 should be monitored closely by the County as reserve flows are introduced into the system. Due to the unique characteristics of the Southpoint Force Main, SPS-21 and SPS-24 have the capacity to handle peak hour flows when operating independently; however, if both stations operate at the same time, with or without the proposed reserved tie-in to the force main, they may not have sufficient capacity for peak hour flows. Due to the relatively low runtime of SPS-24, it is unlikely that both stations will run at the same time frequently. However, if close monitoring of the pump stations reveal capacity issues, especially as new development enters the area, upgrades should be considered by the County.

It should be noted that the Southpoint Business Park capacity could be increased by upgrading SPS-021 and 024 and rerouting the existing 8-inch force main to bypass the hydraulic restrictions within the Route 460 gravity sewer, as summarized by the Southpoint Force Main Relocation Evaluation completed by Dewberry, which is included in Appendix B. This could increase the peak hour flow capacity within the Southpoint Business Park by approximately 0.75 MGD. The County could consider this as a short-term option to add more capacity until the long-term solution is designed and constructed.

APPENDIX A
Hydrant Test Maps

Dewberry

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Glen Allen, VA 23060-9278

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804.290.7928 fax
www.dewberry.com

Technical Memorandum

Date: February 15, 2022
To: Frank Haltom, P.E.
From: Dan Villhauer, P.E.
Richard Kincheloe, P.E
Subject: Water and Sewer Model Update - Fire Hydrant Testing Plan

---

Hydrant flow testing will be conducted to provide data for developing and calibrating the computerized hydraulic model. The location and number of the hydrant flow test to be performed are provided by the attached maps.

A minimum of two hydrants will be used to conduct the flow testing, one designated as the test hydrant to observe static and residual pressures and one designated as the flow hydrant to discharge water. Each hydrant used in the test will be manned. The selection of the flow hydrant will be made to minimize damage to private property, preferably near a catch basin or drainage swale, and to avoid discharging water onto streets.

Below are instructions to complete the attached Fire Hydrant Fire Flow Test form for each test:

1. During all tests, the Central Booster Station pumps should be off.

2. Use the 'Fire Hydrant Fire Flow Test' form, to note the following (use a new form for each test):
   - '***Date***', '***Time***' of the test, and '***Weather***' (time of test shall be the time the flow hydrant is opened)
   - Names of personnel occupying the flow and residual hydrant (***'Flusher/Tester'***)
   - ***'Flow Hydrant'*** ID and information
   - ***'Gauge Hydrant'*** ID (*identified as Residual Hydrant on Maps*)

3. Perform Hydrant Test:
   a. Install a pressure gauge on the flow and residual hydrant and note both ***'Static'*** pressures on the form. Note '***Diameter'*** of nozzle used
   b. Remove pressure gauge from flow hydrant and install flow gauge.
   c. Open hydrant slowly to avoid generating pressure surges within the system.
   d. The flow hydrant will be fully opened and allowed to discharge until the pitot gauge has stabilized so that an accurate reading can be recorded (typically about 2-5 minutes).
   e. Read the flow at the flow hydrant and pressure at the residual hydrant and note '***Flow at Residual Pressure'*** and ***'Residual'*** pressure on the form.
   f. Close hydrant slowly and note the length of time ***'Mins/Flowed'*** the hydrant was flowed

4. The data to be collected during each test will be as noted on the attached Fire **Hydrant Fire Flow Test Form.**

5. SCADA data for the testing days will be collected. SCADA data points will include tank levels, pump station flow rates, and suction and discharge pressures for all pump stations.

6. The discharge from the flow hydrant will be calculated based on the following formula:

$$Q_f = 29.83 \times c \times d^2 \times p^{0.5}$$

Where Q_f = gallons per minute
d = diameter of nozzle in inches (2-1/2")
p = pitot gauge in psi (measured at flow hydrant with pitot gauge instrument)
c = coefficient of discharge (0.85)

7. To determine the available flow at a residual pressure of 20 psi from the test results, the following formula will be used:

$$Q_{20} = Q_F \times (H_s - 20)^{0.54} / (H_s - H_r)^{0.54}$$

Where H_s = static pressure reading at the test hydrant
H_r – residual pressure reading from the test hydrant

Attachments
Fire Hydrant Fire Flow Test Form
Hydrant Testing Maps

Dewberry

FIRE HYDRANT FIRE FLOW TEST

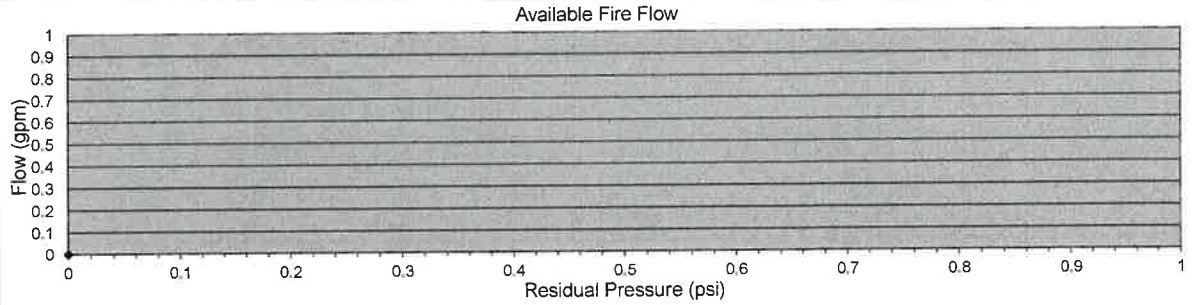
Date _____ Time _____ Weather _____

Flusher / Tester _____ Temperature _____ °F / °C

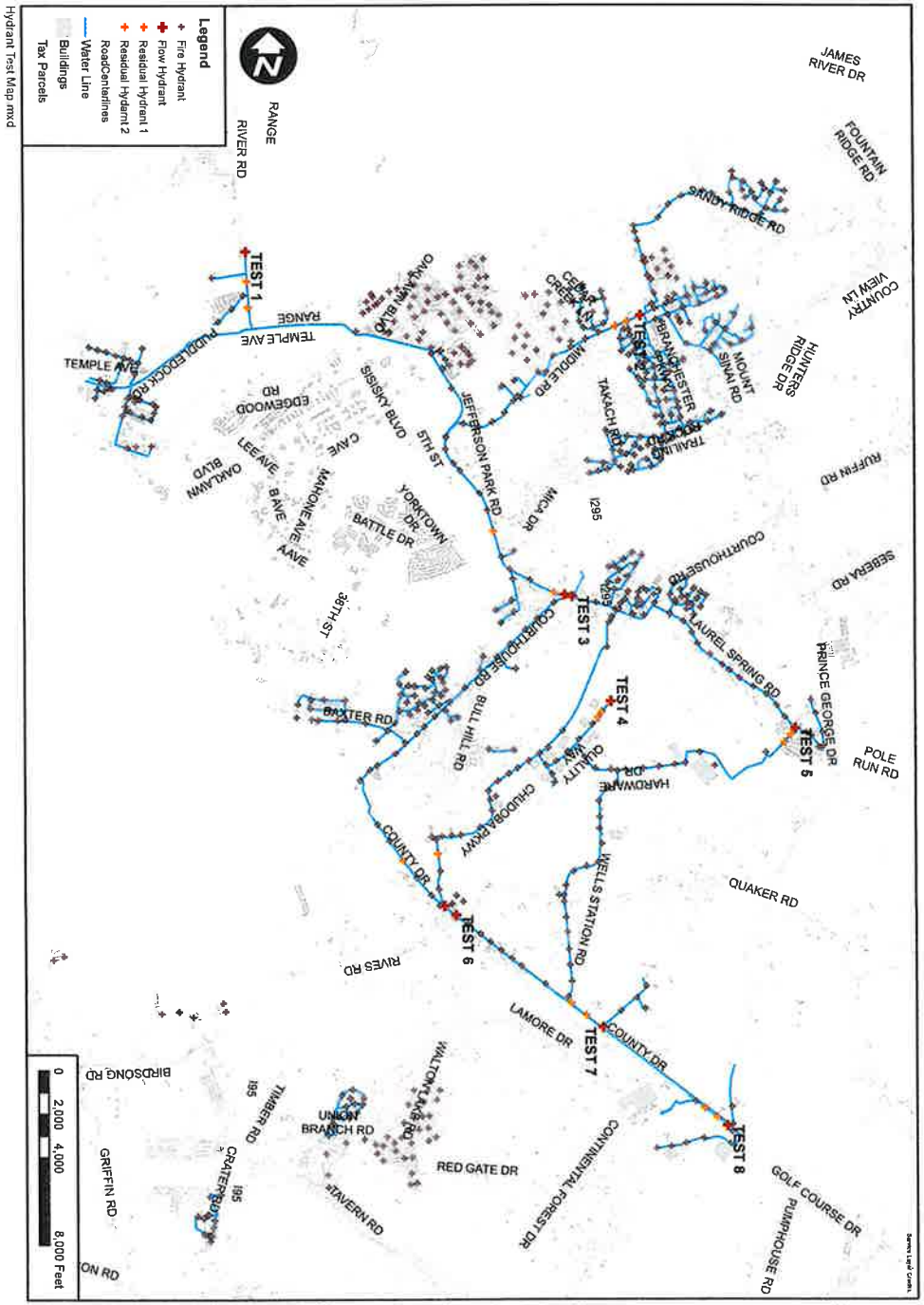
Flow Hydrant _____
Diameter _____ inches
Coefficient _____
Static _____ psi
Pitot _____ psi
Flow at Residual Pressure _____ gpm
Mins/flowed _____ Water Used _____ cubic feet

Gauge Hydrant _____
Static _____ psi
Residual _____ psi

Flow available at 20psi residual _____ gpm



Pitot Chart						Flow Available at Residual Pressure			
psi	gpm	psi	gpm	psi	gpm	psi	gpm	psi	gpm
1	0	28	0	55	0	0	#DIV/0!	-	#VALUE!
2	0	29	0	56	0	-	-	-	-
3	0	30	0	57	0	-	-	-	-
4	0	31	0	58	0	-	-	-	-
5	0	32	0	59	0	-	-	-	-
6	0	33	0	60	0	-	-	-	-
7	0	34	0	61	0	-	-	-	-
8	0	35	0	62	0	-	-	-	-
9	0	36	0	63	0	-	-	-	-
10	0	37	0	64	0	-	-	-	-
11	0	38	0	65	0	-	-	-	-
12	0	39	0	66	0	-	-	-	-
13	0	40	0	67	0	-	-	-	-
14	0	41	0	68	0	-	-	-	-
15	0	42	0	69	0	-	-	-	-
16	0	43	0	70	0	-	-	-	-
17	0	44	0	71	0	-	-	-	-
18	0	45	0	72	0	-	-	-	-
19	0	46	0	73	0	-	-	-	-
20	0	47	0	74	0	-	-	-	-
21	0	48	0	75	0	-	-	-	-
22	0	49	0	76	0	-	-	-	-
23	0	50	0	77	0	-	-	-	-
24	0	51	0	78	0	-	-	-	-
25	0	52	0	79	0	-	-	-	-
26	0	53	0	80	0	-	-	-	-
27	0	54	0	81	0	-	-	-	-
28	0	55	0	82	0	-	-	-	-



Dewberry Dewberry Engineers Inc. 4805 LAKE BROOK DRIVE, SUITE 200 GLEN ALLEN, VIRGINIA 23060 PHONE: 804.290.7957 FAX: 804.290.7828	DATE FEBRUARY 2022	SCALE 1 inch = 4,000 feet	TITLE HYDRANT TESTING MAP	FIGURE NO. HT-0
	PROJ. NO. 50148937	PROJECT PRINCE GEORGE COUNTY WATER MODEL UPDATE		

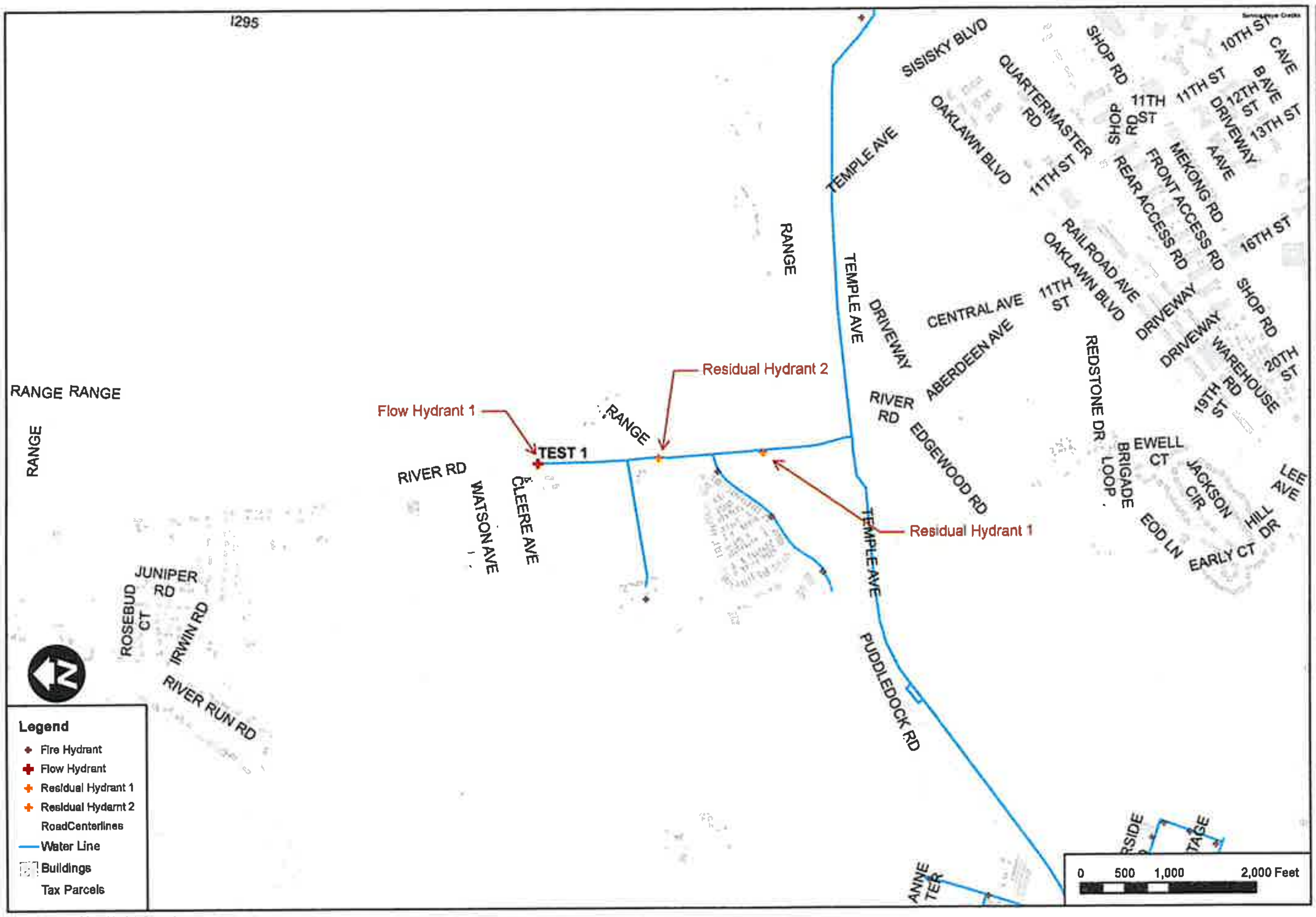

I295
RANGE RANGE
RANGE
RANGE
RANGE
Flow Hydrant 1
TEST 1
Residual Hydrant 2
Residual Hydrant 1
RIVER RD
WATSON AVE
CLEERE AVE
TEMPLE AVE
SISISKY BLVD
OAKLAWN BLVD
QUARTERMASTER RD
11TH ST
SHOP RD
DRIVEWAY
CENTRAL AVE
ABERDEEN AVE
RIVER RD
EDGEWOOD RD
REDSTONE DR
BRIGADE LOOP
EWELL CT
JACKSON CIR
EOD LN
EARLY CT
HILL DR
LEE AVE
RAILROAD AVE
REAR ACCESS RD
FRONT ACCESS RD
MEKONG RD
16TH ST
WAREHOUSE
19TH ST
20TH ST
10TH ST
C AVE
B AVE
12TH ST
13TH ST
A AVE
PUDDLEDOCK RD
ANNE TER
JUNIPER RD
ROSEBUD CT
IRWIN RD
RIVER RUN RD
Legend
Fire Hydrant
Flow Hydrant
Residual Hydrant 1
Residual Hydarnt 2
RoadCenterlines
Water Line
Buildings
Tax Parcels
0 500 1,000 2,000 Feet

FIGURE NO. HT-1

TITLE HYDRANT TESTING MAP TEST 1

SCALE 1 inch = 1,000 feet

DATE FEBRUARY 2022

PROJECT PRINCE GEORGE COUNTY WATER MODEL UPDATE

PROJ. NO. 50148937

Dewberry
Dewberry Engineers Inc.

Hydrant Test Map Hyd 1-8.mxd

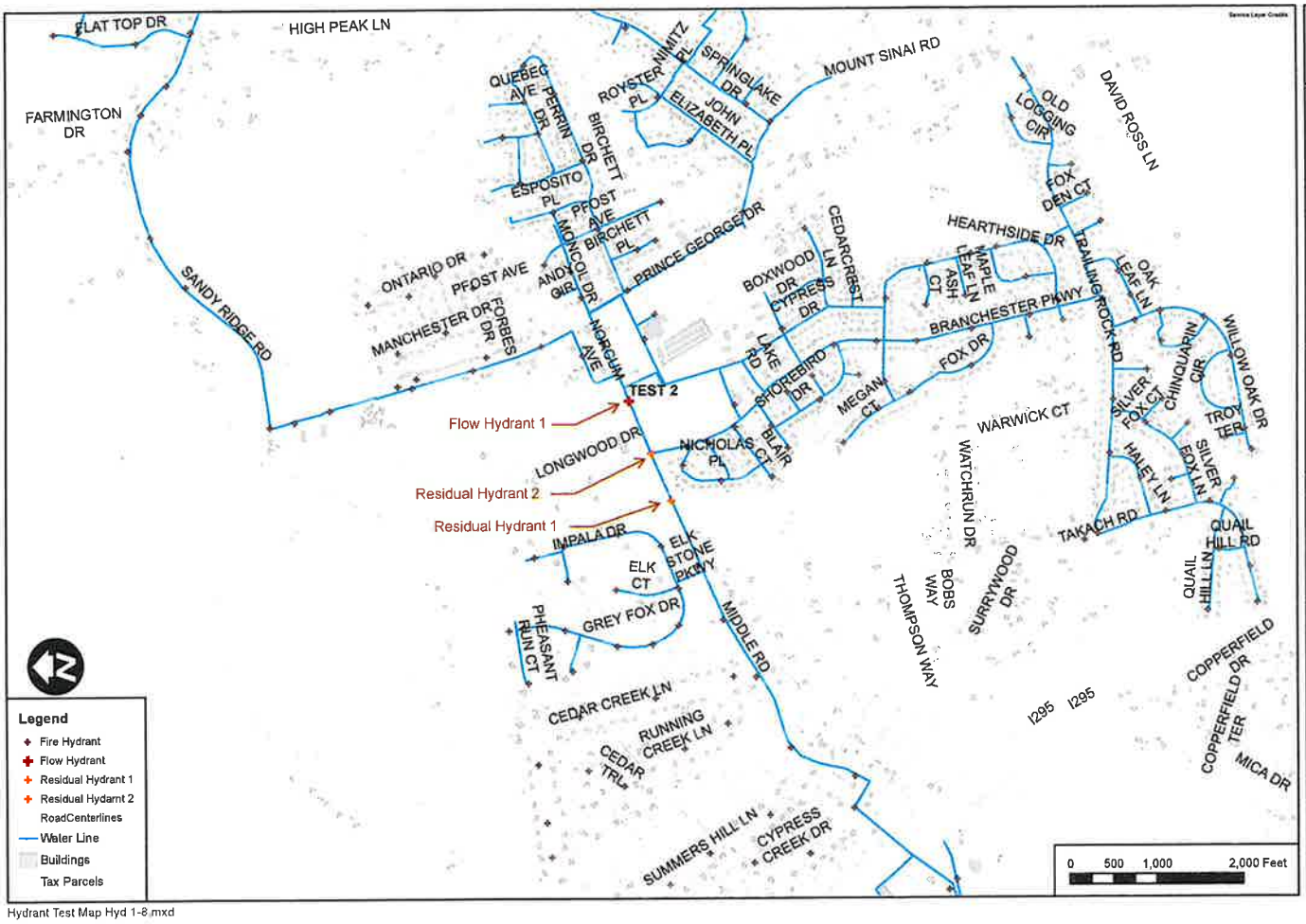


FIGURE NO. HT-2

TITLE HYDRANT TESTING MAP TEST 2

PRINCE GEORGE COUNTY WATER MODEL UPDATE

SCALE 1 inch = 1,000 feet

PROJECT

DATE FEBRUARY 2022

PROJ. NO. 50148937

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Hydrant Test Map Hyd 1-8.mxd

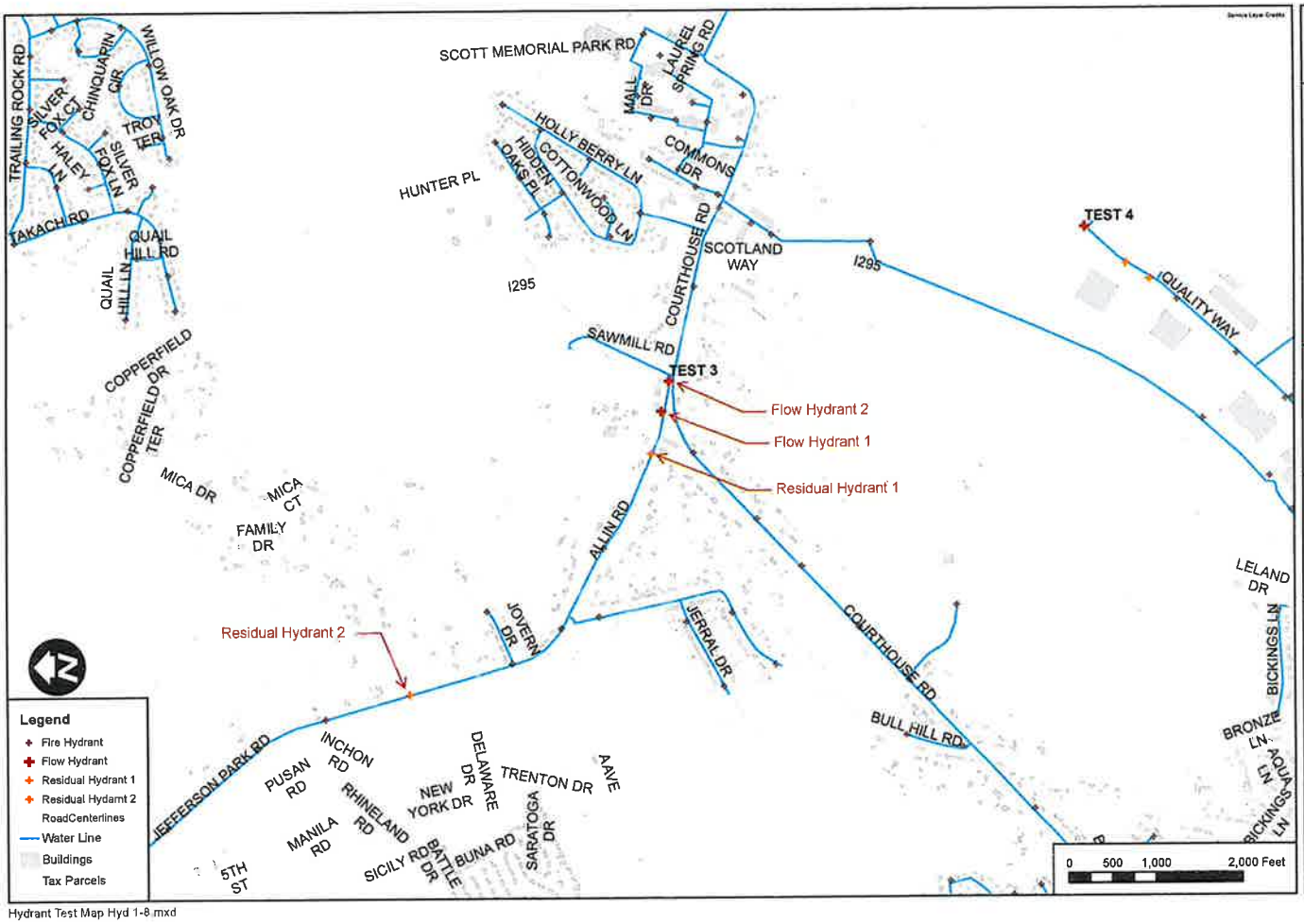

FIGURE NO. HT-3

TITLE HYDRANT TESTING MAP TEST 3

SCALE 1 inch = 1,000 feet

PROJECT PRINCE GEORGE COUNTY WATER MODEL UPDATE

DATE FEBRUARY 2022

PROJ. NO. 50149937

Dewberry
Dewberry Engineers Inc.
4805 LAKE BROOK DRIVE, SUITE 200
GLEN ALLEN, VIRGINIA 23060
PHONE: 804.200.7467
FAX: 804.200.7028

Hydrant Test Map Hyd 1-8.mxd

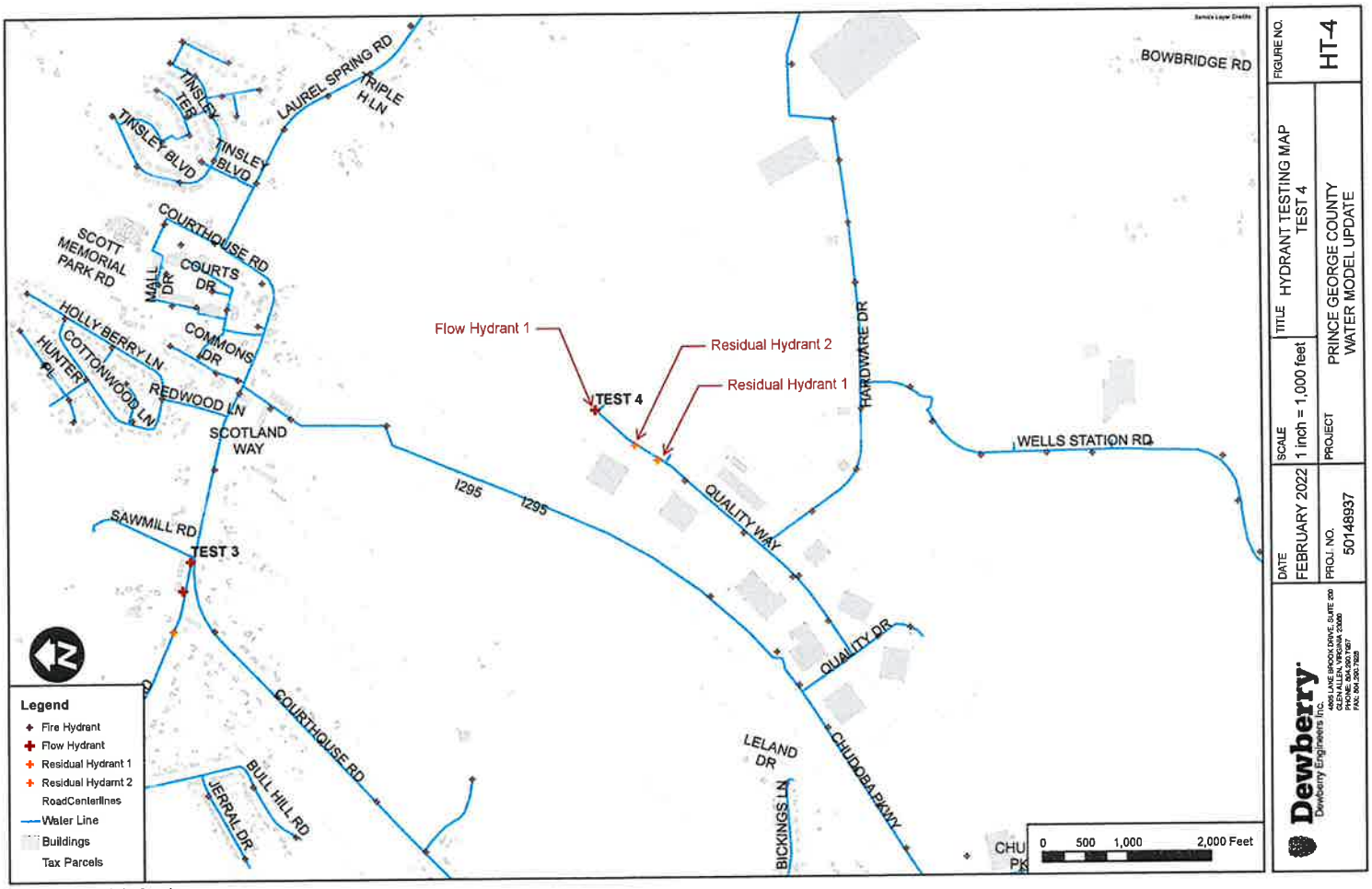

FIGURE NO. HT-4

TITLE HYDRANT TESTING MAP TEST 4

SCALE 1 inch = 1,000 feet

PROJECT PRINCE GEORGE COUNTY WATER MODEL UPDATE

DATE FEBRUARY 2022

PROJ. NO. 50148937

Dewberry

Dewberry Engineers Inc.

4805 LAKE BROOK DRIVE, SUITE 200
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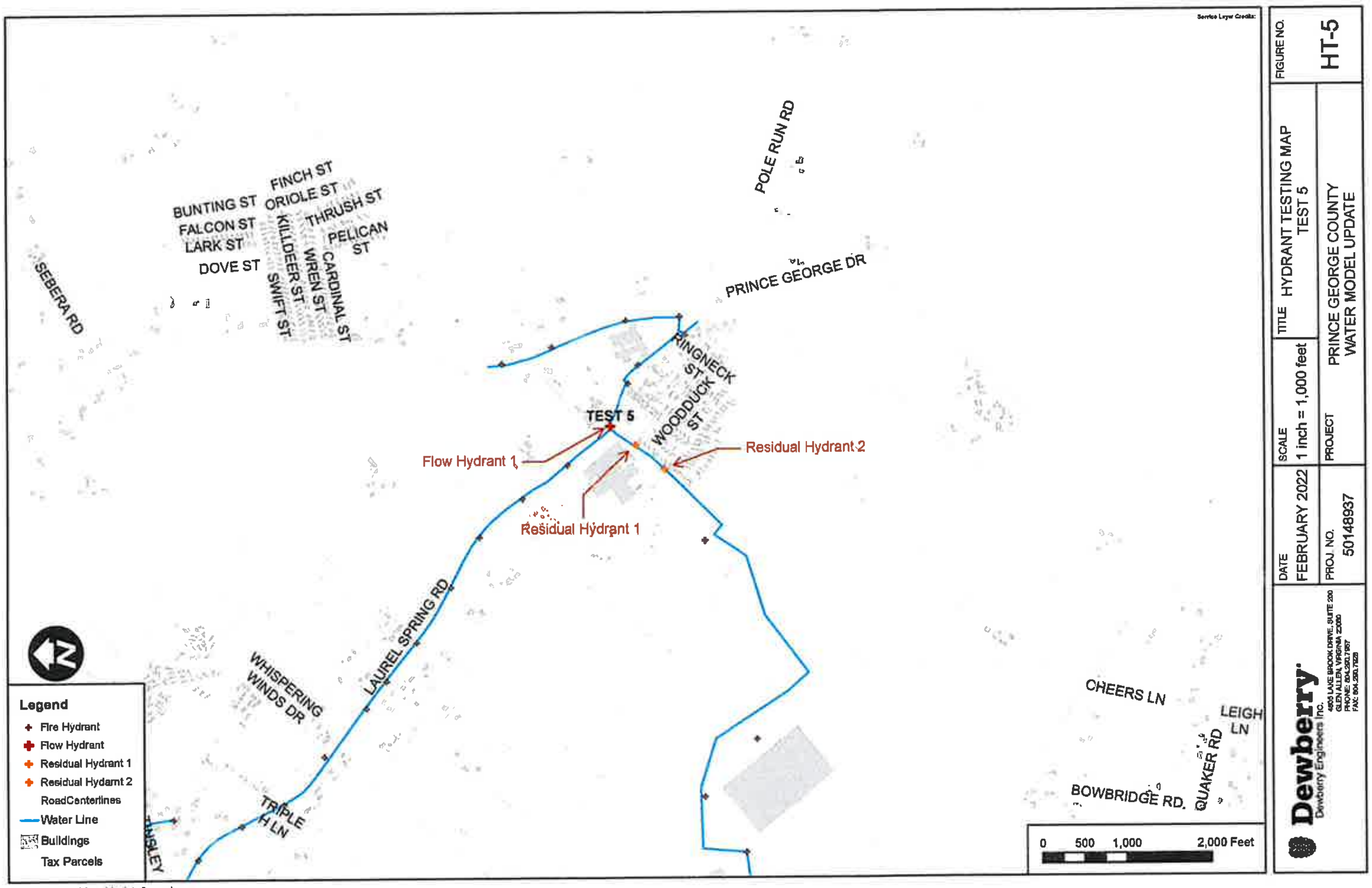
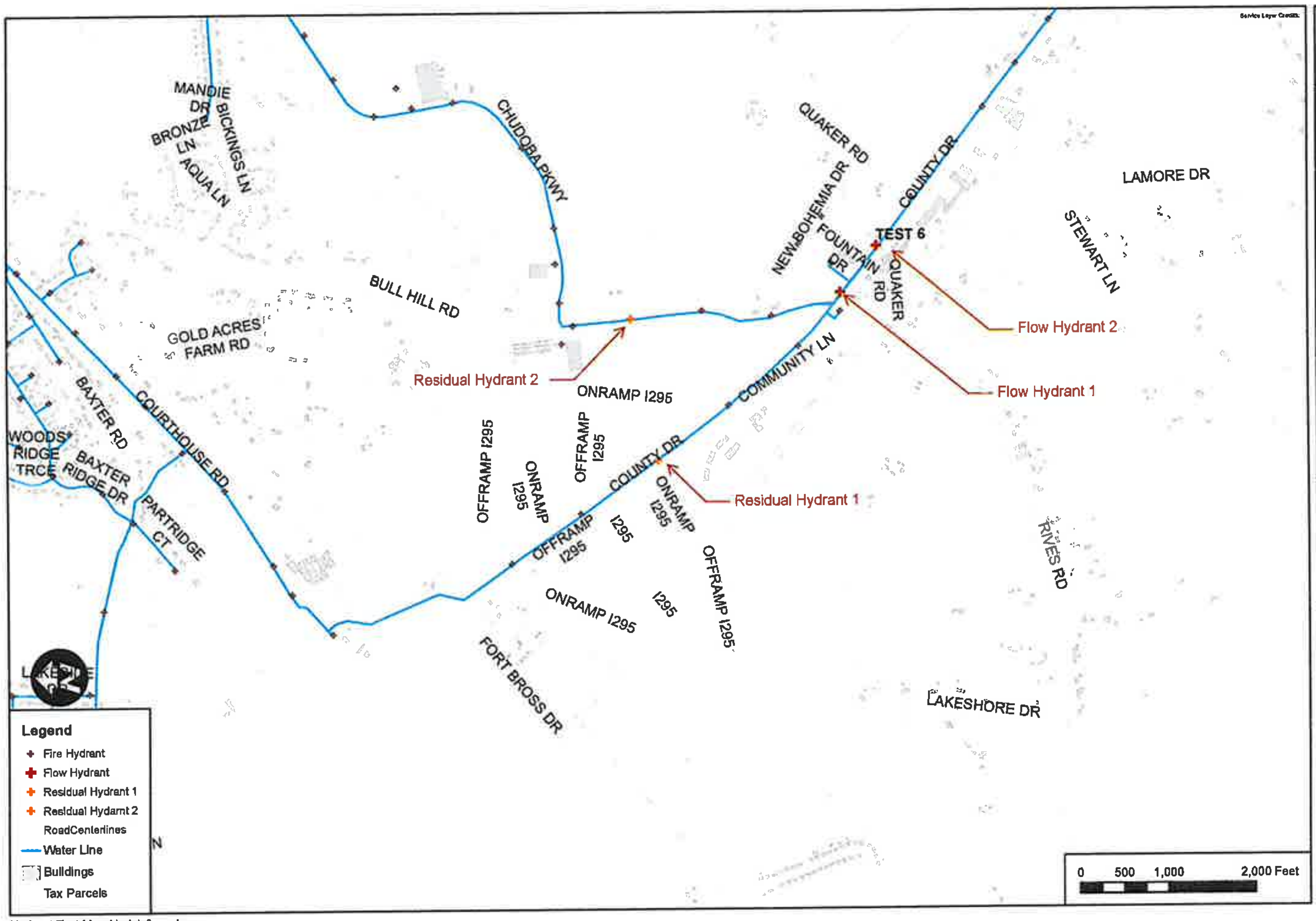
PHONE: 804.200.7927
FAX: 804.200.7925

Hydrant Test Map Hyd 1-8.mxd



Hydrant Test Map Hyd 1-8.mxd


MANDIE DR
BICKINGS LN
BRONZE LN
AQUA LN
CHUDOBA PKWY
QUAKER RD
COUNTY DR
LAMORE DR
NEW BOHEMIA DR
FOUNTAIN DR
QUAKER RD
TEST 6
STEWART LN
BULL HILL RD
GOLD ACRES FARM RD
Flow Hydrant 2
Flow Hydrant 1
Residual Hydrant 2
COMMUNITY LN
ONRAMP I295
BAXTER RD
COURTHOUSE RD
WOODS RIDGE TRCE
BAXTER RIDGE DR
OFFRAMP I295
ONRAMP I295
OFFRAMP I295
COUNTY DR
Residual Hydrant 1
PARTRIDGE CT
OFFRAMP I295
I295
ONRAMP I295
RIVES RD
OFFRAMP I295
ONRAMP I295
I295
FORT BROSS DR
LAKESHORE DR
Legend
Fire Hydrant
Flow Hydrant
Residual Hydrant 1
Residual Hydarnt 2
RoadCenterlines
Water Line
Buildings
Tax Parcels
0 500 1,000 2,000 Feet

Hydrant Test Map Hyd 1-8.mxd

FIGURE NO. HT-6

TITLE HYDRANT TESTING MAP TEST 6

DATE FEBRUARY 2022

SCALE 1 inch = 1,000 feet

PROJECT PRINCE GEORGE COUNTY WATER MODEL UPDATE

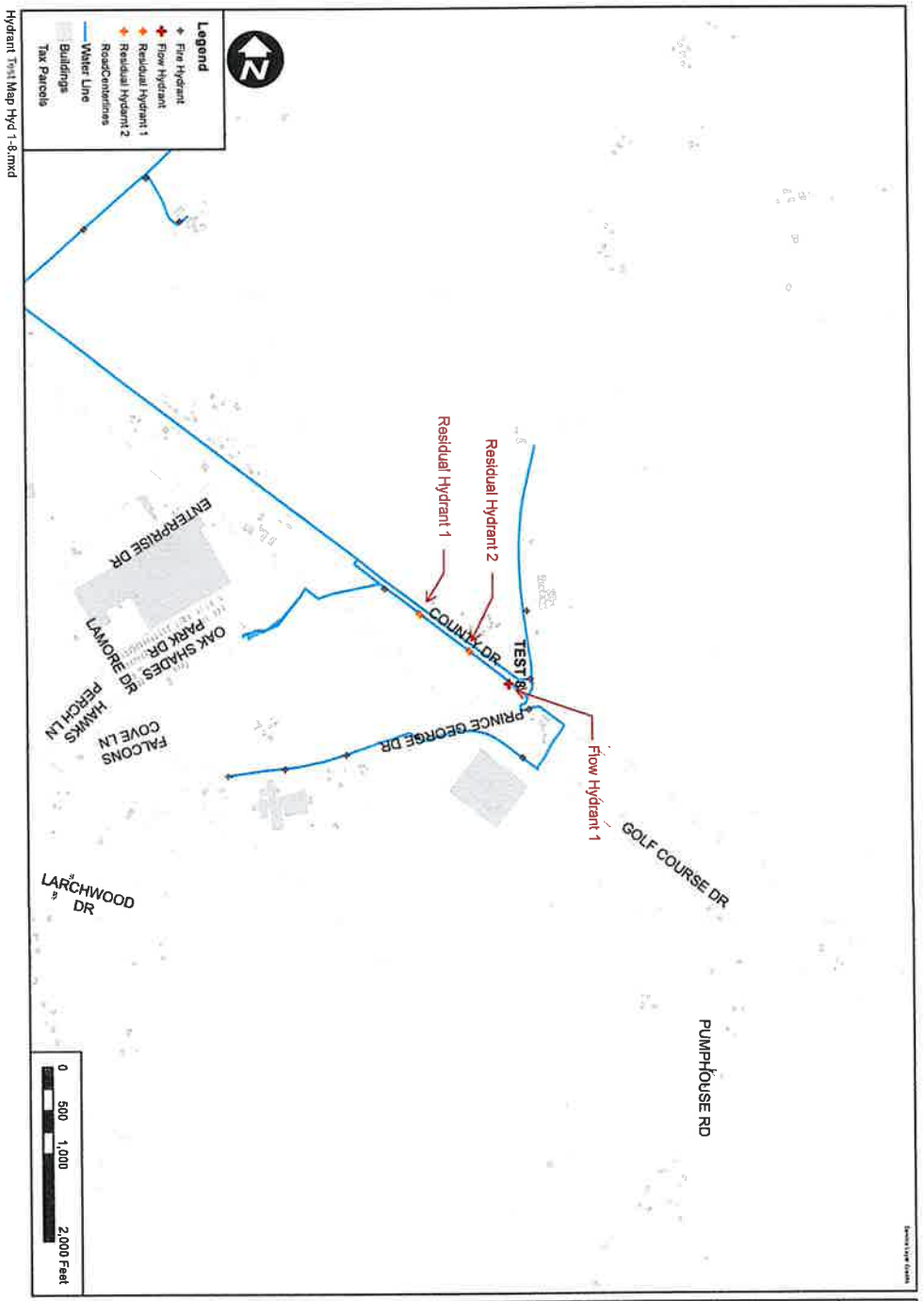
PROJ. NO. 50148937

Dewberry
Dewberry Engineers Inc.

Hydrant Test Map Hyd 1-8.mxd

FIGURE NO.	HT-7
TITLE	HYDRANT TESTING MAP TEST 7
SCALE	1 inch = 1,000 feet
PROJECT	PRINCE GEORGE COUNTY WATER MODEL UPDATE
DATE	FEBRUARY 2022
PROJ. NO.	50148937

Dewberry
Dewberry Engineers Inc.
4035 Lake Brooks Drive, Suite 350
Glen Allen, VA 23060
PHONE: 804.290.7907
FAX: 804.290.7929



Dewberry Dewberry Engineers Inc. 4805 LAKE BROOK DRIVE, SUITE 200 GLEN ALLEN, VIRGINIA 23060 PHONE: 804.290.7907 FAX: 804.290.7926	DATE FEBRUARY 2022	SCALE 1 inch = 1,000 feet	TITLE HYDRANT TESTING MAP TEST 8	FIGURE NO. HT-8
	PROJ. NO. 50148937	PROJECT PRINCE GEORGE COUNTY WATER MODEL UPDATE		

APPENDIX B
Southpoint Force Main Relocation Analysis

Dewberry

MEMORANDUM

DATE: December 6, 2021

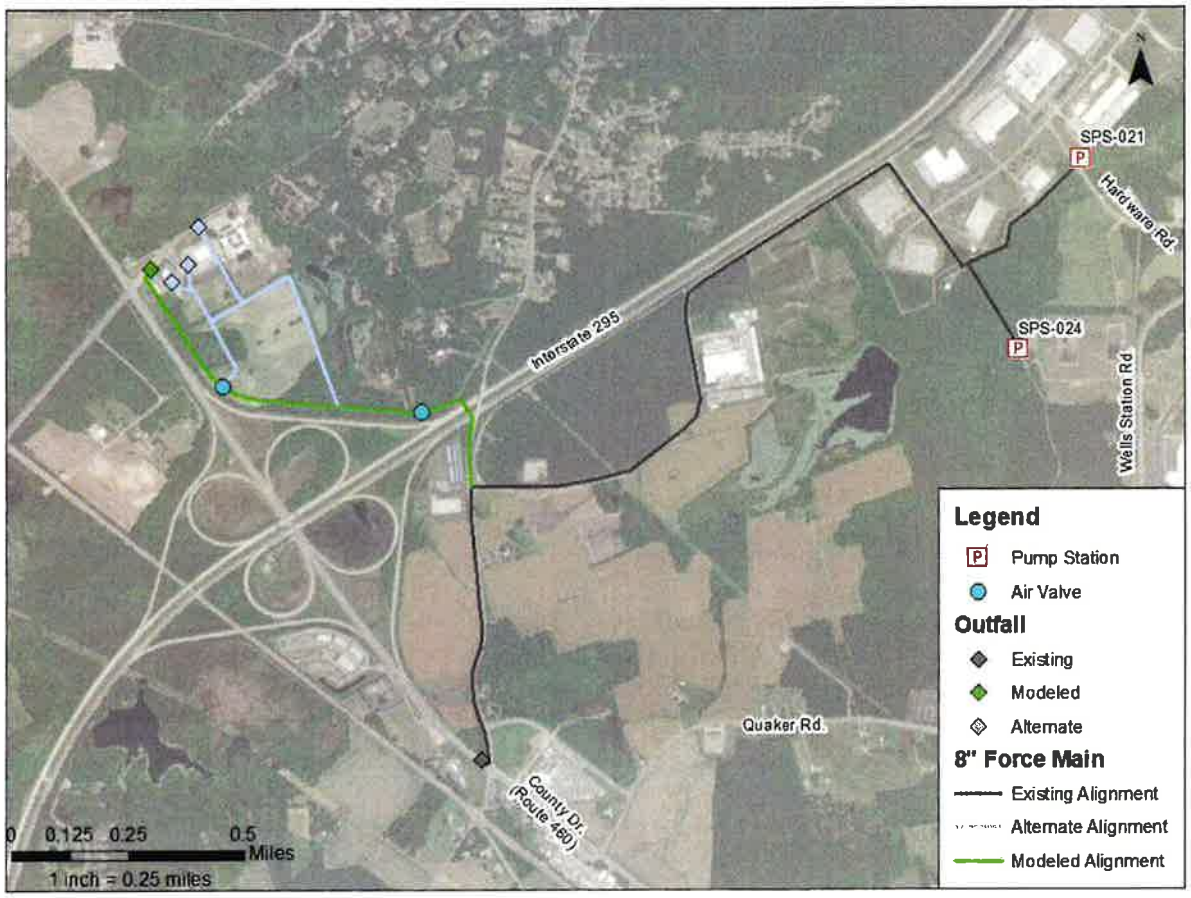
TO: Frank Haltom, PE, Prince George County

FROM: Dan Villhauer, PE

SUBJECT: Pump Stations No. 21 and 24 (Southpoint) Force Main Relocation Analysis

Message

Per your request, Dewberry completed a hydraulic analysis for the proposed realignment of the SPS-021 and SPS-024 force main (Southpoint Force Main). The changes to the force main involve extending the manifolded force main beyond the existing Route 460 outfall (per the attached figure) to increase the available capacity within the Southpoint Business Park. The existing force main and pump stations were calibrated based on drawdown test data provided by the County.



Various potential alignments were presented, all of which have similar operating conditions due to the location of the force main high point; therefore, the hydraulic model focuses on one of these alignments. With this proposed alignment, the firm capacity of both pump stations is 399 gpm with both pump stations operating with one pump on. HGL profiles for the existing and proposed system are attached.

Existing Pump Station Firm Capacity		
	Flow (gpm)	Head (ft)
SPS-021	182	107
SPS-024	178	98
Total	**360**	

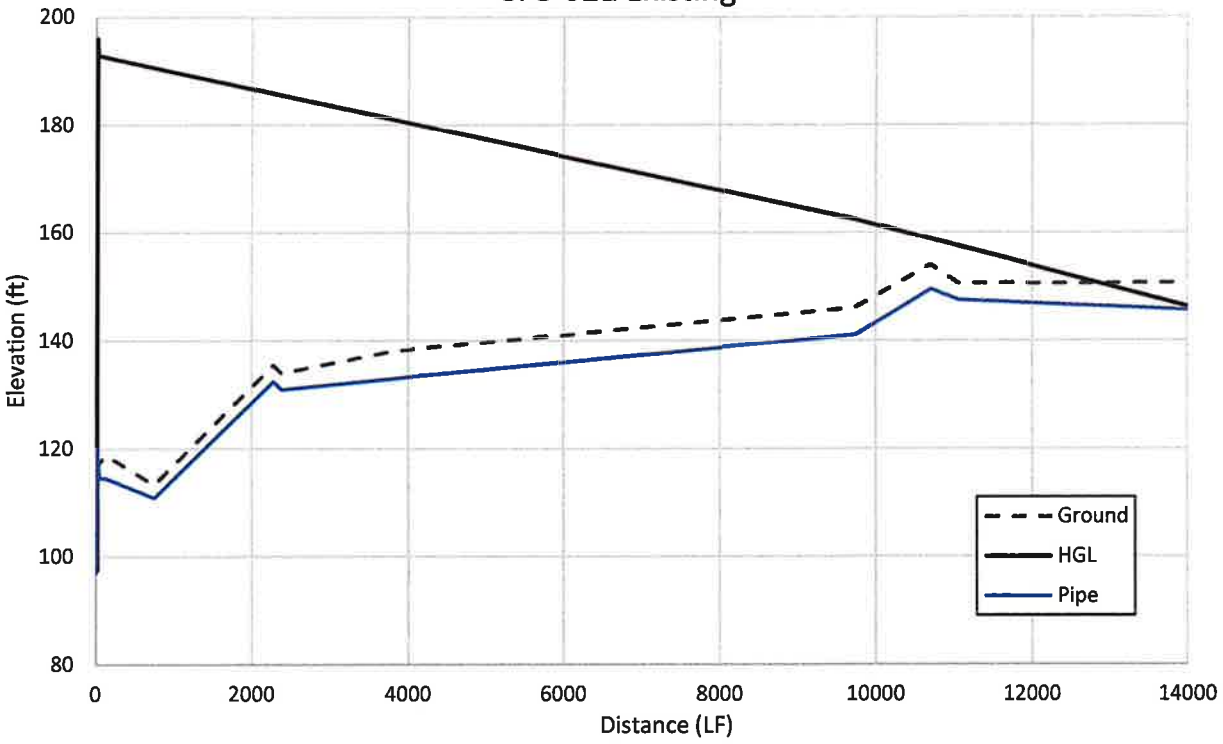
Proposed Pump Station Firm Capacity with Force Main Relocation		
	Flow (gpm)	Head (ft)
SPS-021	200	105
SPS-024	199	96
Total	**399**	

Based on this analysis, if the force main was rerouted to discharge directly upstream of the Route 460 meter, the Southpoint Business Park capacity would be limited by the firm pumping capacity of SPS-021 and SPS-024. The County could consider evaluating the upgrade of these pump stations to increase the capacity within the Southpoint Business Park; however, in order to significantly increase capacity, it is expected that these pump station upgrades would require pump, control panel, generator, and other equipment replacements. Further analysis would be required to identify the recommended pump station upgrades for this scenario.

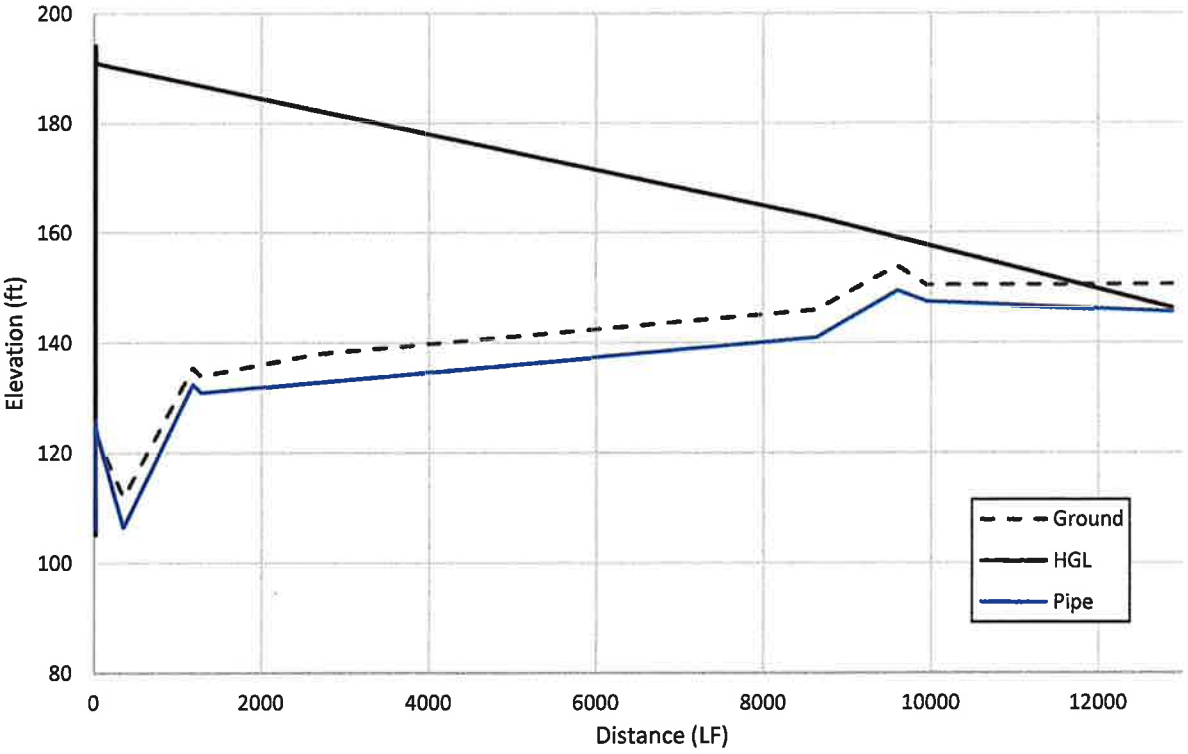
Attachments

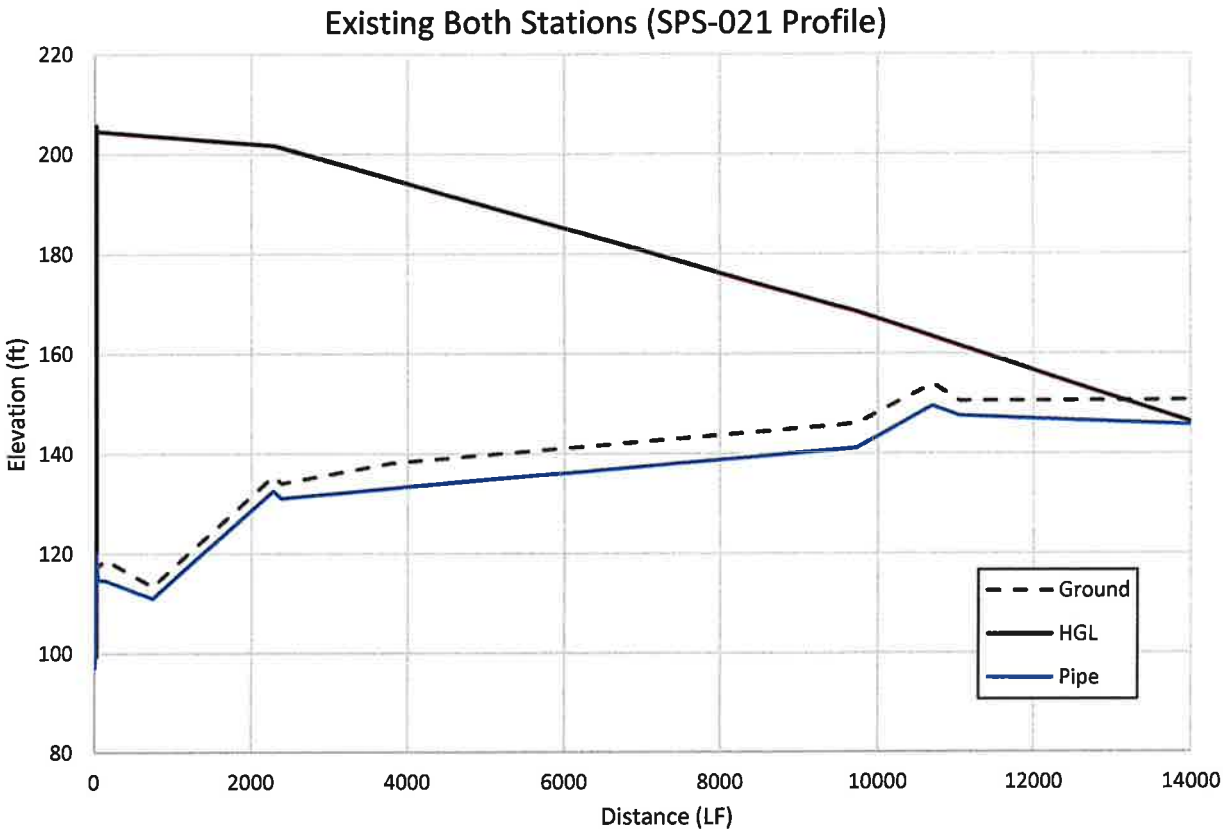
1. **Attachment A** Hydraulic Profiles

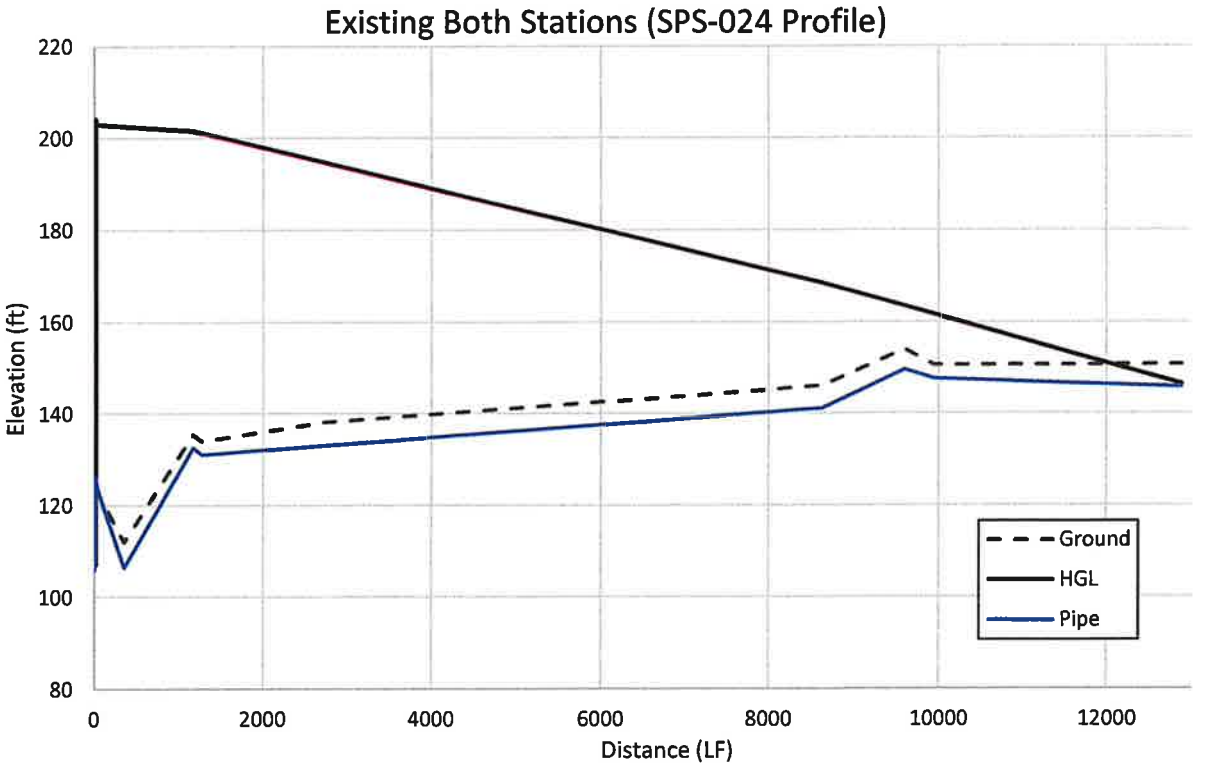
SPS-021 Existing



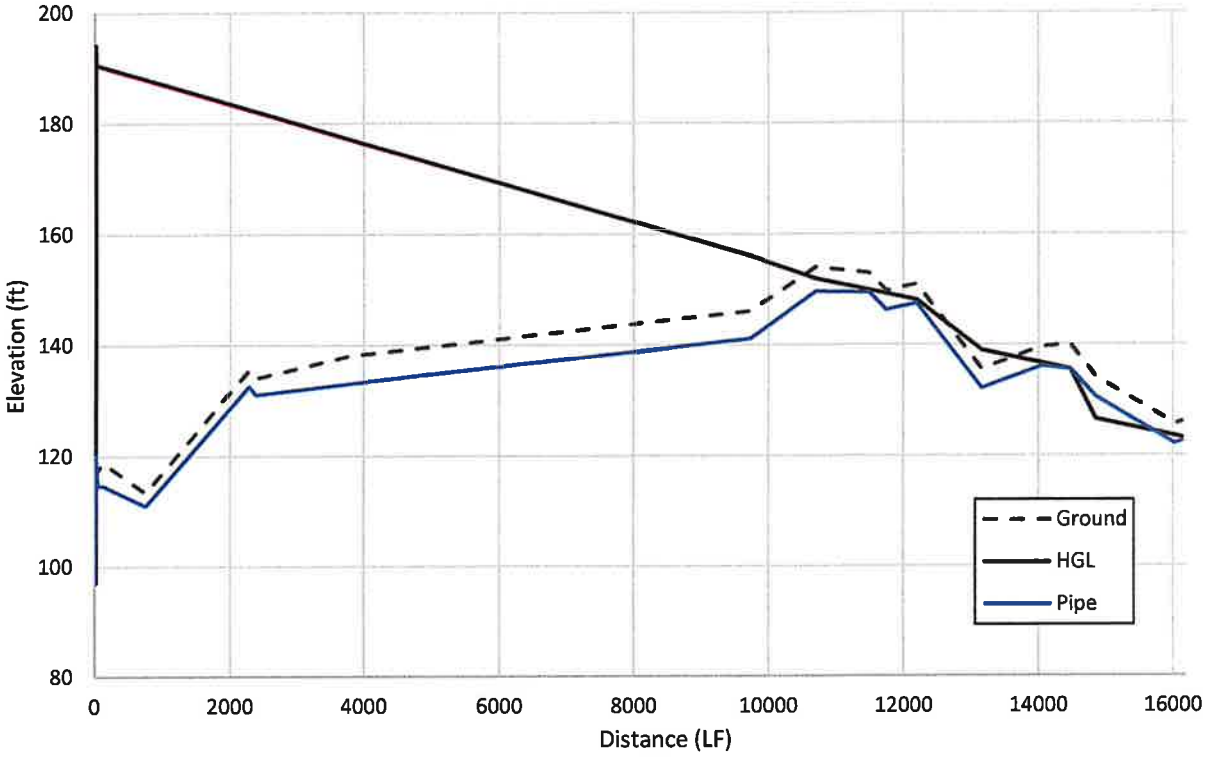
SPS-024 Existing



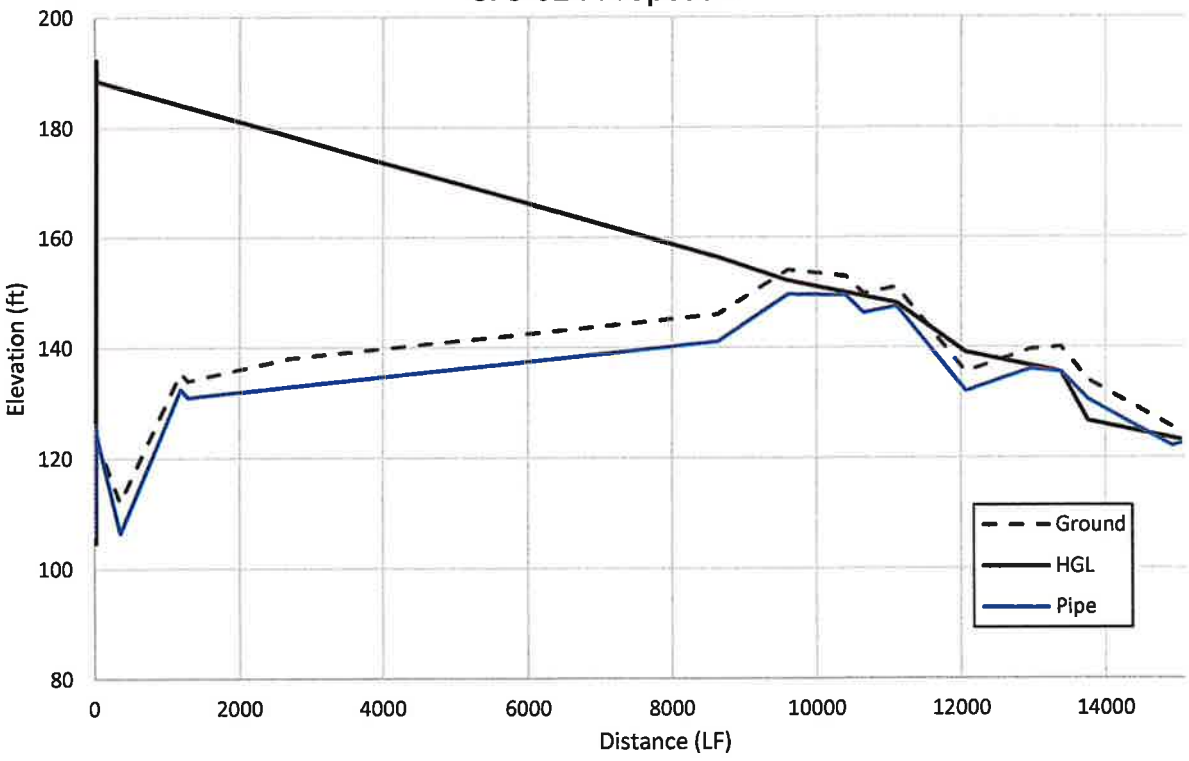

Existing Both Stations (SPS-021 Profile)
220
200
180
160
140
120
100
80
Elevation (ft)
0
2000
4000
6000
8000
10000
12000
14000
Distance (LF)
Ground
HGL
Pipe

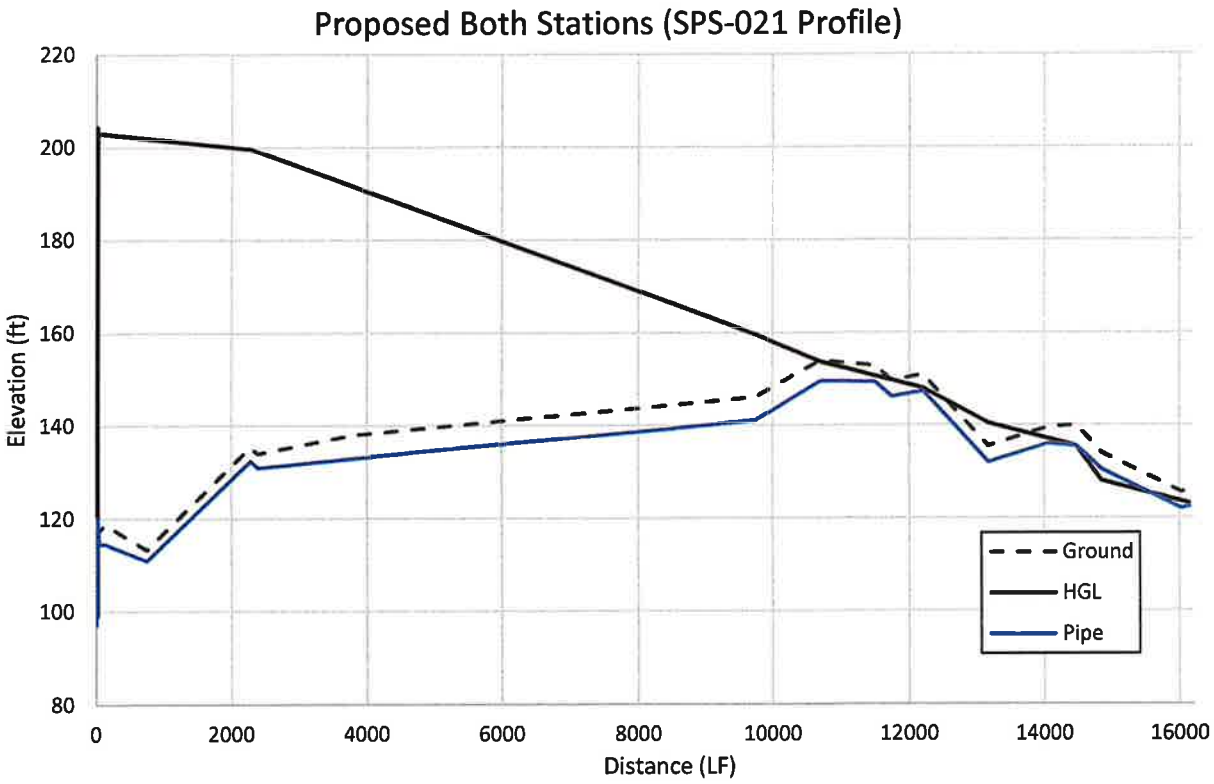

Existing Both Stations (SPS-024 Profile)
220
200
180
160
140
120
100
80
Elevation (ft)
0
2000
4000
6000
8000
10000
12000
Distance (LF)
Ground
HGL
Pipe

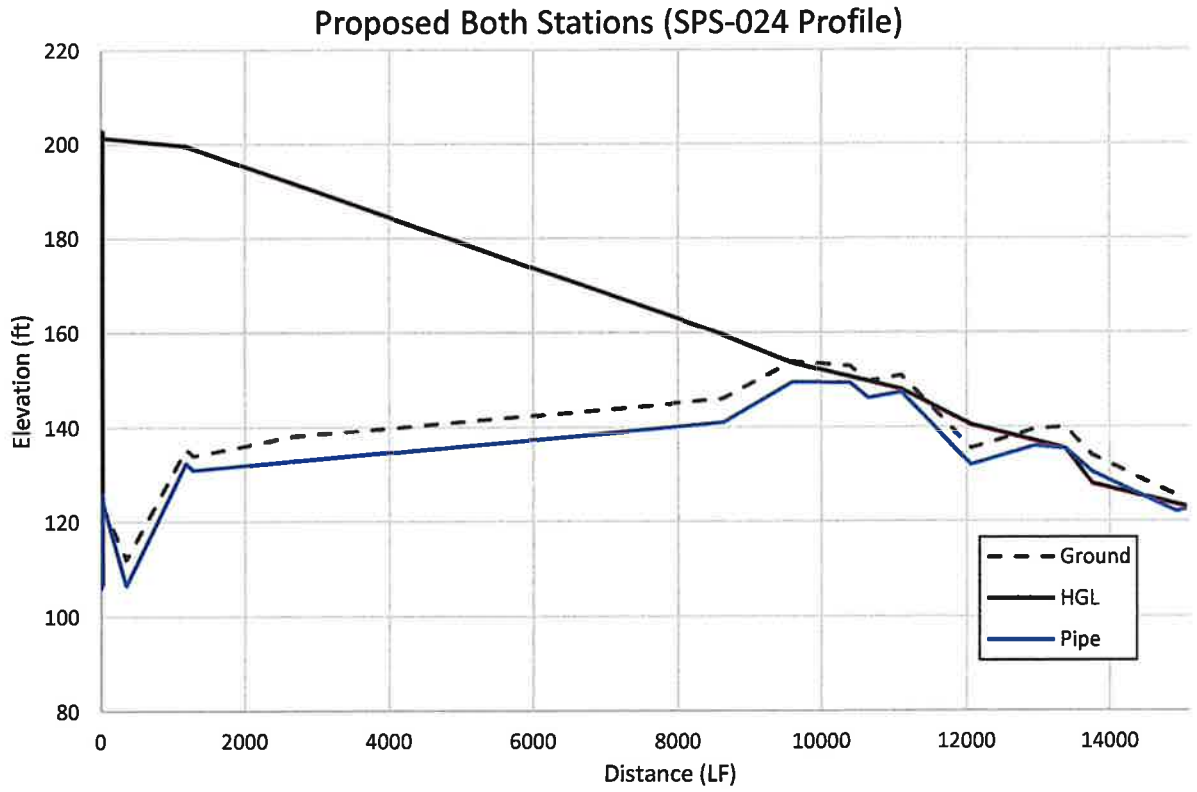
SPS-021 Proposed



SPS-024 Proposed




Proposed Both Stations (SPS-021 Profile)
220
200
180
160
140
120
100
80
Elevation (ft)
0
2000
4000
6000
8000
10000
12000
14000
16000
Distance (LF)
Ground
HGL
Pipe


Proposed Both Stations (SPS-024 Profile)
220
200
180
160
140
120
100
80
Elevation (ft)
0
2000
4000
6000
8000
10000
12000
14000
Distance (LF)
Ground
HGL
Pipe