495 Express Lanes Northern Extension
From: VA Route 267 (Dulles Toll Road)
To: George Washington Parkway
UPC 115401
VDOT Project# 0495-029-419

Fairfax County, Virginia

MS-19 Report

(VPDES Submission)

April 2022

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Fairfax County, Virginia

MS-19 Report

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1. INTRODUCTION

The I-495 Express Lanes Northern Extension is an extension of the 495 HOV/HOT Lanes (Express Lanes) in Fairfax County, Virginia. The proposed project is a public-private partnership (PPP) to construct improvements along I-495 to provide additional capacity in the corridor and provide a single, fully-integrated express lane facility between the Springfield Interchange and the George Washington Memorial Parkway. Proposed improvements encompass an approximate 3.5-mile-long section of the I-495 corridor from Dulles Toll Road to the vicinity of the George Washington Memorial Parkway.

The project is divided into four areas: 1, 2, 3 and 4. Area 1 extends from Dulles Toll Road (station 538+61) to I-495 station 567+50 (just north of Dulles Toll Road). Area 2 extends from I-495 station 567+50 (just north of Dulles Toll Road) to I-495 station 615+00 (Scotts Run Crossing). Area 3 extends from I-495 station 615+00 (Scotts Run Crossing) to I-495 station 675+00 (midway between Georgetown Pike and George Washington Memorial Parkway). Area 4 extends from I-495 station 675+00 (midway between Georgetown Pike and George Washington Memorial Parkway) to I-495 station 722+54 (Virginia/Maryland State Line). The I-495 design corresponds with VDOT GS-INT (Urban Interstate) standards with a 70 miles per hour design speed.

All outfalls associated with the project drain to one HUC as shown in Table 1 and Figure 1 below.

TABLE 1 – PROJECT HUC

HUC 12-DIGIT	VA 6-ORDER	HUC DESCRIPTION	REMARKS
020700081005	PL23	POTOMAC RIVER-NICHOLS RUN-SCOTT RUN	ENTIRE PROJECT

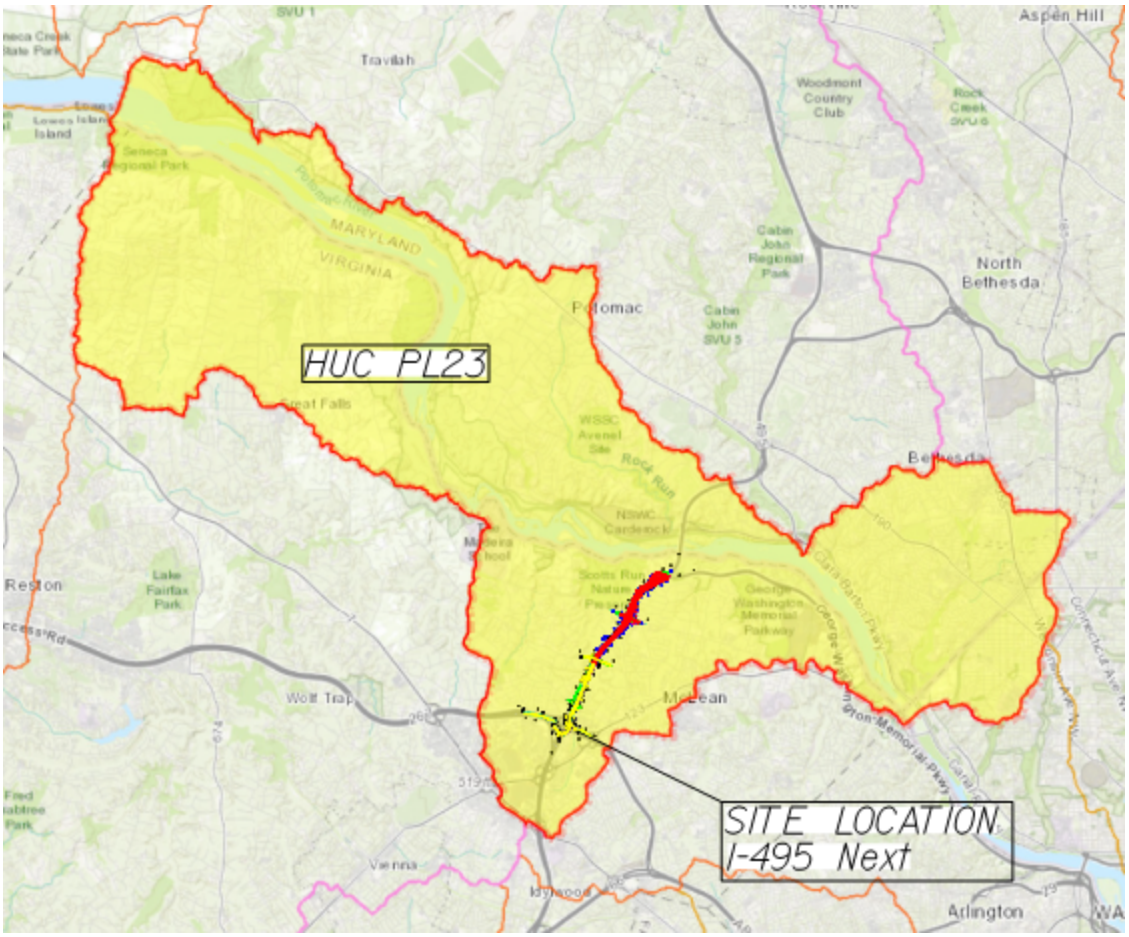


FIGURE 1 – PROJECT HUC

2. STUDY PURPOSE AND SCOPE

The project is grandfathered under the provisions of 9VAC25-870-48 and required to meet Part IIC criteria. Per Section 11.6.2 of the 2002 VDOT Drainage Manual Rev. 05-2017, compliance with the requirements of the Virginia Erosion and Sediment Control Regulations Minimum Standard 19 (9VAC25-840-40 section 19) and the Virginia Stormwater Management Program Regulations (9VAC25-870-97) need to be achieved. Water Quantity criteria are applied for both channel and flood protection.

- *Determination of flooding and channel erosion impacts to receiving streams due to land-disturbing activities shall be measured at each point of discharge from the land disturbance and such determination shall include any runoff from the balance of the watershed that also contributes to that point of discharge.*
- *The specified design storms shall be defined as either a 24-hour storm using the rainfall distribution recommended by the U.S. Department of Agriculture's Natural Resources Conservation Service (NRCS) when using NRCS methods or as the storm of critical duration that produces the greatest required storage volume at the site when using a design method such as the Modified Rational Method.*

- *For purposes of computing runoff, all pervious lands in the site shall be assumed prior to development to be in good condition (if the lands are pastures, lawns, or parks), with good cover (if the lands are woods), or with conservation treatment (if the lands are cultivated); regardless of conditions existing at the time of computation.*
- *Construction of SWM facilities or modifications to channels shall comply with all applicable laws, regulations, and ordinances. Evidence of approval of all necessary permits shall be presented.*
- *Pre-development and post-development runoff rates shall be verified by calculations that are consistent with good engineering practices.*
- *Outflows from a SWM facility or stormwater conveyance system shall be discharged to an adequate channel.*
- *Hydrologic parameters shall reflect the ultimate land disturbance and shall be used in all engineering calculations.*
- *Natural channel characteristics shall be preserved to the maximum extent practicable.*
- *Pre-development conditions should be that which exist at the time the road plans are approved for R/W acquisition.*
- *An adequate receiving channel is required for stormwater outflows from all projects with more than 10,000 ft^2 of land disturbance.*
- *The receiving channel at a pipe or storm drain outlet should be analyzed by use of a 2-yr storm for natural channel capacity and erosion protection; while the 10-yr storm shall be used for man-made channel capacity, with the 2-yr storm for man-made channel erosion protection.*
- *One Percent (1%) Rule - If it can be demonstrated that the total drainage area to the point of analysis within the receiving channel is 100 times greater than the contributing drainage area from within the project site, the receiving channel may be considered adequate without further analysis.*

The impacts of the project on the quantity of stormwater runoff into receiving waters will be assessed at every outfall from the right-of-way as required by the State minimum standard MS-19. The receiving waters, both open channels and closed storm drain systems, will be assessed with regard to capacity and the potential for erosion, and mitigating measures provided where necessary in accordance with MS-19.

This report evaluates the impact of the proposed improvements on existing hydrologic conditions, addresses the potential needs of stormwater management in the proposed conditions, and demonstrates Stormwater Management (SWM) compliance with post-development requirements for water quality and quantity in accordance with Chapter 11 of the 2002 VDOT Drainage Manual Rev. 05-2017, the VSMP Regulations and VDOT IIM-LD-195. This project is considered as a linear development project.

The purpose of this report is to compare computed runoff between existing and proposed conditions to provide analyses of the outfall adequacy. The outfall will be analyzed in accordance with Section 9VAC25-840-40 of the Virginia Erosion and Sediment Control

Handbook (1992), Minimum Standards (MS-19). The post development peak flow shall be discharged to an adequate channel and is analyzed as follows:

- *Natural channel adequacy shall be analyzed with 2-year storm event for erosion and capacity.*
- *Manmade channel shall be analyzed with 2-year storm event for erosion and 10-year storm event for capacity.*
- *Storm sewer system shall be analyzed with 10-year storm event for capacity.*
- *Receiving channel which satisfy one-percent rule is considered adequate for MS-19 criteria.*

There are two proposed best management practice facilities (BMPs) and one stormwater management facility (SWM) located within the project limits in order to meet water quality and quantity requirements.

Local drainage was designed to ensure reduced flows to outfalls. Despite the limited number of stormwater facilities within the project limits, all outfalls have been analyzed and determined to be adequate. Using local drainage, increased stormwater peak flows are either directed into one of the three stormwater facilities or an adequate outfall which can convey the increased flows while meeting stormwater quantity criteria with no adverse impacts. Existing drainage divides have been honored as much as practicable; however, they have changed as necessary to ensure adequate conveyance prior and subsequent to each outfall point. By directing water to the locations which can convey increased runoff without adverse impacts (such as points where the contributing site area is 1% of the total drainage area), the overall stormwater impact of the project has been minimized.

Appendix 7D-2 of the 2002 VDOT Drainage Manual Rev. 05-2017 is utilized to determine maximum flow velocity based on soil type at each outfall. The allowable velocity for bare earth is based on the soil types obtained from the USDA (United States Department of Agriculture) data. The maximum permissible velocity is also based on the outfall surface condition. Hydraulic analysis of the receiving systems has been performed using the following programs:

- Bentley FlowMaster, CONNECT Edition
- CulvertsoftVA, Version 2.1 - Virginia Edition
- PipesoftVA, Version 2.1 – Virginia Edition

Hydraulic computations are provided in Appendix C to show adequacy of existing outfalls for the 2-year and 10-year storm events, based upon the type of receiving system. Outfall sections at the approximate interval of 50’ are provided for each outfall to demonstrate the adequacy of the outfall. For major outfalls, sections were taken at 100’ intervals. Details and computations are described in Appendix C.

There are forty outfalls located within the project based on the existing contours, natural divides, and storm sewer system layouts. Surface flows ultimately drain into Scotts Run and/or the Potomac River. Drainage areas were determined using survey contours and Fairfax County GIS contours. Land uses were determined using topographic survey, proposed design, and Fairfax County GIS information. All flows were performed using VDOT

Rational Method, with the exception of Outfall 35, which used the SCS Method. Existing and proposed conditions drainage area maps for each outfall are provided within the appropriate Appendix C section.

The following list is provided to show the runoff coefficient used in the computations.

Land Use	Coefficient
Paved (Asphalt or Concrete)	0.90
Lawns	0.30
Wooded Areas	0.25
Residential (1/2 acre or more)	0.35

APPENDIX A
SUMMARY TABLES

I495 NEXT - Areas 1 & 2

UPC: 115401

Project # 0495-029-419

Project Outfall ID	Station, Offset	Alignment	Type of Outfall	Existing Drainage Area (ac)	Proposed Drainage Area (ac)	Existing 2 YR Storm Q (cfs)	Existing 2 YR Storm V (fps)	Proposed 2 YR Storm Q (cfs)	Proposed 2 YR Storm V (fps)	Max. Allowable Velocity* V (fps)	Existing 10 YR Storm Q (cfs)	Proposed 10 YR Storm Q (cfs)	Natural Bankfull Capacity Q (cfs)	Manmade Conveyance Capacity Q (cfs)	Channel Protection Check V	Flood Protection Check Q	Existing BMPs	Proposed BMPs	Remarks
PL23-1	585+45, 208' R	495XL_NB	H&H Cross Section Analysis			1500.0	4.6	1500.0	4.6	-	-	-	-	-	OK	OK	VDOT SR-07	VDOT SR-07/SWM 4	Preliminary H&H XS is provided to show 2-year velocity and water surface do not increase from existing to proposed
PL23-2	585+52, 187' R	495XL_NB	1% Rule			-	-	-	-	-	-	-	-	-	OK	OK	-	-	Site area is 0.077% of the total watershed area of 2797 ac
PL23-3	591+88, 153' R	495XL_NB	Natural	3.86	3.74	7.54	-	7.03	2.27	3.50	10.06	9.43	120.2	-	OK	OK	-	-	Reduction in 2 and 10 year peak flow due to a shift in the drainage area divide between outfalls 3 and 4.
PL23-4	601+81, 319' R	495XL_NB	1% Rule			-	-	-	-	-	-	-	-	-	OK	OK	-	-	Site area is 0.176% of the total watershed area of 3213 ac
PL23-5	610+09, 132' R	495XL_NB	Natural	6.28	2.99	13.01	-	3.01	1.96	3.50	17.21	4.02	18.9	-	OK	OK	-	-	Reduction in 2 and 10 year peak flow due to a shift in the drainage area divide between outfalls 5 and 7.
PL23-6	611+50, 116' R	495XL_NB	Sheet flow	0.11	0.03	0.16	-	0.05	-	-	0.21	0.07	-	-	OK	OK	-	-	Reduction in 2 and 10 year peak flow due to a shift in the drainage area divides between outfalls 6, 7 and 14.
PL23-7	612+56, 132' R	495XL_NB	1% Rule			-	-	-	-	-	-	-	-	-	OK	OK	-	-	Site area is 0.184% of the total watershed area of 3238 ac
PL23-8	613+25, 129' R	495XL_NB	Sheet flow	0.12	0.07	0.18	-	0.10	-	-	0.23	0.14	-	-	OK	OK	-	-	Reduction in 2 and 10 year peak flow due to a shift in the drainage area divides between outfalls 7, 8, 9, and 14.
PL23-9	24+35, 109' R	ODD	1% Rule			-	-	-	-	-	-	-	-	-	OK	OK	-	-	Site area is 0.062% of the total watershed area of 3245 ac
PL23-10	24+32, 55' L	ODD	Sheet flow	0.40	0.08	1.14	-	0.12	-	-	1.49	0.16	-	-	OK	OK	-	-	Reduction in 2 and 10 year peak flow due to a shift in the drainage area divides between outfalls 7, 8, 9, 10 and 11.
PL23-11	24+34, 94' L	ODD	1% Rule				-		-	-			-	-	OK	OK	-	-	Site area is 0.030% of the total watershed area of 3302 ac
PL23-12	614+79, 146' R	495XL_NB	Sheet flow	3.34	0.07	11.70	-	0.12	-	-	15.45	0.16	-	-	OK	OK	-	-	Reduction in 2 and 10 year peak flow due to a shift in the drainage area divides between outfalls 9, 12, 15, and 20.
PL23-13	614+62, 120' R	495XL_NB	Sheet flow	0.07	0.02	0.10	-	0.05	-	-	0.13	0.07	-	-	OK	OK	-	-	Reduction in 2 and 10 year peak flow due to a shift in the drainage area divides between outfalls 12, 13, and 14.
PL23-14	615+41, 132' R	495XL_NB	1% Rule			-	-	-	-	-	-	-	-	-	OK	OK	-	-	Site area is 0.021% of the total watershed area of 3302 ac
PL23-15	218+93, 142' L	495XL_SB	1% Rule			-	-	-	-	-	-	-	-	-	OK	OK	-	-	Site area is 0.078% of the total watershed area of 3366 ac
PL23-16	**SEE AREA 3**																		
PL23-17	217+86, 146' L	495XL_SB	Sheet flow	0.62	0.00	0.84	-	0.00	-	-	1.09	0.00	-	-	OK	OK	-	-	Removed with proposed design
SEE AREA 3 FOR OUTFALLS 18-33																			
SEE AREA 4 FOR OUTFALLS 34-37																			
PL23-38	**SEE AREA 3**																		
SEE AREA 4 FOR OUTFALLS 39-40																			

Watersheds: VAHU6 – PL23, HUC12 #020700081005, Potomac River-Nichols Run-Scott Run

*In cases where the post-development velocity exceeds the maximum allowable velocity for given soil type, site design will not cause the pre-development 2-yr storm peak runoff rate to increase when discharging into a natural channel or the 10-yr storm peak runoff rate to increase when discharging into a man-made channel (per Section 11.7.5.1).

**Information not required to prove outfall adequacy has not been provided within this table or within Appendix C.

I495 NEXT - Area 3

UPC: 115401

Project # 0495-029-419

Project Outfall ID	Station, Offset	Alignment	Type of Outfall	Existing Drainage Area (Acres)	Proposed Drainage Area (Acres)	Existing 2 YR Storm		Proposed 2 YR Storm		Max. Allowable Velocity*	Existing 10 YR Storm	Proposed 10 YR Storm	Natural Bankfull Capacity	Manmade Conveyance Capacity	Channel Protection Check	Flood Protection Check	Existing BMPs	Proposed BMPs	Remarks
						Q (cfs)	V (fps)	Q (cfs)	V (fps)	V (fps)	Q (cfs)	Q (cfs)	Q (cfs)	Q (cfs)	V	Q			
SEE AREAS 1 & 2 FOR OUTFALLS 1-15																			
PL23-16	617+11, 130' R	495XL_NB	1% Rule	0.82	4.61	-	-	-	-	-	-	-	-	-	OK	OK	-	-	Site area is 0.139% of the total watershed area of 3309 ac Drainage diverted from OUT20, OUT22, and OUT24
PL23-17	**SEE AREAS 1 & 2**																		
PL23-18	219+85, 111' L	495XL_SB	1% Rule	0.09	0.00	-	-	-	-	-	-	-	-	-	OK	OK	-	-	Removed with Proposed Design Drainage diverted to OUT7 and OUT15
PL23-19	54+30, 35' L	LEW_TRL	1% Rule	0.04	0.03	-	-	-	-	-	-	-	-	-	OK	OK	-	-	Site area is 0.0008% of the total watershed area of 3373 ac Drainage diverted to OUT7 and OUT15
PL23-20	54+60, 101' L	LEW_TRL	1% Rule	2.35	4.38	-	-	-	-	-	-	-	-	-	OK	OK	-	-	Site area is 0.13% of the total watershed area of 3373 ac Drainage diverted from OUT21, OUT22 and OUT24
PL23-21	225+81, 115' L	495XL_SB	Sheet Flow	2.30	0.96	4.19	-	2.04	-	-	5.47	2.66	-	-	OK	OK	-	-	Reduction in 2 and 10 year peak flow Drainage diverted to OUT20
PL23-22	233+72, 140' L	495XL_SB	Manmade	21.23	1.31	36.29	-	1.97	3.58	No Max	48.28	2.61	-	82.54	OK	OK	-	-	Reduction in 2 and 10 year peak flow Drainage diverted to OUT16 and OUT20
PL23-23	241+00, 146' L	495XL_SB	Sheet Flow	0.13	0.06	0.19	-	0.09	-	-	0.24	0.11	-	-	OK	OK	-	-	Reduction in 2 and 10 year peak flow Drainage diverted to OUT20
PL23-24	245+19, 116' L	495XL_SB	Manmade	11.66	0.00	30.62	-	0.00	-	-	40.24	0.00	-	-	OK	OK	-	-	Removed with Proposed Design Drainage diverted to OUT20 and OUT35
PL23-25	245+50, 143' L	495XL_SB	Sheet Flow	0.51	0.17	0.78	-	0.28	-	-	1.01	0.37	-	-	OK	OK	-	-	Reduction in 2 and 10 year peak flow Drainage diverted to OUT20 and OUT35
PL23-26	13+21, 39' R	GTP	Manmade	3.31	3.27	6.29	4.05	6.03	4.01	2.30*	8.33	7.99	-	75.14	OK	OK	-	-	Reduction in 2 and 10 year peak flow Drainage diverted to OUT35
PL23-27	17+50, 62' L	GTP	Natural	1.34	1.24	1.82	-	1.78	1.81	2.30	2.44	2.38	387.22	-	OK	OK	-	-	Reduction in 2 and 10 year peak flow Drainage diverted to OUT35
PL23-28	38+32, 103' R	GTP	Natural	16.58	16.39	22.71	6.38	22.02	6.33	3.50*	30.64	29.68	268.91	-	OK	OK	-	SWM-11	Reduction in 2 and 10 year peak flow Drainage diverted to OUT35 and from OUT29 and OUT30
PL23-29	36+17, 8' R	GTP	Sheet Flow	0.34	0.32	1.47	-	1.39	-	-	1.91	1.82	-	-	OK	OK	-	-	Reduction in 2 and 10 year peak flow Drainage diverted to OUT28
PL23-30	36+50, 58' L	GTP	Natural	2.21	2.03	5.90	2.95	5.20	2.87	2.30*	7.70	6.78	100.74	-	OK	OK	-	-	Reduction in 2 and 10 year peak flow Drainage diverted to OUT28
PL23-31	23+50, 15' L	BH_RD	Manmade	7.10	6.06	19.48	-	16.83	9.74	No Max	25.74	22.24	-	29.67	OK	OK	-	-	Reduction in 2 and 10 year peak flow Drainage diverted to OUT35
PL23-32	268+21, 201' L	495XL_SB	Natural	0.95	0.83	1.03	-	0.97	1.30	2.30	1.37	1.28	266.79	-	OK	OK	-	-	Reduction in 2 and 10 year peak flow Drainage diverted to OUT35
PL23-33	269+75, 144' L	495XL_SB	Sheet Flow	0.15	0.05	0.23	-	0.08	-	-	0.30	0.11	-	-	OK	OK	-	-	Reduction in 2 and 10 year peak flow Drainage diverted to OUT35
SEE AREA 4 FOR OUTFALLS 34-37																			
PL23-38	19+30, 41' R	BH_RD	Natural	0.19	0.18	0.50	2.29	0.50	2.29	2.30	0.65	0.65	2233.60	-	OK	OK	-	-	No change in 2 and 10 year peak flow
SEE AREA 4 FOR OUTFALLS 39-40																			

Watersheds: VAHU6 – PL23, HUC12 #020700081005, Potomac River-Nichols Run-Scott Run

*In cases where the post-development velocity exceeds the maximum allowable velocity for given soil type, site design will not cause the pre-development 2-yr storm peak runoff rate to increase when discharging into a natural channel or the 10-yr storm peak runoff rate to increase when discharging into a man-made channel (per Section 11.7.5.1).

**Information not required to prove outfall adequacy has not been provided within this table or within Appendix C.

I495 NEXT - Area 4

UPC: 115401

Project # 0495-029-419

Project Outfall ID	Station, Offset	Alignment	Type of Outfall	Existing Drainage Area (Acres)	Proposed Drainage Area (Acres)	Existing 2 YR Storm		Proposed 2 YR Storm		Max. Allowable Velocity*	Existing 10 YR Storm	Proposed 10 YR Storm	Natural Bankfull Capacity	Manmade Conveyance Capacity	Channel Protection Check	Flood Protection Check	Existing BMPs	Proposed BMPs	Remarks
						Q (cfs)	V (fps)	Q (cfs)	V (fps)	V (fps)	Q (cfs)	Q (cfs)	Q (cfs)	Q (cfs)	V	Q			
SEE AREAS 1 & 2 FOR OUTFALLS 1-15																			
PL23-16	SEE AREA 3																		
PL23-17	SEE AREAS 1 & 2																		
SEE AREA 3 FOR OUTFALLS 18-33																			
PL23-34	18+14, 82' L	LOD	Natural	1.14	0.09	3.07	-	0.16	0.66	2.30	4.00	0.20	18.83	-	OK	OK	-	-	Reduction in 2 and 10 year peak flow Drainage directed to OUT35
PL23-35	28+92, 160' L	LOD	Natural	169.00	179.49	121.50	7.23	102.50	6.91	3.50*	285.26	255.69	811.84	-	OK	OK	-	BMP-14	Reduction in 2 and 10 year peak flow Drainage diverted from OUT24, OUT25, OUT26, OUT27, OUT28, OUT31, OUT32, OUT33, OUT34 and OUT39
PL23-35A	28+46, 118' L	LOD	Manmade	59.90	17.48	39.99	-	9.52	-	-	96.86	25.00	811.84	-	OK	OK	-	-	Reduction in 2 and 10 year peak flow
PL23-35B	18+89, 8' R	GWMP_E22	Manmade	65.17	92.63	48.77	-	69.29	-	No Max	111.05	158.14	-	329.49	OK	OK	-	-	Downstream storm sewer system is adequate to handle increased flow
PL23-35C	24+16, 75' R	GWMP_G22	Manmade	36.87	66.72	29.18	-	24.35	-	No Max	69.04	69.97	-	218.96	OK	OK	-	BMP-14	Downstream storm sewer system is adequate to handle increased flow
PL23-35D	28+92, 160' L	LOD	Natural	7.06	2.67	5.97	-	2.32	-	-	13.49	5.65	811.84	-	OK	OK	-	-	Reduction in 2 and 10 year peak flow
PL23-36	722+52, 130' L	495XL_NBC	1% Rule	7.57	7.32	-	-	-	-	-	-	-	-	-	OK	OK	-	-	Site area is 0.00010% of the total watershed area of 7398400 ac Drainage directed to OUT37
PL23-37	710+39, 6' L	495XL_NBC	Manmade	1.55	1.75	6.65	-	7.53	10.45	No Max	8.71	9.86	-	19.83	OK	OK	-	-	Downstream storm sewer system is adequate to handle increased flow Drainage directed from OUT36
PL23-38	SEE AREA 3																		
PL23-39	280+00, 218' L	495XL_SB	Sheet Flow	1.38	1.11	2.76	-	2.20	-	-	3.60	2.87	-	-	OK	OK	-	-	Reduction in 2 and 10 year peak flow Drainage directed to OUT35
PL23-40	54+84, 40' L	GWMP_E22	Natural	1.17	1.19	2.00	2.37	2.00	2.37	3.50	2.66	2.66	116.21	-	OK	OK	-	-	No change in 2 and 10 year peak flow

Watersheds: VAHU6 – PL23, HUC12 #020700081005, Potomac River-Nichols Run-Scott Run

*In cases where the post-development velocity exceeds the maximum allowable velocity for given soil type, site design will not cause the pre-development 2-yr storm peak runoff rate to increase when discharging into a natural channel or the 10-yr storm peak runoff rate to increase when discharging into a man-made channel (per Section 11.7.5.1).

**Information not required to prove outfall adequacy has not been provided within this table or within Appendix C.

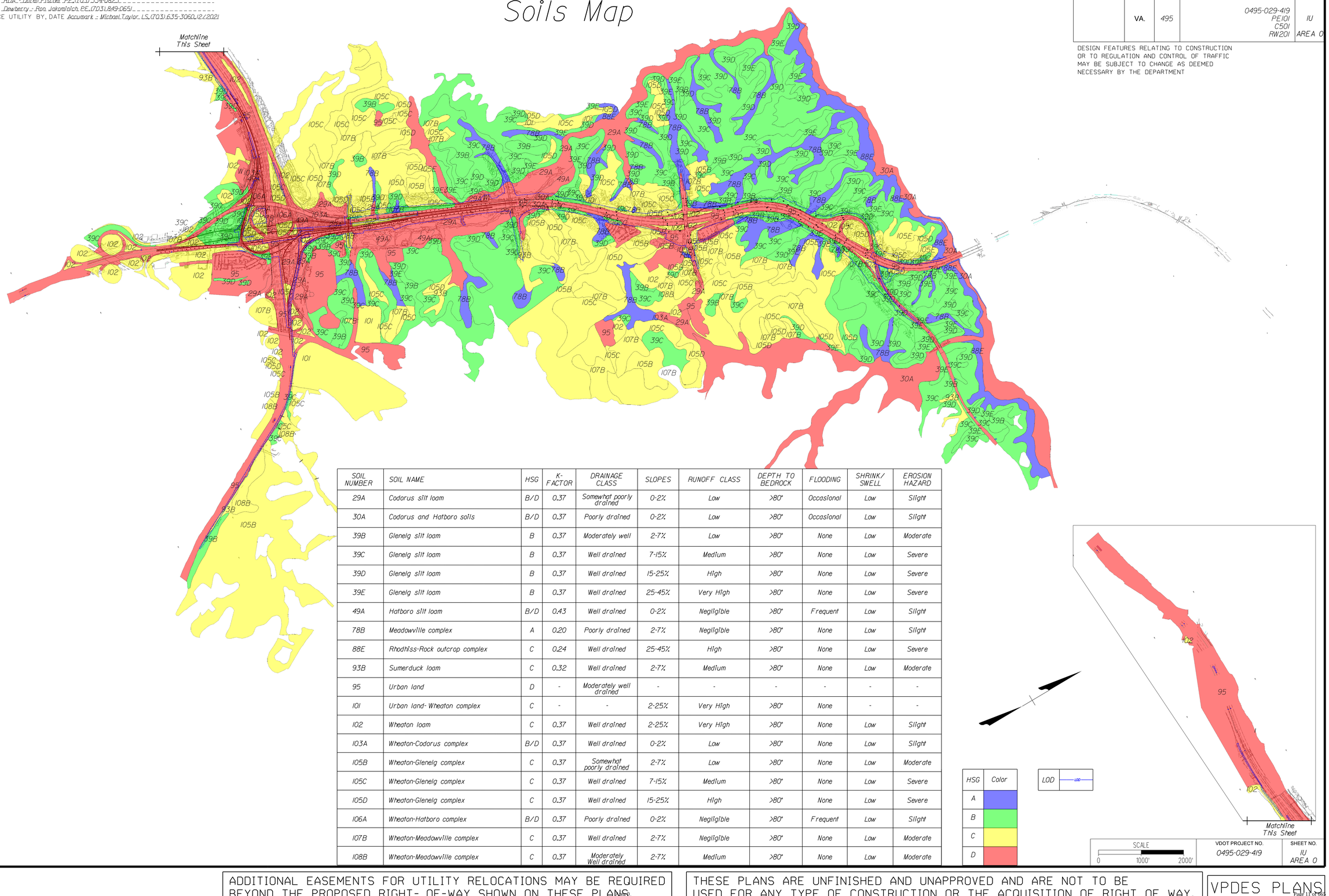
APPENDIX B
SOILS INFORMATION

PROJECT MANAGER _VDOT_-_Rimpal Shah, PE_(703) 259-2362_____
SURVEYED BY, DATE _RDA_-_Nicholas. Kaugauli's LS_(703) 334-0837_1/2019_____
DESIGN BY _RDA_-_Darrell Fischer_PE_(703) 334-0823_____
Dewberry-_Ron Jakomiolch, PE_(703) 849-0651_____
SUBSURFACE UTILITY BY, DATE _Accumark_-_Michael T. Taylor_LS_(703) 635-3060_12/2021

Soils Map

REVISED	STATE	STATE ROUTE	STATE VDOT PROJECT NO.	SHEET NO.
	VA.	495	0495-029-419 PE101 C501 RW201	IU AREA 0

DESIGN FEATURES RELATING TO CONSTRUCTION OR TO REGULATION AND CONTROL OF TRAFFIC MAY BE SUBJECT TO CHANGE AS DEEMED NECESSARY BY THE DEPARTMENT



SOIL NUMBER	SOIL NAME	HSG	K-FACTOR	DRAINAGE CLASS	SLOPES	RUNOFF CLASS	DEPTH TO BEDROCK	FLOODING	SHRINK/SWELL	EROSION HAZARD
29A	Codorus silt loam	B/D	0.37	Somewhat poorly drained	0-2%	Low	>80"	Occasional	Low	Slight
30A	Codorus and Hatboro soils	B/D	0.37	Poorly drained	0-2%	Low	>80"	Occasional	Low	Slight
39B	Glenelg silt loam	B	0.37	Moderately well	2-7%	Low	>80"	None	Low	Moderate
39C	Glenelg silt loam	B	0.37	Well drained	7-15%	Medium	>80"	None	Low	Severe
39D	Glenelg silt loam	B	0.37	Well drained	15-25%	High	>80"	None	Low	Severe
39E	Glenelg silt loam	B	0.37	Well drained	25-45%	Very High	>80"	None	Low	Severe
49A	Hatboro silt loam	B/D	0.43	Well drained	0-2%	Negligible	>80"	Frequent	Low	Slight
78B	Meadowville complex	A	0.20	Poorly drained	2-7%	Negligible	>80"	None	Low	Slight
88E	Rhodhiss-Rock outcrop complex	C	0.24	Well drained	25-45%	High	>80"	None	Low	Severe
93B	Sumerduck loam	C	0.32	Well drained	2-7%	Medium	>80"	None	Low	Moderate
95	Urban land	D	-	Moderately well drained	-	-	-	-	-	-
101	Urban land-Wheaton complex	C	-	-	2-25%	Very High	>80"	None	-	-
102	Wheaton loam	C	0.37	Well drained	2-25%	Very High	>80"	None	Low	Slight
103A	Wheaton-Codorus complex	B/D	0.37	Well drained	0-2%	Low	>80"	None	Low	Slight
105B	Wheaton-Glenelg complex	C	0.37	Somewhat poorly drained	2-7%	Low	>80"	None	Low	Moderate
105C	Wheaton-Glenelg complex	C	0.37	Well drained	7-15%	Medium	>80"	None	Low	Severe
105D	Wheaton-Glenelg complex	C	0.37	Well drained	15-25%	High	>80"	None	Low	Severe
106A	Wheaton-Hatboro complex	B/D	0.37	Poorly drained	0-2%	Negligible	>80"	Frequent	Low	Slight
107B	Wheaton-Meadowville complex	C	0.37	Well drained	2-7%	Negligible	>80"	None	Low	Moderate
108B	Wheaton-Meadowville complex	C	0.37	Moderately Well drained	2-7%	Medium	>80"	None	Low	Moderate

HSG	Color
A	
B	
C	
D	

LOD

SCALE 0 1000' 2000'

VDOT PROJECT NO.	SHEET NO.
0495-029-419	IU AREA 0

NOVA DISTRICT

3/21/2022

04/2022

ADDITIONAL EASEMENTS FOR UTILITY RELOCATIONS MAY BE REQUIRED BEYOND THE PROPOSED RIGHT- OF-WAY SHOWN ON THESE PLANS.

THESE PLANS ARE UNFINISHED AND UNAPPROVED AND ARE NOT TO BE USED FOR ANY TYPE OF CONSTRUCTION OR THE ACQUISITION OF RIGHT OF WAY.

VPDES PLANS

APPENDIX C
OUTFALL COMPUTATIONS

APPENDIX C1
PL23-OUT1

Outfall PL23-OUT 1

Outfall PL23-OUT1 is an existing outfall at Interstate 495 station 1088+90 right (495GP_NB baseline). The outfall point is located in the Scott's Run stream. In existing conditions, the channel receives 33.17 acres of project site area and 33.08 acres in proposed conditions. The total watershed drainage area at this outfall point is 2,797 acres (4.37 square miles). Outfall 1 is a part of the proposed Hydrologic and Hydraulic Analysis report of Scott's Run.

Drainage Area:

The drainage areas and resulting changes are summarized in the table below:

PL23-OUT 1			
Drainage Area	**Watershed Area**	**Site Area**	**% of Total Watershed**
Existing	2797 ac	33.59 ac	1.201%
Proposed	2797 ac	33.65 ac	1.203%

Limits of Study:

The location of the outfall is shown in the included outfall drainage map. The point of analysis is at Scott's Run.

Easement Requirements:

No additional easements are required.

Channel and Flood Protection:

The main channel of Outfall PL23-OUT1 is denoted as Scott's Run and is modeled as part of the Hydrologic and Hydraulic Analysis for Scott's Run. The results for the HEC-RAS cross section (RS 5975) located at the outfall in the preliminary H&H analysis are provided. These results are preliminary. The cross section results show that the 2.33-year velocity within the channel remains the same from existing to proposed conditions and the 2.33-year water surface elevation shows a 0.01' increase from existing to proposed and is contained within the Scott's Run floodplain area.

Final Opinion:

This outfall is a natural stormwater conveyance system. Final analysis will be provided with the full H&HA report. We have shown compliance with the channel and flood protection criteria based on preliminary analysis of Scott's Run at the Outfall 1 point. It is our opinion that this outfall is adequate.

Pre-Developed Outfall Map
PL23-I
I-495
Fairfax, VA

EXISTING CONTOURS

SITE AREA

PL23-OUT 1
SITE DA = 33.59 AC
WATERSHED DA = 2797 AC

SEE SITE AREA LIMIT MAP A1 MAPS 0-2 IN SWM REPORT FOR ADDITIONAL SITE AREA ALONG DULLES TOLL RD.

SCALE
0 400' 800'

Post-Developed Outfall Map
PL23-I
I-495
Fairfax, VA

EXISTING CONTOURS

SITE AREA

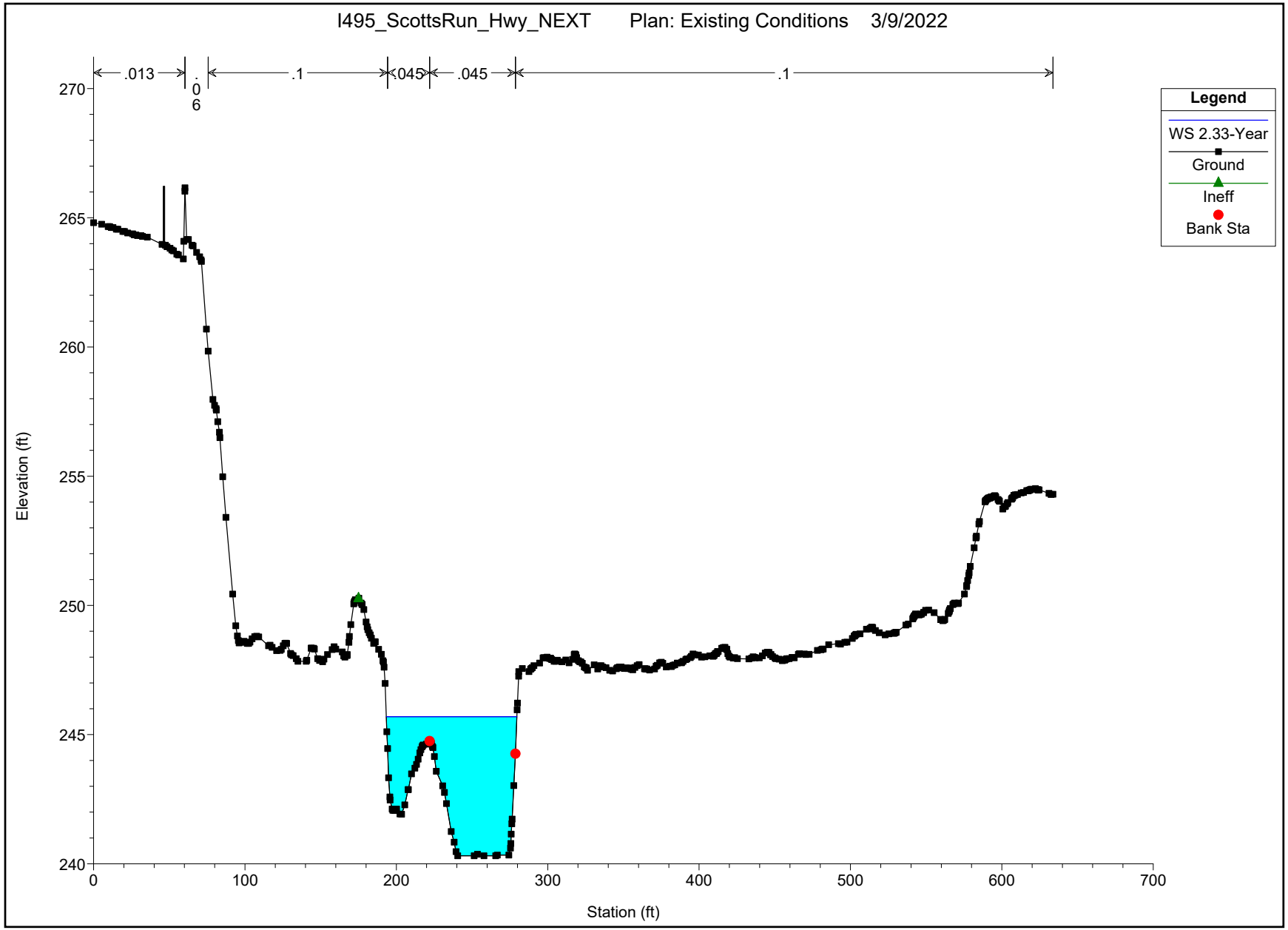
PL23-OUT 1
SITE DA = 33.65 AC
WATERSHED DA = 2797 AC

SEE SITE AREA LIMIT MAP AI MAPS 0-2 IN SWM REPORT FOR ADDITIONAL SITE AREA ALONG DULLES TOLL RD.

SCALE
0 400' 800'

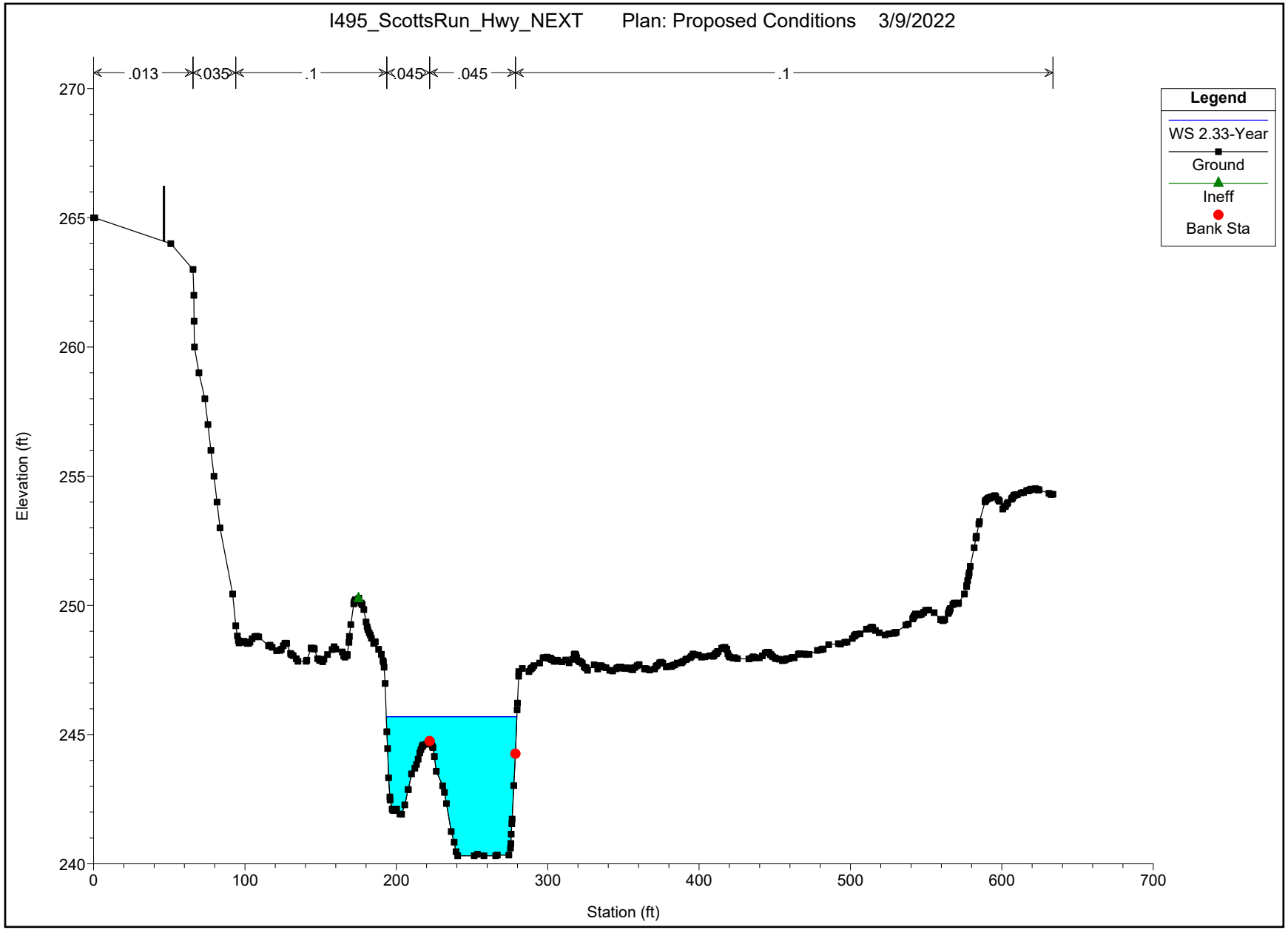
Plan: Existing Scott Run 1 RS: 5975 Profile: 2.33-Year

E.G. Elev (ft)	246.05	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.35	Wt. n-Val.	0.045	0.045	0.100
W.S. Elev (ft)	245.69	Reach Len. (ft)	254.50	254.50	254.50
Crit W.S. (ft)	243.81	Flow Area (sq ft)	69.60	254.92	0.67
E.G. Slope (ft/ft)	0.003229	Area (sq ft)	69.60	254.92	0.67
Q Total (cfs)	1500.00	Flow (cfs)	230.73	1268.97	0.30
Top Width (ft)	86.27	Top Width (ft)	28.64	56.70	0.93
Vel Total (ft/s)	4.61	Avg. Vel. (ft/s)	3.32	4.98	0.45
Max Chl Dpth (ft)	5.38	Hydr. Depth (ft)	2.43	4.50	0.72
Conv. Total (cfs)	26396.6	Conv. (cfs)	4060.3	22331.0	5.3
Length Wtd. (ft)	254.50	Wetted Per. (ft)	30.60	59.00	1.71
Min Ch El (ft)	240.31	Shear (lb/sq ft)	0.46	0.87	0.08
Alpha	1.06	Stream Power (lb/ft s)	1.52	4.34	0.04
Frctn Loss (ft)	1.18	Cum Volume (acre-ft)	3.64	25.69	3.35
C & E Loss (ft)	0.03	Cum SA (acres)	2.49	6.07	1.63

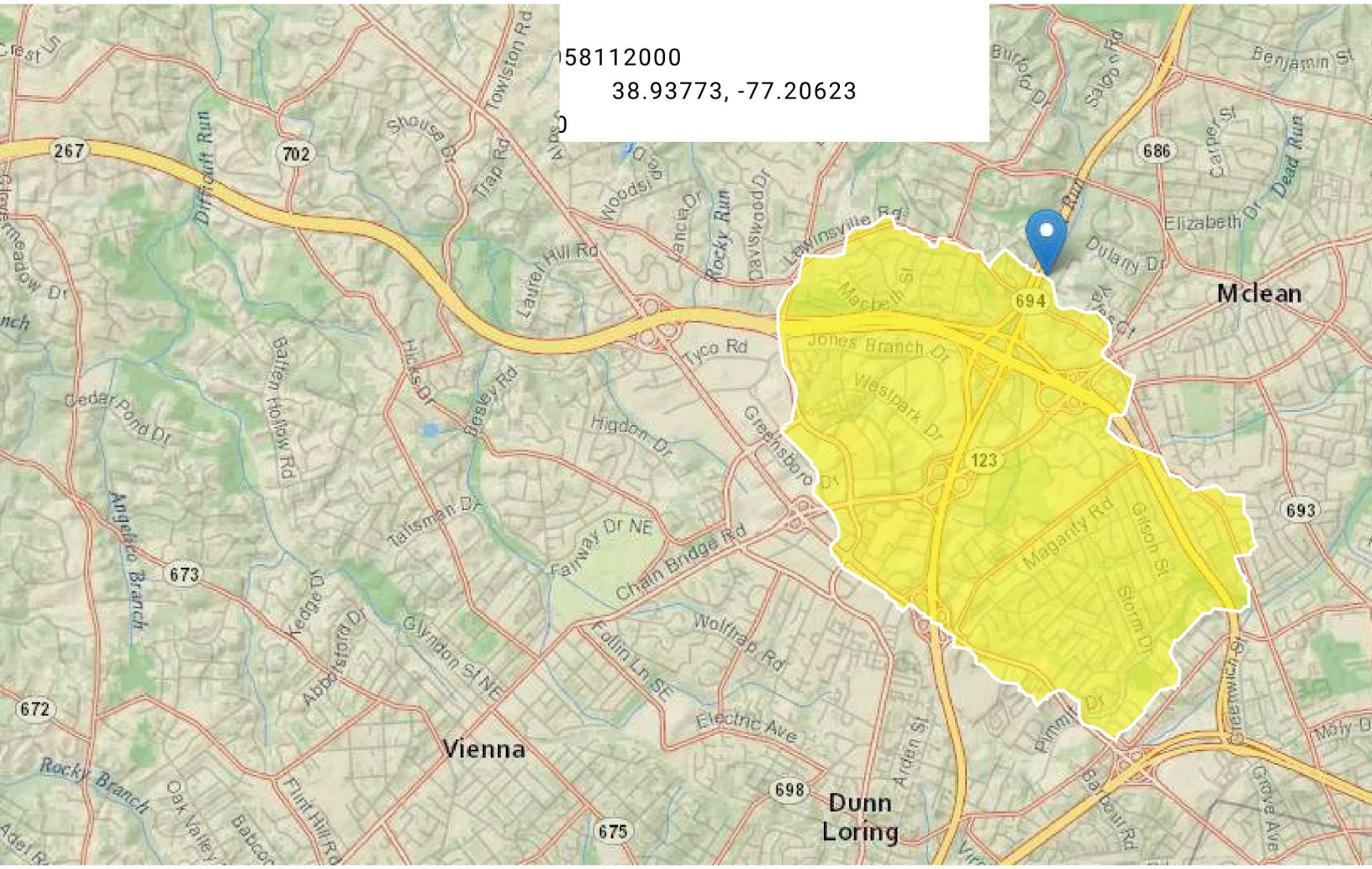

I495_ScottsRun_Hwy_NEXT Plan: Existing Conditions 3/9/2022
.013
.06
.1
.045
.045
.1
Legend
WS 2.33-Year
Ground
Ineff
Bank Sta
Elevation (ft)
270
265
260
255
250
245
240
0
100
200
300
400
500
600
700
Station (ft)

Plan: Proposed Con Scott Run 1 RS: 5975 Profile: 2.33-Year

E.G. Elev (ft)	246.05	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.35	Wt. n-Val.	0.045	0.045	0.100
W.S. Elev (ft)	245.70	Reach Len. (ft)	254.50	254.50	254.50
Crit W.S. (ft)	243.81	Flow Area (sq ft)	69.62	254.96	0.67
E.G. Slope (ft/ft)	0.003236	Area (sq ft)	69.62	254.96	0.67
Q Total (cfs)	1500.00	Flow (cfs)	229.12	1270.58	0.30
Top Width (ft)	86.27	Top Width (ft)	28.64	56.70	0.93
Vel Total (ft/s)	4.61	Avg. Vel. (ft/s)	3.29	4.98	0.45
Max Chl Dpth (ft)	5.39	Hydr. Depth (ft)	2.43	4.50	0.72
Conv. Total (cfs)	26370.5	Conv. (cfs)	4027.9	22337.3	5.3
Length Wtd. (ft)	254.50	Wetted Per. (ft)	30.60	59.00	1.71
Min Ch El (ft)	240.31	Shear (lb/sq ft)	0.46	0.87	0.08
Alpha	1.07	Stream Power (lb/ft s)	1.51	4.35	0.04
Frctn Loss (ft)	1.18	Cum Volume (acre-ft)	3.52	25.48	3.33
C & E Loss (ft)	0.03	Cum SA (acres)	2.34	6.09	1.63


I495_ScottsRun_Hwy_NEXT Plan: Proposed Conditions 3/9/2022
.013
.035
.1
.045
.045
.1
Legend
WS 2.33-Year
Ground
Ineff
Bank Sta
Elevation (ft)
270
265
260
255
250
245
240
0
100
200
300
400
500
600
700
Station (ft)

StreamStats Report for Outfall PL23-OUT1



Scott's Run

Basin Characteristics

Parameter Code	Parameter Description	Value	Unit
DRNAREA	Area that drains to a point on a stream	4.37	square miles

USGS Data Disclaimer: Unless otherwise stated, all data, metadata and related materials are considered to satisfy the quality standards relative to the purpose for which the data were collected. Although these data and associated metadata have been reviewed for accuracy and completeness and approved for release by the U.S. Geological Survey (USGS), no warranty expressed or implied is made regarding the display or utility of the data for other purposes, nor on all computer systems, nor shall the act of distribution constitute any such warranty.

Str. 5J-04 - Preliminary Existing Conditions

Culvert Computations

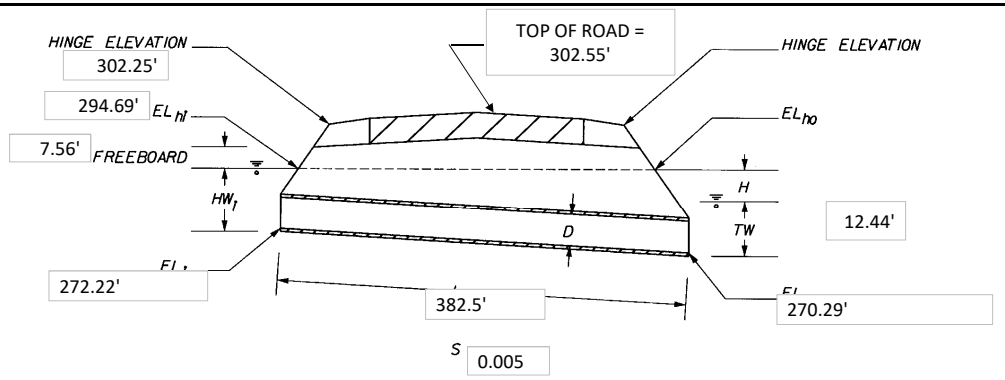
PROJECT: I-495 NEXT
DATE: 4-Mar-22
DESIGNER: JS
STATION: 22+25 DTR E3
STRUCTURE: Str. Ex 352 to ex 351

HYDROLOGICAL DATA:

x	Method:	Anderson			
x	Drainage Area:	1.40	Sq. Miles	x	Stream Slope: 0.007 ft/ft
x	Channel Shape:	Trapezoidal			
	Routing:				Other:

DESIGN FLOWS / TAILWATERS:

R.I. (years)	Flow (cfs)	TW (ft)
50 Year	2430	12.4



Barrel	CULVERT DESCRIPTION: Material	Shape	Size	Entrance	Total Flow Q (cfs)	Flow Per Barrel Q/N	HEADWATER CALCULATIONS: INLET CONTROL HW_i / D	HW_i	FALL	EL_{hi}	OUTLET CONTROL: TW	d_c	$(d_c + D) / 2$	h_o	H	EL_{ho}	OUTLET: Control Headwater Elevation	VELOCITY C.M.	VELOCITY Conc.
2	Concrete	Box	8'x8'	Square edge with 45°wingwalls	2430.00	1215.00	2.81	22.47		294.69	12.44	5.01	6.51	12.44	11.96	282.73	282.73		1.13

TECHNICAL FOOTNOTES:

SUBSCRIPT DEFINITIONS:

hd	Design headwater
hi	Headwater in inlet control
ho	Headwater in outlet control
i	Inlet control section
o	Outlet
sf	Streambed at culvet face
tw	Tailwater

CULVERT BARREL SELECTED:

SIZE: 8'x8'
SHAPE: Box
MATERIAL: Concrete n: 0.013
ENTRANCE: Square edge with 45°wingwalls

COMMENTS: All computations have been performed using HEC-RAS. This form is for informational purposes only and all values match those calculated in HEC-RAS.

Str. 5J-04 - Preliminary Proposed Conditions

Culvert Computations

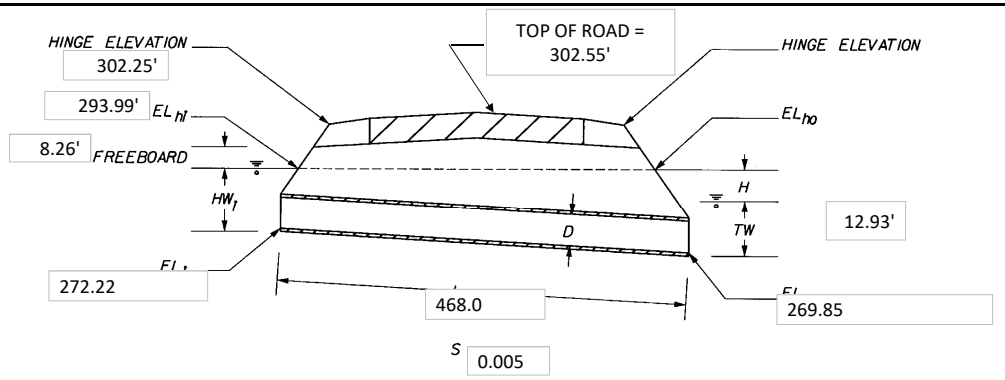
PROJECT: I-495 NEXT
DATE: 4-Mar-22
DESIGNER: JS
STATION: 22+50 DTR E3
STRUCTURE: Str. Ex 352 to 5J-04

HYDROLOGICAL DATA:

x	Method:	Anderson			
x	Drainage Area:	1.40	Sq. Miles	x	Stream Slope: 0.007 ft/ft
x	Channel Shape:	Trapezoidal			
	Routing:				Other:

DESIGN FLOWS / TAILWATERS:

R.I. (years)	Flow (cfs)	TW (ft)
50 Year	2430	12.9



Barrel	Material	Shape	Size	Entrance	Total Flow Q (cfs)	Flow Per Barrel Q/N	HEADWATER CALCULATIONS: INLET CONTROL HW_i / D	HW_i	FALL	EL_{hi}	OUTLET CONTROL: TW	d_c	$(d_c + D) / 2$	h_o	H	EL_{ho}	OUTLET: Control Headwater Elevation	VELOCITY C.M.	VELOCITY Conc.
2	Concrete	Box	8'x8' with 10'x10' extension	Square edge with 45°wingwalls	2430.00	1215.00	2.72	21.77		293.99	12.93	6.03	8.01	12.93	11.21	282.76	282.76		2.10

TECHNICAL FOOTNOTES:

HW/D is decreased from existing to proposed conditions.

SUBSCRIPT DEFINITIONS:

hd	Design headwater
hi	Headwater in inlet control
ho	Headwater in outlet control
i	Inlet control section
o	Outlet
sf	Streambed at culvet face
tw	Tailwater

CULVERT BARREL SELECTED:

SIZE: 8'x8' to 10'x10'
SHAPE: Box
MATERIAL: Concrete n: 0.013
ENTRANCE: Square edge with 45°wingwalls

COMMENTS: All computations have been performed using HY-8. This form is for informational purposes only and all values match those calculated in HY-8.

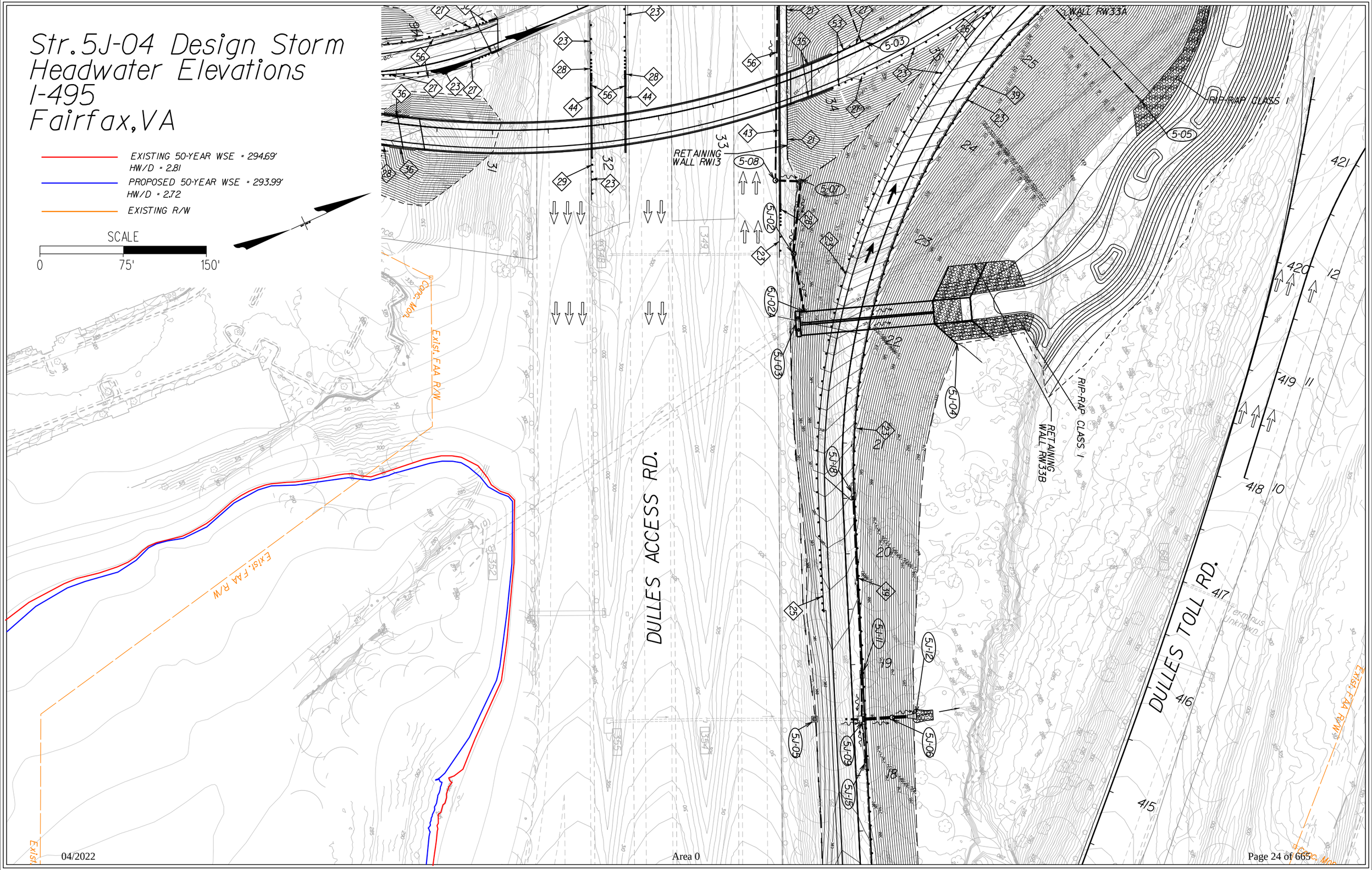
Str. 5J-04 Design Storm Headwater Elevations I-495 Fairfax, VA

EXISTING 50-YEAR WSE = 294.69'
HW/D = 2.81

PROPOSED 50-YEAR WSE = 293.99'
HW/D = 2.72

EXISTING R/W

SCALE
0 75' 150'



Str. 6-15 - Preliminary Proposed Conditions

Culvert Computations

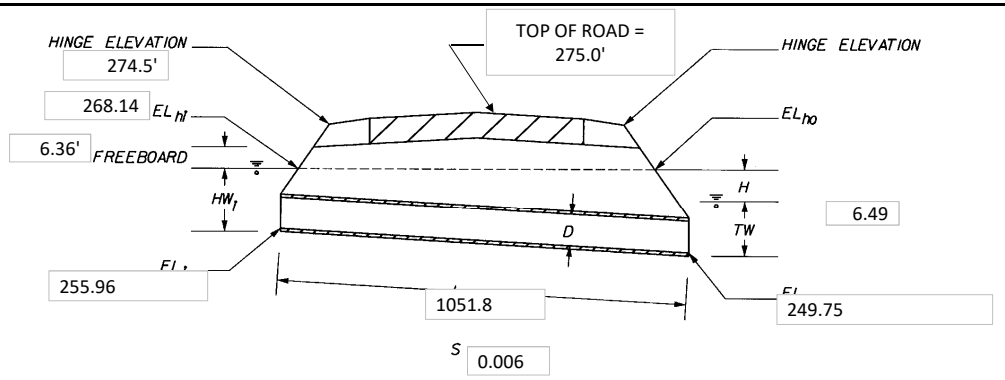
PROJECT: I-495 NEXT
DATE: 4-Mar-22
DESIGNER: JS
STATION: 1081+00 495 NB
STRUCTURE: 6-15

HYDROLOGICAL DATA:

x	Method:	Anderson			
x	Drainage Area:	2.76	Sq. Miles	x	Stream Slope: 0.024 ft/ft
x	Channel Shape:	Trapezoidal			
	Routing:				Other:

DESIGN FLOWS / TAILWATERS:

R.I. (years)	Flow (cfs)	TW (ft)
50 Year	3880	6.5



Barrel	Material	Shape	Size	Entrance	Total Flow Q (cfs)	Flow Per Barrel Q/N	HEADWATER CALCULATIONS: INLET CONTROL HW_i / D	HW_i	FALL	EL_{hi}	OUTLET CONTROL: TW	d_c	$(d_c + D) / 2$	h_o	H	EL_{ho}	OUTLET: Control Headwater Elevation	VELOCITY C.M.	VELOCITY Conc.
3	Concrete	Box	10'x10'	Concrete Retaining Wall and 43° wingwall	3880.00	1293.33	1.22	12.18		268.14	6.49	8.04	9.02	9.02	11.90	257.01	257.01		17.93

TECHNICAL FOOTNOTES:

SUBSCRIPT DEFINITIONS:

hd	Design headwater
hi	Headwater in inlet control
ho	Headwater in outlet control
i	Inlet control section
o	Outlet
sf	Streambed at culvet face
tw	Tailwater

CULVERT BARREL SELECTED:

SIZE: 10'x10'
SHAPE: Box
MATERIAL: Concrete n: 0.013
ENTRANCE: Square edge 30-75 deg. Wingwall

COMMENTS: All computations have been performed using HEC-RAS. This form is for informational purposes only and all values match those calculated in HEC-RAS.

Str.6-15 Design Storm Headwater Elevations I-495 Fairfax, VA

PROPOSED 50-YEAR WSE = 268.14'
HW/D = 1.22

EXISTING R/W

PROPOSED R/W

SCALE
0 75' 150'

Exist. FAA R/W & L/A Line

RW Pins

Exist. FAA R/W & L/A Line

RW Pins

Exist. FAA R/W

RW Pins

End Limited Access Line Pin

RW Line

Exist. VDOT R/W & L/A Line Per Highway Plan 0495-029-138, R201

Exist. VDOT R/W Per Highway Plan 0495-029-138, R201

Exist. FAA R/W

Exist. VDOT R/W & L/A Line Per Highway Plan 0413-029-007, RW-1

End Limited Access Line

RW Line

CAPITAL BELTWAY (I-495 SB)

Begin Proj.: 0495-029-419, RW201
Sta. 573+94.70

CAPITAL BELTWAY OUTER LOOP (TOLL RD.)

STR.6-15 UPSTREAM INLET

Approximate Culvert Location

CAPITAL BELTWAY INNER LOOP (TOLL RD.)

RETAINING WALL RW01

RETAINING WALL RW01

CAPITAL BELTWAY (I-495 NB)

LOD

Area 0

APPENDIX C2
PL23-OUT2

Outfall PL23-OUT 2

Outfall PL23-OUT2 is a proposed outfall at Interstate 495NB station 585+52 right. This is a new outfall which has been added in proposed conditions due to the addition of a new "restored" channel (designed in accordance with stream restoration principles). The runoff from local roadway drainage had previously been flowing to PL23-OUT4. The total watershed drainage area of the receiving channel at the new outfall 2 point is 2797 acres (4.37 square miles).

In proposed conditions the project (site) area to the outfall will 2.16 acres.

Drainage Area:

The drainage areas and resulting changes are summarized in the table below:

PL23-OUT 2			
Drainage Area	**Watershed Area**	**Site Area**	**% of Total Watershed**
Proposed	2797 ac	2.16 ac	0.077%

Limits of Study:

The location of the outfall is shown in the included outfall drainage map. The point of analysis is at the end of the restored channel where it meets Scotts Run.

Easement Requirements:

No additional easements are required.

Channel and Flood Protection:

Under Section 11.7.5.1 and 11.7.5.2 of the VDOT drainage manual, channel and flood protection for an outfall must be analyzed to a point where the contributing site drainage area for the outfall is less than or equal to one percent of the total watershed area at that point. Outfall PL23-OUT2 is located where the contributing site area is 2.16 acres of the total watershed (2,797 acres) at the outfall limit, which represents 0.077% of the watershed. As adequacy of all drainage structures within the limits of construction has been provided and these structures outfall directly into Scott's Run, no further analysis is required.

Final Opinion:

This outfall is a natural stormwater conveyance system. We have shown compliance with the channel and flood protection criteria, by analyzing the system to the 1% point, which is located at Scotts Run. As the contributing site area is less than 1% of the total watershed area, it is our opinion that this outfall is adequate.

Outfall PL23-OUT2: Looking Upstream at Str. 287

Outfall PL23-OUT2: Looking Downstream at Prop. Outfall Location

Outfall PL23-OUT2: Upstream from Outfall Point

Post-Developed Outfall Map
PL23-2
I-495
Fairfax, VA

EXISTING CONTOURS

SITE AREA

PL23-OUT 2
SITE DA = 2.16 AC
WATERSHED DA = 2797 AC

PROPOSED CLASS I RIPRAP WITH GEOTEXTILE

Exist. R/W & L/A Line Per VDOT Highway Plan 0413-029-007, RW-1

Ex. 25' Sanitary Sewer Esmt. DB 2576 PG 169 DB 2576 PG 173

Ex. Private Conservation Esmt. DB 19319 PG 125

Ex. 10' Sanitary Sewer Esmt. DB 4760 PG 357

Centerline of Ex. VEPCO Esmt. (No Width Specified) DB 1815 PG 216

Exist. R/W & L/A Line Per VDOT Highway Plan 0413-029-007, RW-1

Prop. R/W

Prop. L/A

Ex. 10' Trail Esmt. DB [illegible]

@ LEW_TRL

@ 495XL_SB

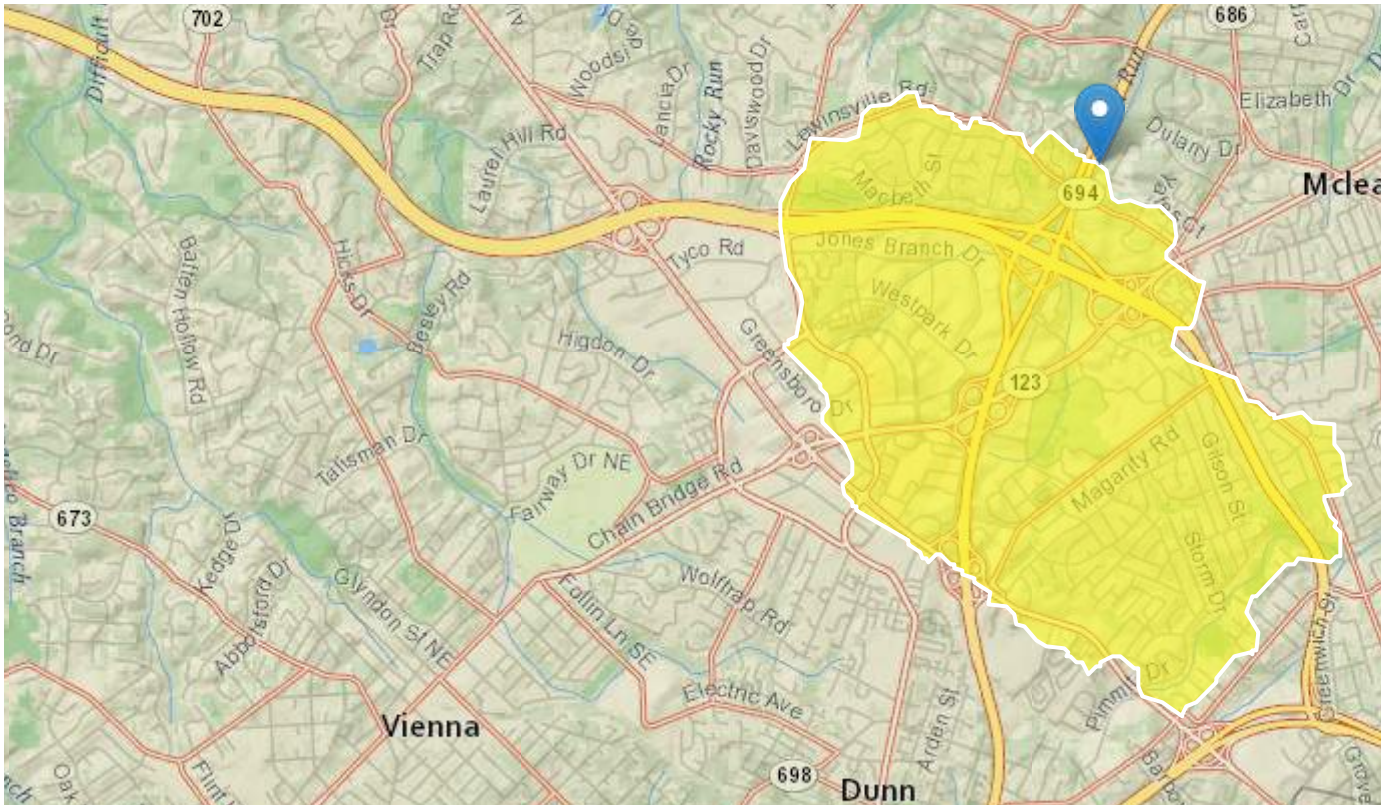
@ 495XL_NB

@ 495GP_NB

SCALE
0 100' 200'

StreamStats Report

Region ID: VA
Workspace ID: VA20210810192058112000
Clicked Point (Latitude, Longitude): 38.93773, -77.20623
Time: 2021-08-10 15:21:26 -0400



Scott's Run

Basin Characteristics

Parameter Code	Parameter Description	Value	Unit
DRNAREA	Area that drains to a point on a stream	4.37	square miles

USGS Data Disclaimer: Unless otherwise stated, all data, metadata and related materials are considered to satisfy the quality standards relative to the purpose for which the data were collected. Although these data and associated metadata have been reviewed for accuracy and completeness and approved for release by the U.S. Geological Survey (USGS), no warranty expressed or implied is made regarding the display or utility of the data for other purposes, nor on all computer systems, nor shall the act of distribution constitute any such warranty.

APPENDIX C3
PL23-OUT3

Outfall PL23-OUT 3

Outfall PL23-OUT3 is an existing outfall at Interstate 495 NB station 591+88 right. The outfall consists of a natural stormwater conveyance system. In existing conditions, flow is conveyed through an existing storm sewer to the point of analysis. The drainage area to the outfall prior to development is 3.86 acres.

Development of this area will result in decreased area to this outfall. The resulting drainage area to the outfall will be 3.74 acres.

Drainage Area:

The drainage areas and resulting changes are summarized in the table below:

PL23-OUT 3			
Drainage Area	**Total Area**	**C (Total)**	**Tc**
Existing	3.86 ac	0.58	16.21 min
Proposed	3.74 ac	0.61	18.86 min

Limits of Study:

The location of the outfall is shown in the included outfall drainage map. The point of analysis is within the existing channel east of I-495.

Easement Requirements:

No additional easements are required.

Outfall Discharge:

All discharges were calculated using the Rational Method and are summarized below:

PL23-OUT 3		
Drainage Area	**Peak Flow Rate (Total)**	
	2 Year	10 Year
Existing	7.54 cfs	10.06 cfs
Proposed	7.03 cfs	9.43 cfs
Net Change	**-0.51 cfs**	**-0.63 cfs**

Channel Description:

The channel at Outfall PL23-OUT 3 is a natural channel. Cross Sections were prepared utilizing topography prepared by Rinker Design Associates, P.C. and Fairfax County GIS.

Channel Protection:

Under Section 11.7.5.1 of the VDOT drainage manual, areas draining to a natural stormwater conveyance channel shall satisfy the channel protection criteria by providing conveyance of the 2-year storm without causing erosion of the system. Calculations have been provided below supporting the 2-year velocities in the system:

Cross Section	Channel Protection - 2 Year Velocity			Outfall Adequate?
	Channel Lining	Max Permissible Velocity (ft/s)	Proposed Velocity (ft/s)	
A-A	Codorus Silt Loam	3.50	1.59	Yes
B-B	Codorus Silt Loam	3.50	1.70	Yes
C-C	Codorus Silt Loam	3.50	2.27	Yes

Flood Protection:

Under Section 11.7.5.2 of the VDOT drainage manual, areas draining to a natural stormwater conveyance channel shall satisfy the flood protection criteria by demonstrating that the peak flow rate from a 2-year storm will be contained within the existing channel. The post developed flows to the channel have been analyzed and yield the following results:

Cross Section	Flood Protection - 2 Year Capacity		Outfall Adequate?
	Channel Depth (ft)	Normal Depth (ft)	
A-A	1.32	0.60	Yes
B-B	1.64	0.80	Yes
C-C	2.00	0.70	Yes

Final Opinion:

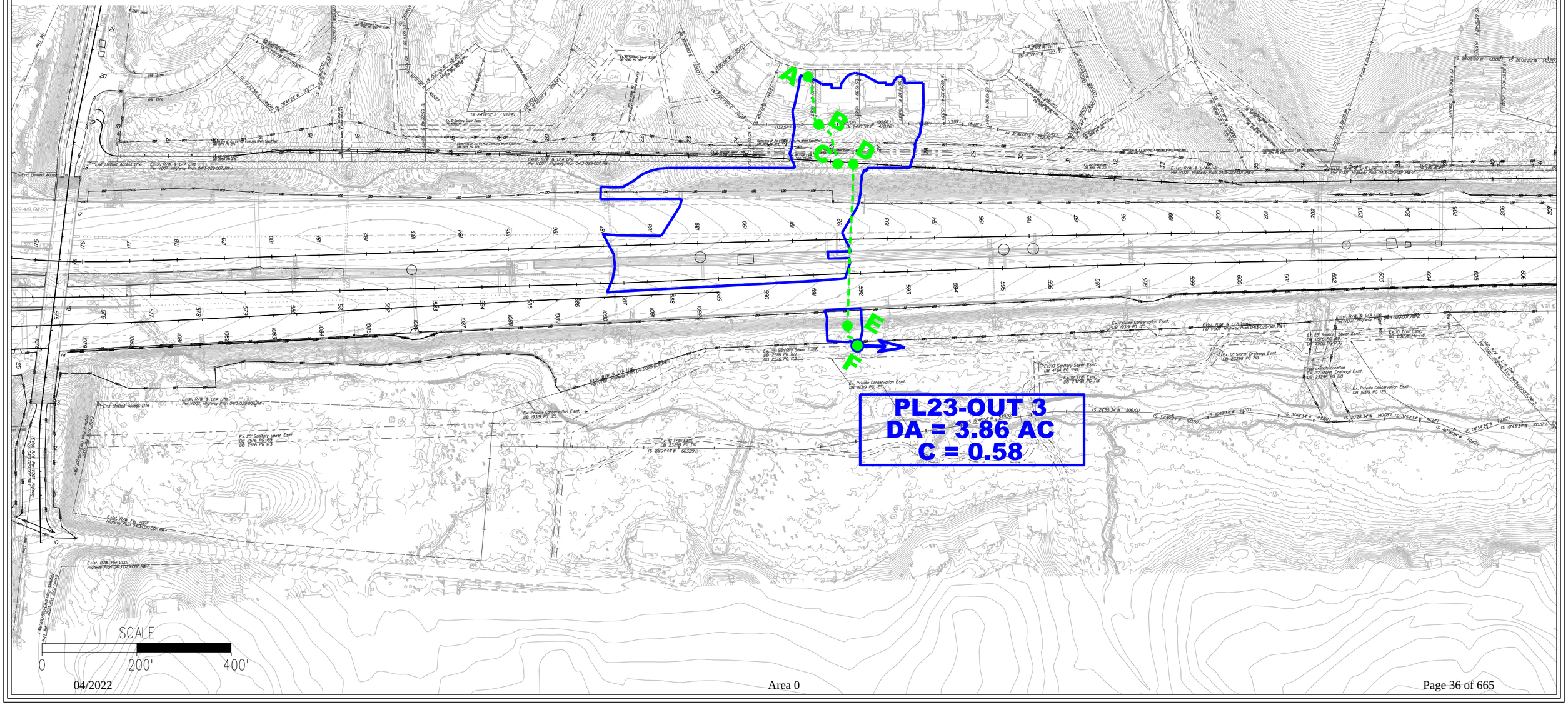
This outfall is a natural stormwater conveyance system. We have shown compliance with the channel protection criteria by providing calculations demonstrating non-erosive velocities from a 2-year storm. We have shown compliance with the flood protection criteria, by demonstrating the peak discharge from a 2-year storm will be contained within the existing channel. It is therefore our opinion that this outfall is adequate.

Pre-Developed Outfall Map
PL23-3
I-495
Fairfax, VA

DRAINAGE AREA BOUNDARY

EXISTING CONTOURS

TIME OF CONCENTRATION

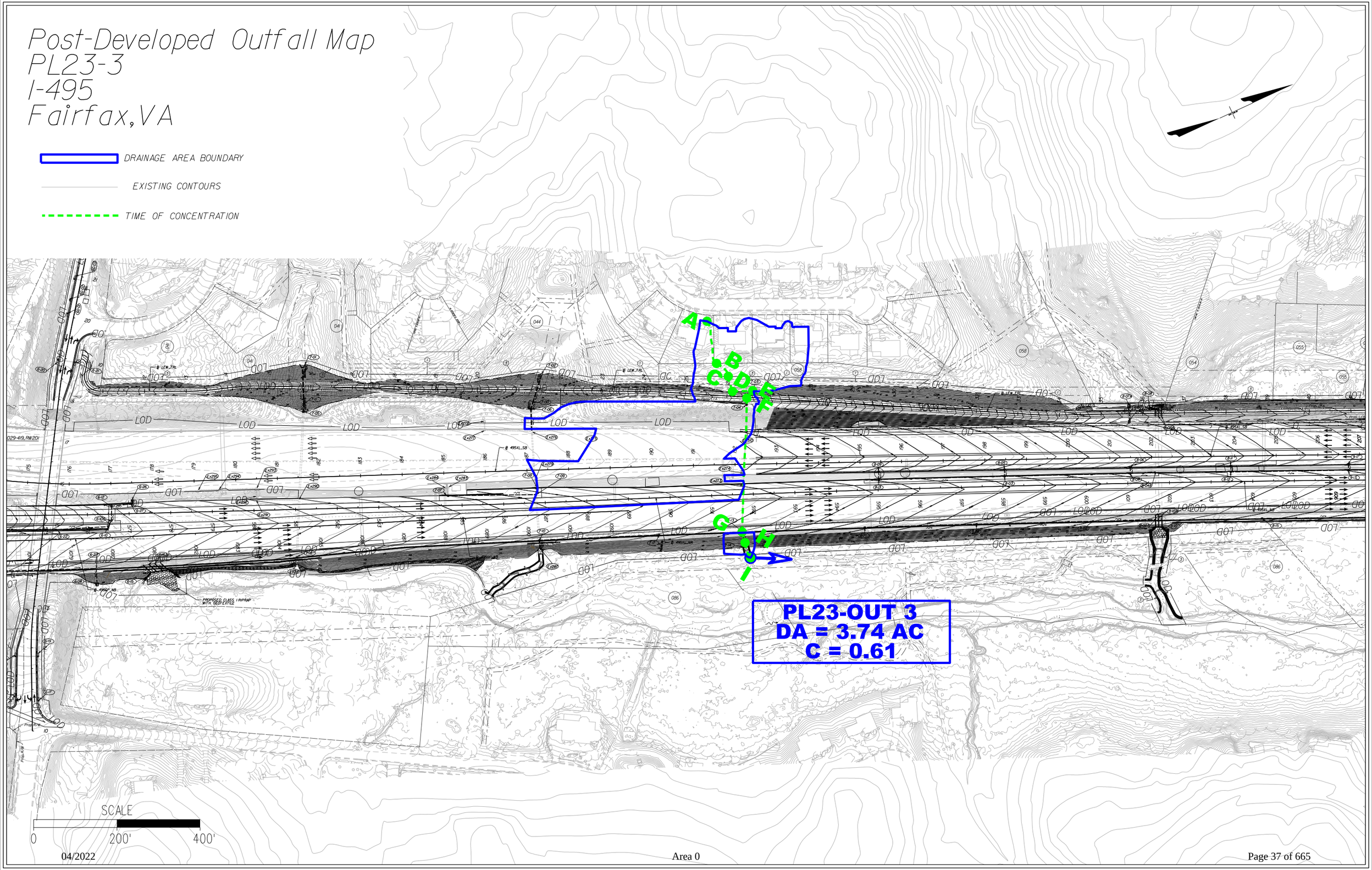


Post-Developed Outfall Map
PL23-3
I-495
Fairfax, VA

DRAINAGE AREA BOUNDARY

EXISTING CONTOURS

TIME OF CONCENTRATION



PL23-OUT3 Cross Sections
I-495 NEXT
Fairfax,VA

DRAINAGE AREA BOUNDARY

EXISTING CONTOURS

SCALE
0 50' 100'

SECTION A-A

SECTION B-B

SECTION C-C

Name of Project:	495-NEXT			Designed By:	CT
State:	VA	**County:**	Fairfax County	Date:	03/14/22
Name of Culvert:	Pre Development			Checked By:	KB
NOAA Station:	Vienna Tysons 44-8737			Date:	03/14/22
LOCATION:	PL23-OUT 3				
				UNITS	**ENGLISH**

RATIONAL METHOD - DATA:

DRAINAGE BASIN

SUBSHED #	Land Use Description	Area Acres	C	C A
	Business: Industrial and Commercial (0.80-0.90)			
	Apartments and Townhomes (0.65-0.75)			
	Schools (0.50-0.60)			
	Residential - lots 10,000 sq. ft. (0.40-0.50)			
	- lots 12,000 sq. ft. (0.40-0.45)			
	- lots 17,000 sq. ft. (0.35-0.45)			
	- lots ½ acre or more (0.30-0.40)	0.57	0.35	0.20
	Parks, Cemeteries and Unimproved Areas (0.20-0.35)			
	Paved and Roof Areas (0.90)	1.84	0.90	1.66
	Cultivated Areas (0.50-0.70)			
	Pasture (0.35-0.45)			
	Lawns (0.25-0.35)	0.58	0.30	0.18
	Forest (0.20-0.30)	0.85	0.25	0.21
	Steep Grass (2:1) (0.40-0.70)			
	Shoulder and Ditch Areas (0.35-0.50)			
	Totals =	**3.86 Acres**	**0.58**	**2.25**

Time of Concentration (Tc)

	Reach	Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Rational C		Tc (Minutes)
Overland Flow (E.E. Seelye - VDOT Modified)								
Soil / Surface Type/Land Cover		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Rational C		
Residential	A-B	107.22	321.27	305.70	0.145	0.35		6.61
Forest	B-C	98.25	305.70	291.50	0.145	0.25		8.93
Channel Flow		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
	C-D	33.36	291.50	289.26	0.067	0.050	7.42	0.07
			Area =	12.00		Wetted P =	12.70	
Pipe Flow		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
309 to 272	D-E	342.06	272.96	242.69	0.088	0.013	17.68	0.32
Pipe Diameter (in) =		18	Area =	1.77		Wetted P =	4.71	
Channel Flow		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
	E-F	53.28	242.69	242.05	0.012	0.050	3.14	0.28
			Area =	12.00		Wetted P =	12.70	
							Total Tc (Minutes) =	**16.21**

		2-Year	**5-Year**	**10-Year**	**25-Year**	**50-Year**	**100-Year**
Rainfall Intensity	Inches / Hour.	**3.35**	**3.94**	**4.47**	**5.09**	**5.54**	**5.97**
Aosorption Coefficient / Ground Saturation Correction Coefficient Cf		1.00	1.00	1.00	1.10	1.20	1.25
Peak Discharge	CFS.	**7.54**	**8.85**	**10.06**	**12.61**	**14.96**	**16.77**

Name of Project:	495-NEXT			Designed By:	CT
State:	VA	**County:**	Fairfax County	Date:	03/14/22
Name of Culvert:	Post Development			Checked By:	KB
NOAA Station:	Vienna Tysons 44-8737			Date:	03/14/22
LOCATION:	PL23-OUT 3				
				UNITS	**ENGLISH**

RATIONAL METHOD - DATA:

DRAINAGE BASIN

SUBSHED #	Land Use Description	Area Acres	C	C A
	Business: Industrial and Commercial (0.80-0.90)			
	Apartments and Townhomes (0.65-0.75)			
	Schools (0.50-0.60)			
	Residential - lots 10,000 sq. ft. (0.40-0.50)			
	- lots 12,000 sq. ft. (0.40-0.45)			
	- lots 17,000 sq. ft. (0.35-0.45)			
	- lots ½ acre or more (0.30-0.40)	0.57	0.35	0.20
	Parks, Cemeteries and Unimproved Areas (0.20-0.35)			
	Paved and Roof Areas (0.90)	1.88	0.90	1.69
	Cultivated Areas (0.50-0.70)			
	Pasture (0.35-0.45)			
	Lawns (0.25-0.35)	1.09	0.30	0.33
	Forest (0.20-0.30)	0.20	0.25	0.05
	Steep Grass (2:1) (0.40-0.70)			
	Shoulder and Ditch Areas (0.35-0.50)			
	Totals =	**3.74 Acres**	**0.61**	**2.27**

Time of Concentration (Tc)

		Reach	Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Rational C		Tc (Minutes)
Overland Flow (E.E. Seelye - VDOT Modified)									
	Soil / Surface Type/Land Cover		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Rational C		
	Residential	A-B	107.22	321.27	305.70	0.145	0.35		6.61
	Forest	B-C	44.17	305.70	300.62	0.115	0.25		6.66
	Lawn	C-D	37.91	300.62	294.64	0.158	0.30		4.90
Channel Flow			Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Grass ditch		D-E	48.66	294.64	291.48	0.065	0.050	7.29	0.11
				Area =	12.00		Wetted P =	12.70	
Pipe Flow			Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
6-03 to 6-04		E-F	22.89	273.08	272.96	0.005	0.013	5.21	0.07
	Pipe Diameter (in) =		24	Area =	3.14		Wetted P =	6.28	
Pipe Flow			Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
6-04 to 6-13		F-G	321.77	272.96	243.75	0.091	0.013	17.91	0.30
	Pipe Diameter (in) =		18	Area =	1.77		Wetted P =	4.71	
Pipe Flow			Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
6-13 to 6-14		G-H	26.73	243.75	243.62	0.005	0.013	5.02	0.09
	Pipe Diameter (in) =		24	Area =	3.14		Wetted P =	6.28	
Channel Flow			Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Natural Channel		H-I	39.40	243.62	242.05	0.040	0.050	5.71	0.11
				Area =	12.00		Wetted P =	12.70	
								Total Tc (Minutes) =	**18.86**

		2-Year	5-Year	10-Year	25-Year	50-Year	100-Year
Rainfall Intensity	Inches / Hour.	**3.10**	**3.65**	**4.16**	**4.75**	**5.17**	**5.57**
Aosorption Coefficient / Ground Saturation Correction Coefficient	Cf	1.00	1.00	1.00	1.10	1.20	1.25
Peak Discharge	CFS.	**7.03**	**8.28**	**9.43**	**11.84**	**14.06**	**15.79**

Outfall PL23-OUT3: Looking Upstream

Outfall PL23-OUT3: Looking Downstream

Name of Project:	495-NEXT			Designed By:	TP
State:	VA	**County:**	Fairfax County	Date:	03/14/22
Name of Culvert:	Post Development			Checked By:	KB
NOAA Station:	Vienna Tysons 44-8737			Date:	03/14/22
LOCATION:	PL23-OUT 3 A-A				
				UNITS	**ENGLISH**

RATIONAL METHOD - DATA:

DRAINAGE BASIN

SUBSHED #	Land Use Description	Area Acres	C	C A
	Business: Industrial and Commercial (0.80-0.90)			
	Apartments and Townhomes (0.65-0.75)			
	Schools (0.50-0.60)			
	Residential - lots 10,000 sq. ft. (0.40-0.50)			
	- lots 12,000 sq. ft. (0.40-0.45)			
	- lots 17,000 sq. ft. (0.35-0.45)			
	- lots ½ acre or more (0.30-0.40)	0.57	0.35	0.20
	Parks, Cemeteries and Unimproved Areas (0.20-0.35)			
	Paved and Roof Areas (0.90)	1.94	0.90	1.75
	Cultivated Areas (0.50-0.70)			
	Pasture (0.35-0.45)			
	Lawns (0.25-0.35)	1.73	0.30	0.52
	Forest (0.20-0.30)	1.37	0.25	0.34
	Steep Grass (2:1) (0.40-0.70)			
	Shoulder and Ditch Areas (0.35-0.50)			
	Totals =	**5.62 Acres**	**0.50**	**2.81**

Time of Concentration (Tc)

		Reach	Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Rational C		Tc (Minutes)
Overland Flow (E.E. Seelye - VDOT Modified)									
	Soil / Surface Type/Land Cover		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Rational C		
	Residential	A-B	107.22	321.27	305.70	0.145	0.35		6.61
	Forest	B-C	44.17	305.70	300.62	0.115	0.25		6.66
	Lawn	C-D	37.91	300.62	294.64	0.158	0.30		4.90
Channel Flow			Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Grass ditch		D-E	48.66	294.64	291.48	0.065	0.050	7.29	0.11
				Area =	12.00		Wetted P =	12.70	
Pipe Flow			Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
6-03 to 6-04		E-F	22.89	273.08	272.96	0.005	0.013	5.21	0.07
	Pipe Diameter (in) =		24	Area =	3.14		Wetted P =	6.28	
Pipe Flow			Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
6-04 to 6-13		F-G	321.77	272.96	243.75	0.091	0.013	17.91	0.30
	Pipe Diameter (in) =		18	Area =	1.77		Wetted P =	4.71	
Pipe Flow			Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
6-13 to 6-14		G-H	26.73	243.75	243.62	0.005	0.013	5.02	0.09
	Pipe Diameter (in) =		24	Area =	3.14		Wetted P =	6.28	
Channel Flow			Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Natural Channel		H-I	89.40	243.62	241.68	0.022	0.050	4.22	0.35
				Area =	12.00		Wetted P =	12.70	
								Total Tc (Minutes) =	**19.10**

		2-Year	**5-Year**	**10-Year**	**25-Year**	**50-Year**	**100-Year**
Rainfall Intensity	Inches / Hour.	**3.08**	**3.63**	**4.13**	**4.72**	**5.14**	**5.54**
Aosorption Coefficient / Ground Saturation Correction Coefficient Cf		1.00	1.00	1.00	1.10	1.20	1.25
Peak Discharge	CFS.	**8.67**	**10.21**	**11.62**	**14.60**	**17.34**	**19.47**

Worksheet for PL23-OUT3 (A-A) Post - 2yr

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Channel Slope	0.022 ft/ft
Discharge	8.67 cfs

Section Definitions

Station (ft)	Elevation (ft)
0+00	243.00
0+29	242.00
0+33	241.68
0+35	242.00
0+72	243.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 243.00)	(0+72, 243.00)	0.050

Options	
Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results	
Normal Depth	0.6 ft
Roughness Coefficient	0.050
Elevation	242.28 ft
Elevation Range	241.7 to 243.0 ft
Flow Area	5.4 ft²
Wetted Perimeter	25.0 ft
Hydraulic Radius	0.2 ft
Top Width	24.98 ft
Normal Depth	0.6 ft
Critical Depth	0.5 ft
Critical Slope	0.064 ft/ft
Velocity	1.59 ft/s
Velocity Head	0.04 ft
Specific Energy	0.64 ft
Froude Number	0.602
Flow Type	Subcritical

Worksheet for PL23-OUT3 (A-A) Post - 2yr

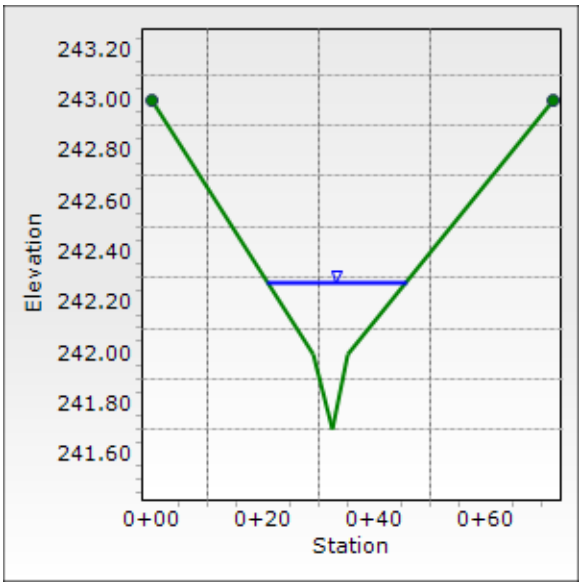
GVF Input Data	
Downstream Depth	0.0 ft
Length	0.0 ft
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.0 ft
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	0.00 ft/s
Upstream Velocity	0.00 ft/s
Normal Depth	0.6 ft
Critical Depth	0.5 ft
Channel Slope	0.022 ft/ft
Critical Slope	0.064 ft/ft

Cross Section for PL23-OUT3 (A-A) Post - 2yr

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Channel Slope	0.022 ft/ft
Normal Depth	0.6 ft
Discharge	8.67 cfs



Name of Project:	495-NEXT		Designed By: TP
State:	VA	**County:** Fairfax County	Date: 03/14/22
Name of Culvert:	Post Development		Checked By: KB
NOAA Station:	Vienna Tysons 44-8737		Date: 03/14/22
LOCATION:	PL23-OUT 3 B-B		UNITS **ENGLISH**

RATIONAL METHOD - DATA:

DRAINAGE BASIN

SUBSHED #	Land Use Description	Area Acres	C	C A
	Business: Industrial and Commercial (0.80-0.90)			
	Apartments and Townhomes (0.65-0.75)			
	Schools (0.50-0.60)			
	Residential - lots 10,000 sq. ft. (0.40-0.50)			
	- lots 12,000 sq. ft. (0.40-0.45)			
	- lots 17,000 sq. ft. (0.35-0.45)			
	- lots ½ acre or more (0.30-0.40)	0.57	0.35	0.20
	Parks, Cemeteries and Unimproved Areas (0.20-0.35)			
	Paved and Roof Areas (0.90)	1.95	0.90	1.75
	Cultivated Areas (0.50-0.70)			
	Pasture (0.35-0.45)			
	Lawns (0.25-0.35)	1.78	0.30	0.53
	Forest (0.20-0.30)	1.47	0.25	0.37
	Steep Grass (2:1) (0.40-0.70)			
	Shoulder and Ditch Areas (0.35-0.50)			
	Totals =	**5.77 Acres**	**0.49**	**2.85**

Time of Concentration (Tc)

	Reach	Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Rational C		Tc (Minutes)
Overland Flow (E.E. Seelye - VDOT Modified)								
Soil / Surface Type/Land Cover		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Rational C		
Residential	A-B	107.22	321.27	305.70	0.145	0.35		6.61
Forest	B-C	44.17	305.70	300.62	0.115	0.25		6.66
Lawn	C-D	37.91	300.62	294.64	0.158	0.30		4.90
Channel Flow		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Grass ditch	D-E	48.66	294.64	291.48	0.065	0.050	7.29	0.11
			Area =	12.00		Wetted P =	12.70	
Pipe Flow		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
6-03 to 6-04	E-F	22.89	273.08	272.96	0.005	0.013	5.21	0.07
Pipe Diameter (in) =		24	Area =	3.14		Wetted P =	6.28	
Pipe Flow		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
6-04 to 6-13	F-G	321.77	272.96	243.75	0.091	0.013	17.91	0.30
Pipe Diameter (in) =		18	Area =	1.77		Wetted P =	4.71	
Pipe Flow		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
6-13 to 6-14	G-H	26.73	243.75	243.62	0.005	0.013	5.02	0.09
Pipe Diameter (in) =		24	Area =	3.14		Wetted P =	6.28	
Channel Flow		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Natural Channel	H-I	139.40	243.62	241.36	0.016	0.050	3.64	0.64
			Area =	12.00		Wetted P =	12.70	
							Total Tc (Minutes) =	**19.38**

	2-Year	5-Year	10-Year	25-Year	50-Year	100-Year
Rainfall Intensity Inches / Hour.	**3.06**	**3.60**	**4.10**	**4.69**	**5.10**	**5.50**
Aosorption Coefficient / Ground Saturation Correction Coefficient Cf	1.00	1.00	1.00	1.10	1.20	1.25
Peak Discharge CFS.	**8.73**	**10.29**	**11.72**	**14.72**	**17.49**	**19.64**

Worksheet for PL23-OUT3 (B-B) Post - 2yr

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Channel Slope	0.022 ft/ft
Discharge	8.73 cfs

Section Definitions

Station (ft)	Elevation (ft)
0+00	243.00
0+27	242.00
0+31	241.36
0+35	242.00
0+80	243.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 243.00)	(0+80, 243.00)	0.050

Options	
Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results	
Normal Depth	0.8 ft
Roughness Coefficient	0.050
Elevation	242.19 ft
Elevation Range	241.4 to 243.0 ft
Flow Area	5.1 ft²
Wetted Perimeter	21.4 ft
Hydraulic Radius	0.2 ft
Top Width	21.26 ft
Normal Depth	0.8 ft
Critical Depth	0.7 ft
Critical Slope	0.059 ft/ft
Velocity	1.70 ft/s
Velocity Head	0.05 ft
Specific Energy	0.87 ft
Froude Number	0.611
Flow Type	Subcritical

Worksheet for PL23-OUT3 (B-B) Post - 2yr

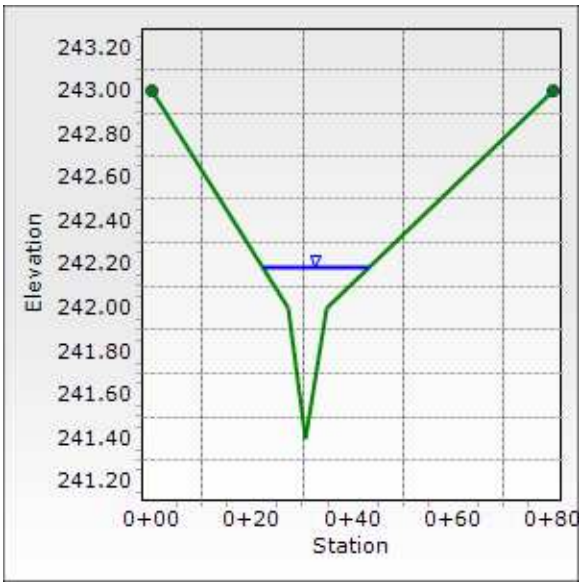
GVF Input Data	
Downstream Depth	0.0 ft
Length	0.0 ft
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.0 ft
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	0.00 ft/s
Upstream Velocity	0.00 ft/s
Normal Depth	0.8 ft
Critical Depth	0.7 ft
Channel Slope	0.022 ft/ft
Critical Slope	0.059 ft/ft

Cross Section for PL23-OUT3 (B-B) Post - 2yr

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Channel Slope	0.022 ft/ft
Normal Depth	0.8 ft
Discharge	8.73 cfs



Name of Project:	495-NEXT		Designed By: TP
State:	VA	**County:** Fairfax County	Date: 03/14/22
Name of Culvert:	Post Development		Checked By: KB
NOAA Station:	Vienna Tysons 44-8737		Date: 03/14/22
LOCATION:	PL23-OUT 3 C-C		UNITS **ENGLISH**

RATIONAL METHOD - DATA:

DRAINAGE BASIN

SUBSHED #	Land Use Description	Area Acres	C	C A
	Business: Industrial and Commercial (0.80-0.90)			
	Apartments and Townhomes (0.65-0.75)			
	Schools (0.50-0.60)			
	Residential - lots 10,000 sq. ft. (0.40-0.50)			
	- lots 12,000 sq. ft. (0.40-0.45)			
	- lots 17,000 sq. ft. (0.35-0.45)			
	- lots ½ acre or more (0.30-0.40)	0.57	0.35	0.20
	Parks, Cemeteries and Unimproved Areas (0.20-0.35)			
	Paved and Roof Areas (0.90)	1.95	0.90	1.76
	Cultivated Areas (0.50-0.70)			
	Pasture (0.35-0.45)			
	Lawns (0.25-0.35)	1.83	0.30	0.55
	Forest (0.20-0.30)	1.57	0.25	0.39
	Steep Grass (2:1) (0.40-0.70)			
	Shoulder and Ditch Areas (0.35-0.50)			
	Totals =	**5.93 Acres**	**0.49**	**2.90**

Time of Concentration (Tc)

		Reach	Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Rational C		Tc (Minutes)
Overland Flow (E.E. Seelye - VDOT Modified)									
	Soil / Surface Type/Land Cover		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Rational C		
	Residential	A-B	107.22	321.27	305.70	0.145	0.35		6.61
	Forest	B-C	44.17	305.70	300.62	0.115	0.25		6.66
	Lawn	C-D	37.91	300.62	294.64	0.158	0.30		4.90
Channel Flow			Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Grass ditch		D-E	48.66	294.64	291.48	0.065	0.050	7.29	0.11
				Area =	12.00		Wetted P =	12.70	
Pipe Flow			Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
6-03 to 6-04		E-F	22.89	273.08	272.96	0.005	0.013	5.21	0.07
	Pipe Diameter (in) =		24	Area =	3.14		Wetted P =	6.28	
Pipe Flow			Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
6-04 to 6-13		F-G	321.77	272.96	243.75	0.091	0.013	17.91	0.30
	Pipe Diameter (in) =		18	Area =	1.77		Wetted P =	4.71	
Pipe Flow			Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
6-13 to 6-14		G-H	26.73	243.75	243.62	0.005	0.013	5.02	0.09
	Pipe Diameter (in) =		24	Area =	3.14		Wetted P =	6.28	
Channel Flow			Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Natural Channel		H-I	189.40	243.62	241.03	0.014	0.050	3.35	0.94
				Area =	12.00		Wetted P =	12.70	
								Total Tc (Minutes) =	**19.69**

		2-Year	5-Year	10-Year	25-Year	50-Year	100-Year
Rainfall Intensity	Inches / Hour.	**3.03**	**3.57**	**4.07**	**4.65**	**5.07**	**5.46**
Aosorption Coefficient / Ground Saturation Correction Coefficient Cf		1.00	1.00	1.00	1.10	1.20	1.25
Peak Discharge	CFS.	**8.80**	**10.37**	**11.82**	**14.84**	**17.64**	**19.81**

Worksheet for PL23-OUT3 (C-C) Post - 2yr

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Channel Slope	0.022 ft/ft
Discharge	8.80 cfs

Section Definitions

Station (ft)	Elevation (ft)
0+00	243.00
0+14	242.00
0+23	242.00
0+26	242.30
0+30	242.00
0+37	241.00
0+44	242.00
0+48	242.30
0+51	242.00
0+64	242.00
1+03	243.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 243.00)	(1+03, 243.00)	0.050

Options	
Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results	
Normal Depth	0.7 ft
Roughness Coefficient	0.050
Elevation	241.74 ft
Elevation Range	241.0 to 243.0 ft
Flow Area	3.9 ft²
Wetted Perimeter	10.5 ft
Hydraulic Radius	0.4 ft
Top Width	10.43 ft
Normal Depth	0.7 ft
Critical Depth	0.6 ft

Worksheet for PL23-OUT3 (C-C) Post - 2yr

Results	
Critical Slope	0.054 ft/ft
Velocity	2.27 ft/s
Velocity Head	0.08 ft
Specific Energy	0.82 ft
Froude Number	0.655
Flow Type	Subcritical

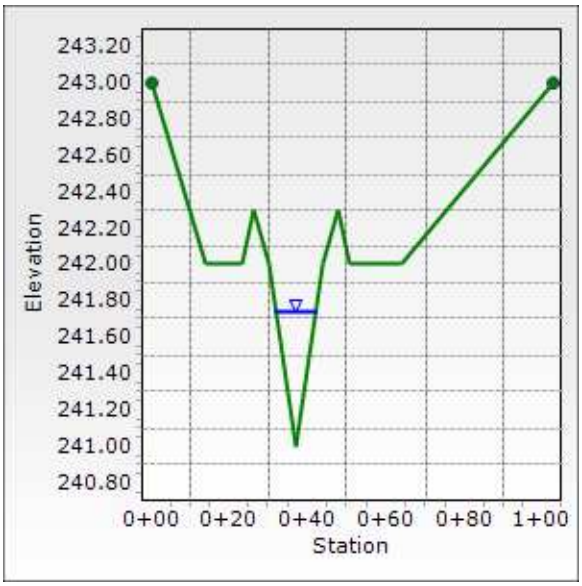
GVF Input Data	
Downstream Depth	0.0 ft
Length	0.0 ft
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.0 ft
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	0.00 ft/s
Upstream Velocity	0.00 ft/s
Normal Depth	0.7 ft
Critical Depth	0.6 ft
Channel Slope	0.022 ft/ft
Critical Slope	0.054 ft/ft

Cross Section for PL23-OUT3 (C-C) Post - 2yr

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Channel Slope	0.022 ft/ft
Normal Depth	0.7 ft
Discharge	8.80 cfs



APPENDIX C4
PL23-OUT4

Outfall PL23-OUT 4

Outfall PL23-OUT4 is an existing outfall at Interstate 495 station 601+81 right. The outfall consists of a natural channel flowing into Scotts Run. The total watershed drainage area at this outfall point is 3,213 acres (5.02 square miles).

In proposed conditions the project (site) area to the outfall will be 5.66 acres.

Drainage Area:

The drainage areas and resulting changes are summarized in the table below:

PL23-OUT 4			
Drainage Area	**Watershed Area**	**Site Area**	**% of Total Watershed**
Proposed	3213 ac	5.66 ac	0.176%

Limits of Study:

The location of the outfall is shown in the included outfall drainage map. The point of analysis is at the end of the natural channel where it meets Scotts Run.

Easement Requirements:

No additional easements are required.

Channel and Flood Protection:

Under Section 11.7.5.1 and 11.7.5.2 of the VDOT drainage manual, channel and flood protection for an outfall must be analyzed to a point where the contributing site drainage area for the outfall is less than or equal to one percent of the total watershed area at that point. Outfall PL23-OUT4 is located where the contributing site area is 5.66 acres of the total watershed (3,213 acres) at the outfall limit, which represents 0.176% of the watershed. As adequacy of all drainage structures within the limits of construction has been provided, and the natural conveyance channel within the outfall has been analyzed and shown to be adequate in Outfall 3, no further analysis is required.

Final Opinion:

This outfall is a natural stormwater conveyance system. We have shown compliance with the channel and flood protection criteria, by analyzing the system to the 1% point, which is located at Scotts Run. As the contributing site area is less than 1% of the total watershed area, it is our opinion that this outfall is adequate.

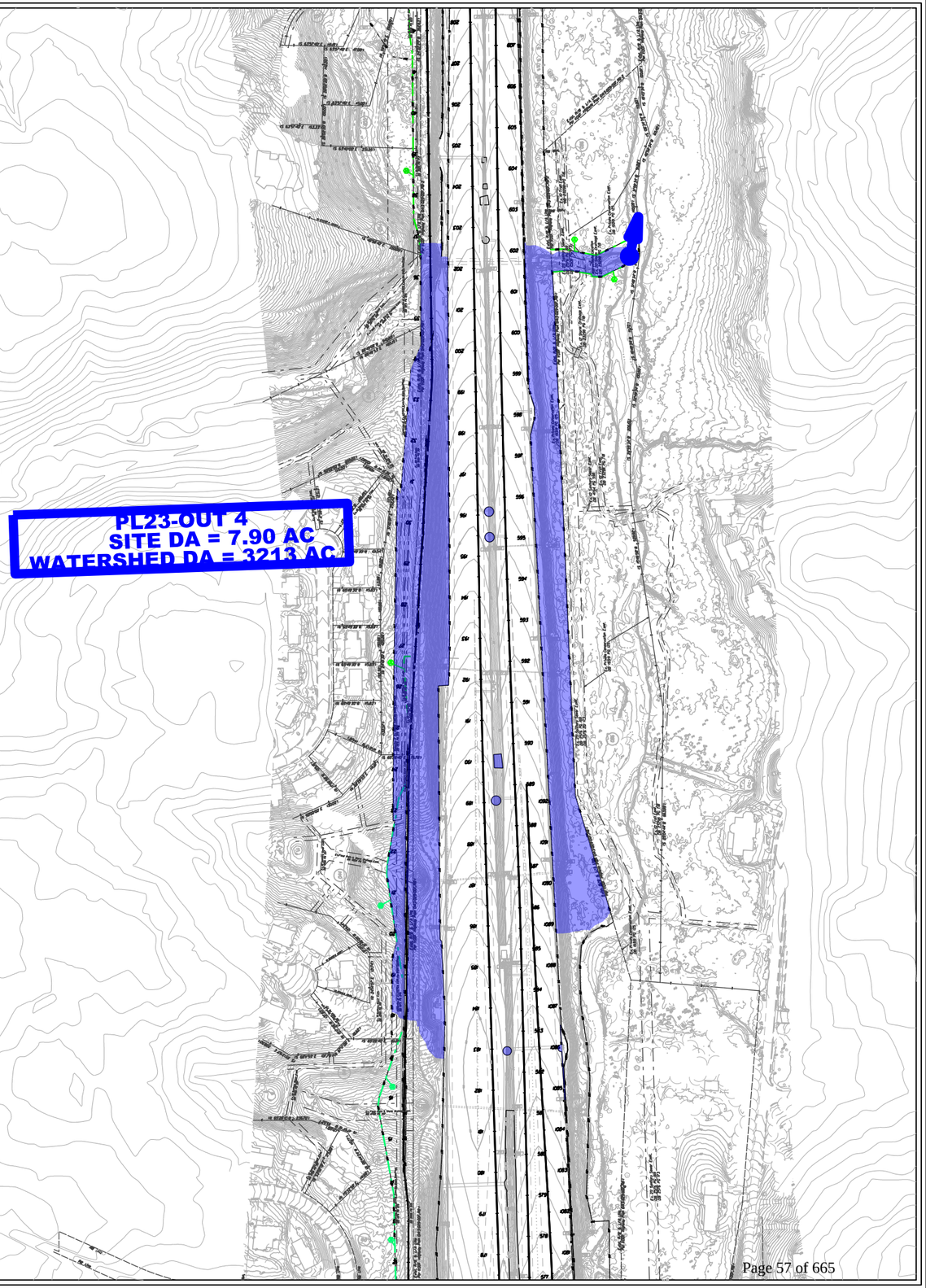
Outfall PL23-OUT4: Looking Upstream

Outfall PL23-OUT4: Looking Downstream

Pre-Developed Outfall Map
PL23-4
I-495
Fairfax, VA

EXISTING CONTOURS

SITE AREA



SCALE

0 300' 600'

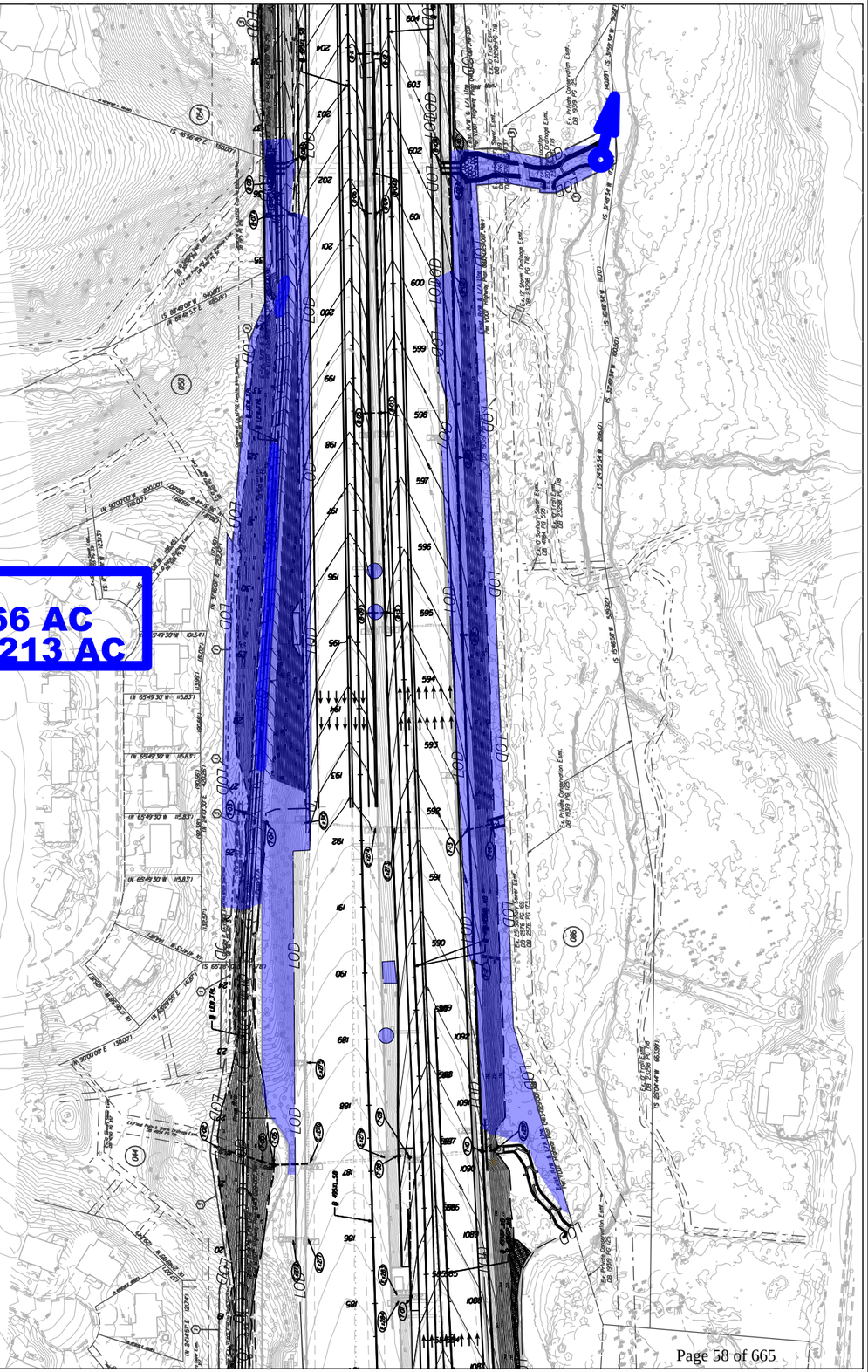
04/2022

Post-Developed Outfall Map
PL23-4
I-495
Fairfax, VA

EXISTING CONTOURS

SITE AREA

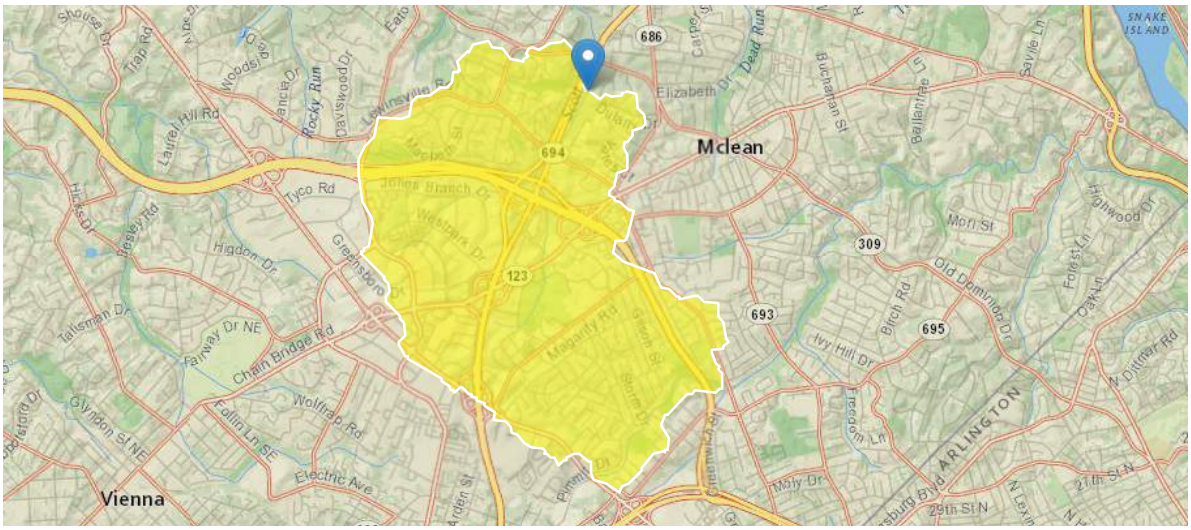
PL23-OUT 4
SITE DA = 5.66 AC
WATERSHED DA = 3213 AC



SCALE
0 200' 400'

StreamStats Report

Region ID: VA
Workspace ID: VA20210910200736916000
Clicked Point (Latitude, Longitude): 38.94222, -77.20325
Time: 2021-09-10 16:07:56 -0400



Basin Characteristics

Parameter Code	Parameter Description	Value	Unit
DRNAREA	Area that drains to a point on a stream	5.02	square miles

USGS Data Disclaimer: Unless otherwise stated, all data, metadata and related materials are considered to satisfy the quality standards relative to the purpose for which the data were collected. Although these data and associated metadata have been reviewed for accuracy and completeness and approved for release by the U.S. Geological Survey (USGS), no warranty expressed or implied is made regarding the display or utility of the data for other purposes, nor on all computer systems, nor shall the act of distribution constitute any such warranty.

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Application Version: 4.6.2
StreamStats Services Version: 1.2.22
NSS Services Version: 2.1.2

Str. 8-10 - Preliminary Proposed Conditions

Culvert Computations

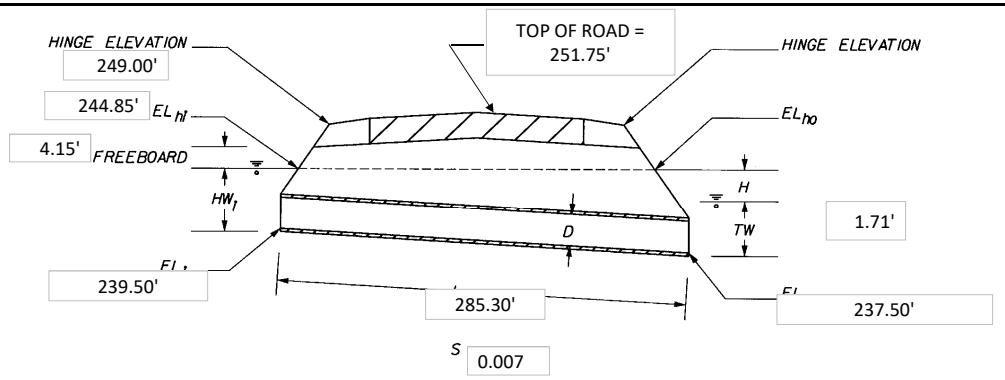
PROJECT: I-495 NEXT
DATE: 4-Mar-22
DESIGNER: JS
STATION: 601+75 495 NB
STRUCTURE: 8-08 to 8-10

HYDROLOGICAL DATA:

x	Method:	Anderson			
x	Drainage Area:	0.38 Sq. Miles	x	Stream Slope:	0.042 ft/ft
x	Channel Shape:	Trapezoidal			
	Routing:			Other:	

DESIGN FLOWS / TAILWATERS:

R.I. (years)	Flow (cfs)	TW (ft)
50 Year	257.5	1.7



Barrel	CULVERT DESCRIPTION: Material	Shape	Size	Entrance	Total Flow Q (cfs)	Flow Per Barrel Q/N	HEADWATER CALCULATIONS: INLET CONTROL HW_i / D	HW_i	FALL	EL_{hi}	OUTLET CONTROL: TW	d_c	$(d_c + D) / 2$	h_o	H	EL_{ho}	OUTLET: Control Headwater Elevation	VELOCITY C.M.	VELOCITY Conc.
2	Concrete	Box	7'x6'	Square edge with 30° and 77° wingwalls	257.50	128.75	0.89	5.35		244.85	1.71	3.48	4.74	4.74	5.64	240.41	240.41		12.76

TECHNICAL FOOTNOTES:

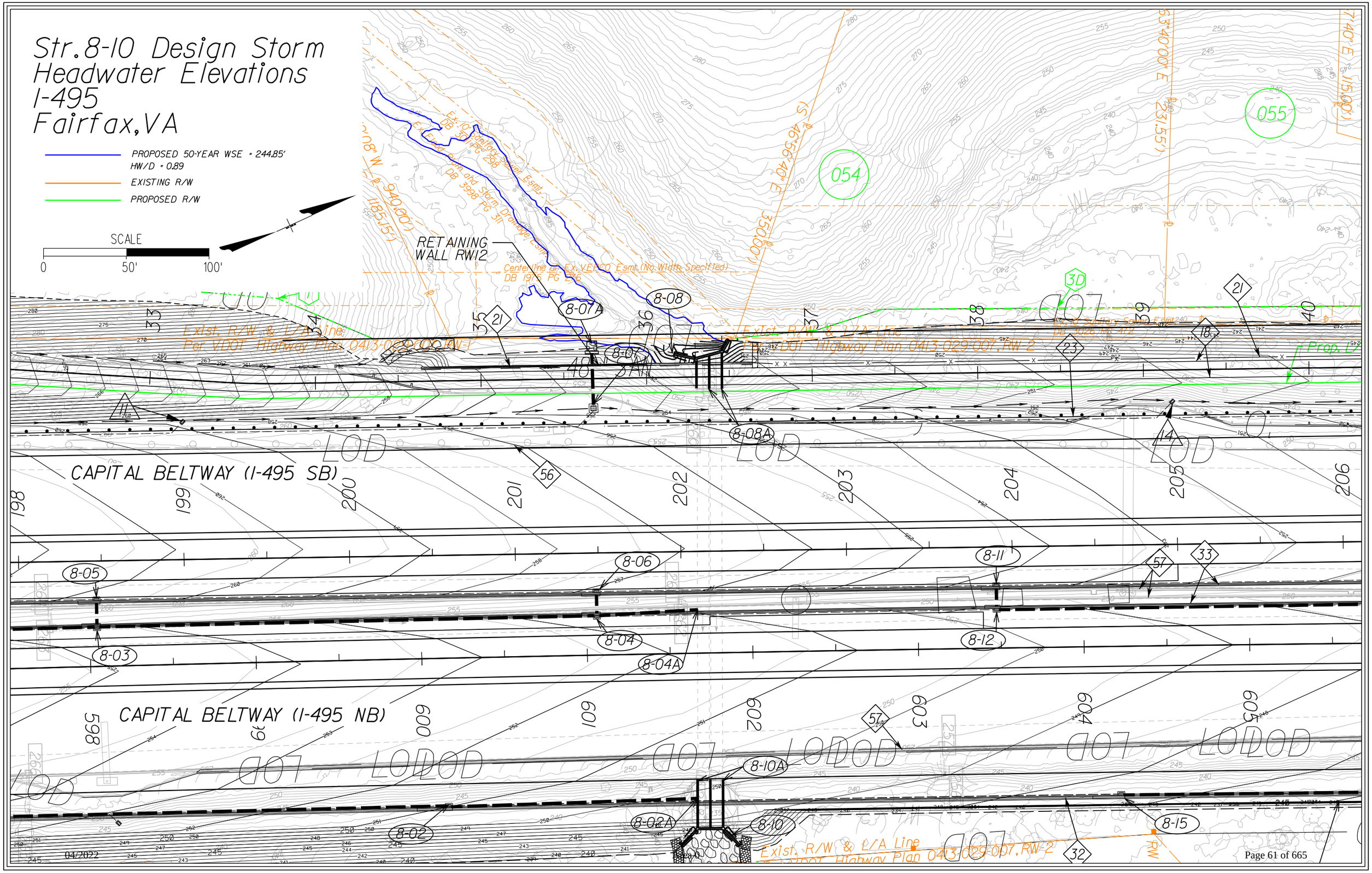
SUBSCRIPT DEFINITIONS:

hd	Design headwater
hi	Headwater in inlet control
ho	Headwater in outlet control
i	Inlet control section
o	Outlet
sf	Streambed at culvet face
tw	Tailwater

CULVERT BARREL SELECTED:

SIZE: 7'x6'
SHAPE: Box
MATERIAL: Concrete n: 0.013
ENTRANCE: Square edge with 30° and 77°

COMMENTS: All computations have been performed using HEC-RAS. This form is for informational purposes only and all values match those calculated in HEC-RAS.


Str. 8-10 Design Storm
Headwater Elevations
I-495
Fairfax, VA
PROPOSED 50-YEAR WSE = 244.85'
HW/D = 0.89
EXISTING R/W
PROPOSED R/W
SCALE
0
50'
100'
RETAINING WALL RW12
Centerline of Ex. VEPCO Esmt. (No Width Specified)
DB 1975 PG 276
Exist. R/W & L/A Line
Per VDOT Highway Plan 0413-029-007, RW-1
Exist. R/W & L/A Line
Per VDOT Highway Plan 0413-029-007, RW-2
CAPITAL BELTWAY (I-495 SB)
CAPITAL BELTWAY (I-495 NB)
8-07A
8-08
8-08A
8-07
8-05
8-06
8-11
8-03
8-04
8-04A
8-12
8-10A
8-02
8-02A
8-10
8-15
LOD
054
055
21
23
18
14
56
57
33
32
3D
198
199
200
201
202
203
204
205
206
598
600
601
602
603
604
605

APPENDIX C5
PL23-OUT5

Outfall PL23-OUT 5

Outfall PL23-OUT5 is an existing outfall at Interstate 495 Northbound station 610+09 right. The outfall consists of a natural channel flowing into Scotts Run. The drainage area to the outfall prior to development is 6.28 acres. Outfall 5 is the outfall point for an existing storm sewer system in existing conditions. In proposed conditions, that system will be abandoned and flow leaves the project area as sheet flow down the fill slope and later concentrates in the existing channel.

Development of this area will result in a decreased area to this outfall. The resulting drainage area to the outfall will be 2.99 acres.

Drainage Area:

The drainage areas and resulting changes are summarized in the table below:

PL23-OUT 5			
Drainage Area	**Total Area**	**C (Total)**	**Tc**
Existing	6.28 ac	0.52	11.23 min
Proposed	2.99 ac	0.31	17.51 min

Limits of Study:

The location of the outfall is shown in the included outfall drainage map. The point of analysis is at the end of the natural channel where it meets Scotts Run.

Easement Requirements:

No additional easements are required.

Outfall Discharge:

All discharges were calculated using the Rational Method and are summarized below:

PL23-OUT 5		
Drainage Area	**Peak Flow Rate (Total)**	
	2 Year	10 Year
Existing	13.01 cfs	17.21 cfs
Proposed	3.01 cfs	4.02 cfs
Net Change	**-10.00 cfs**	**-13.19 cfs**

Channel Description:

The channel at Outfall PL23-OUT 5 is a natural channel. Cross Sections were prepared utilizing topography prepared by Rinker Design Associates, P.C. and Fairfax County GIS.

Channel Protection:

Under Section 11.7.5.1 of the VDOT drainage manual, areas draining to a natural stormwater conveyance channel shall satisfy the channel protection criteria by providing conveyance of the 2-year storm without causing erosion of the system. Calculations have been provided below supporting the 2-year velocities in the system:

Cross Section	Channel Protection - 2 Year Velocity			Outfall Adequate?
	Channel Lining	Max Permissible Velocity (ft/s)	Proposed Velocity (ft/s)	
A-A	Codorus Silt Loam	3.50	1.96	Yes

Flood Protection:

Under Section 11.7.5.2 of the VDOT drainage manual, areas draining to a natural stormwater conveyance channel shall satisfy the flood protection criteria by demonstrating that the peak flow rate from a 2-year storm will be contained within the existing channel. The post developed flows to the channel have been analyzed and yield the following results:

Cross Section	Flood Protection - 2 Year Capacity		Outfall Adequate?
	Channel Depth (ft)	Normal Depth (ft)	
A-A	1.00	0.50	Yes

Final Opinion:

This outfall is a natural stormwater conveyance system. We have shown compliance with the channel protection criteria by providing calculations demonstrating non-erosive velocities from a 2-year storm. We have shown compliance with the flood protection criteria, by demonstrating the peak discharge from a 2-year storm will be contained within the existing channel. It is therefore our opinion that this outfall is adequate.

Outfall PL23-OUT5: Outfall Point

Outfall PL23-OUT5: Upstream View

Outfall PL23-OUT5: Downstream view

Outfall PL23-OUT5: Downstream view, Scott Run

Pre-Developed Outfall Map
PL23-5
I-495
Fairfax, VA

DRAINAGE AREA BOUNDARY

EXISTING CONTOURS

TIME OF CONCENTRATION

PL23-OUT 5
DA = 6.28 AC
C = 0.52

SCALE
0 150' 300'

Post-Developed Outfall Map
PL23-5
I-495
Fairfax, VA

DRAINAGE AREA BOUNDARY

EXISTING CONTOURS

TIME OF CONCENTRATION

PL23-OUT 5
DA = 2.99 AC
C = 0.31

SECTION A-A

SCALE
0 100' 200'

Name of Project:	495-NEXT			Designed By:	JS
State:	VA	**County:**	Fairfax County	Date:	03/14/22
Name of Culvert:	Pre Development			Checked By:	KB
NOAA Station:	Vienna Tysons 44-8737			Date:	03/14/22
LOCATION:	PL23-OUT 5				
				UNITS	**ENGLISH**

RATIONAL METHOD - DATA:

DRAINAGE BASIN

SUBSHED #	Land Use Description	Area Acres	C	C A
	Business: Industrial and Commercial (0.80-0.90)			
	Apartments and Townhomes (0.65-0.75)			
	Schools (0.50-0.60)			
	Residential - lots 10,000 sq. ft. (0.40-0.50)			
	- lots 12,000 sq. ft. (0.40-0.45)			
	- lots 17,000 sq. ft. (0.35-0.45)			
	- lots ½ acre or more (0.30-0.40)		0.35	
	Parks, Cemeteries and Unimproved Areas (0.20-0.35)			
	Paved and Roof Areas (0.90)	2.62	0.90	2.36
	Cultivated Areas (0.50-0.70)			
	Pasture (0.35-0.45)			
	Lawns (0.25-0.35)	0.28	0.30	0.08
	Forest (0.20-0.30)	3.38	0.25	0.85
	Steep Grass (2:1) (0.40-0.70)			
	Shoulder and Ditch Areas (0.35-0.50)			
	Totals =	**6.28 Acres**	**0.52**	**3.29**

Time of Concentration (Tc)

		Reach	Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Rational C		Tc (Minutes)
Overland Flow (E.E. Seelye - VDOT Modified)									
	Soil / Surface Type/Land Cover		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Rational C		
	Paved	A-B	65.14	255.42	253.70	0.026	0.90		2.88
Shallow Concentrated Flow			Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Intercept Coeff.		
Paved		B-C	541.09	253.70	248.57	0.009	0.619		4.56
Pipe Flow			Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
257 to 256		C-D	19.77	242.02	241.61	0.021	0.013	8.56	0.04
	Pipe Diameter (in) =		18	Area =	1.77		Wetted P =	4.71	
Channel Flow			Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Grass ditch		D-E	877.47	241.61	225.30	0.019	0.050	3.90	3.75
				Area =	12.00		Wetted P =	12.70	
								Total Tc (Minutes) =	**11.23**

		2-Year	**5-Year**	**10-Year**	**25-Year**	**50-Year**	**100-Year**
Rainfall Intensity	Inches / Hour.	**3.96**	**4.62**	**5.24**	**5.94**	**6.45**	**6.93**
Aosorption Coefficient / Ground Saturation Correction Coefficient Cf		1.00	1.00	1.00	1.10	1.20	1.25
Peak Discharge	CFS.	**13.01**	**15.20**	**17.21**	**21.48**	**25.43**	**28.46**

Name of Project:	495-NEXT			Designed By:	JS
State:	VA	**County:**	Fairfax County	Date:	03/14/22
Name of Culvert:	Post Development			Checked By:	KB
NOAA Station:	Vienna Tysons 44-8737			Date:	03/14/22
LOCATION:	PL23-OUT 5				
				UNITS	**ENGLISH**

RATIONAL METHOD - DATA:

DRAINAGE BASIN

SUBSHED #	Land Use Description	Area Acres	C	C A
	Business: Industrial and Commercial (0.80-0.90)			
	Apartments and Townhomes (0.65-0.75)			
	Schools (0.50-0.60)			
	Residential - lots 10,000 sq. ft. (0.40-0.50)			
	- lots 12,000 sq. ft. (0.40-0.45)			
	- lots 17,000 sq. ft. (0.35-0.45)			
	- lots ½ acre or more (0.30-0.40)	0.00	0.35	
	Parks, Cemeteries and Unimproved Areas (0.20-0.35)			
	Paved and Roof Areas (0.90)	0.12	0.90	0.10
	Cultivated Areas (0.50-0.70)			
	Pasture (0.35-0.45)			
	Lawns (0.25-0.35)	2.21	0.30	0.66
	Forest (0.20-0.30)	0.66	0.25	0.17
	Steep Grass (2:1) (0.40-0.70)			
	Shoulder and Ditch Areas (0.35-0.50)			
	Totals =	**2.99 Acres**	**0.31**	**0.93**

Time of Concentration (Tc)

		Reach	Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Rational C		Tc (Minutes)
Overland Flow (E.E. Seelye - VDOT Modified)									
	Soil / Surface Type/Land Cover		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Rational C		
	Lawn	A-B	27.67	239.19	237.96	0.044	0.30		5.47
	Forest	B-C	43.83	239.19	237.72	0.034	0.25		8.39
Channel Flow			Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Grass ditch		C-D	788.03	237.72	225.30	0.016	0.050	3.59	3.66
				Area =	12.00		Wetted P =	12.70	
								Total Tc (Minutes) =	**17.51**

		2-Year	**5-Year**	**10-Year**	**25-Year**	**50-Year**	**100-Year**
Rainfall Intensity	Inches / Hour.	**3.22**	**3.79**	**4.31**	**4.92**	**5.35**	**5.76**
Aosorption Coefficient / Ground Saturation Correction Coefficient Cf		1.00	1.00	1.00	1.10	1.20	1.25
Peak Discharge	CFS.	**3.01**	**3.53**	**4.02**	**5.04**	**5.99**	**6.72**

Worksheet for PL23-OUT5 (A-A) Post - 2yr

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Channel Slope	0.028 ft/ft
Discharge	3.01 cfs

Section Definitions

Station (ft)	Elevation (ft)
0+00	226.30
0+01	226.00
0+04	225.30
0+09	226.00
0+13	226.30

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 226.30)	(0+13, 226.30)	0.050

Options	
Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results	
Normal Depth	6.0 in
Roughness Coefficient	0.050
Elevation	225.80 ft
Elevation Range	225.3 to 226.3 ft
Flow Area	1.5 ft²
Wetted Perimeter	6.2 ft
Hydraulic Radius	3.0 in
Top Width	6.13 ft
Normal Depth	6.0 in
Critical Depth	5.2 in
Critical Slope	0.062 ft/ft
Velocity	1.96 ft/s
Velocity Head	0.06 ft
Specific Energy	0.56 ft
Froude Number	0.689
Flow Type	Subcritical

Worksheet for PL23-OUT5 (A-A) Post - 2yr

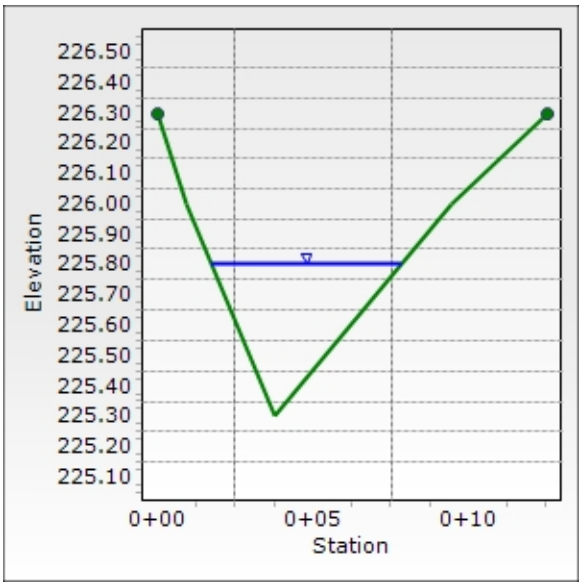
GVF Input Data	
Downstream Depth	0.0 in
Length	0.0 ft
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	0.00 ft/s
Upstream Velocity	0.00 ft/s
Normal Depth	6.0 in
Critical Depth	5.2 in
Channel Slope	0.028 ft/ft
Critical Slope	0.062 ft/ft

Cross Section for PL23-OUT5 (A-A) Post - 2yr

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Channel Slope	0.028 ft/ft
Normal Depth	6.0 in
Discharge	3.01 cfs



APPENDIX C6
PL23-OUT6

Outfall PL23-OUT 6

Outfall PL23-OUT6 is an existing outfall at I-495 Northbound station 611+50 right. The outfall consists of an area of uncontrolled sheet flow. The outfall drainage area prior to development is 0.11 acres.

Development of this area will result in a reduced area to this outfall, due to the proposed roadway widening and addition of a retaining wall in the area. The resulting drainage area to the outfall will be 0.03 acres.

Drainage Area:

The drainage areas and resulting changes are summarized in the table below:

PL23-OUT 6			
Drainage Area	**Total Area**	**C (Total)**	**Tc**
Existing	0.11 ac	0.29	5.00 min
Proposed	0.03 ac	0.30	5.00 min

Limits of Study:

The location of the outfall is shown in the included outfall drainage map. The point of analysis is at the site limits.

Easement Requirements:

No additional easements are required.

Outfall Discharge:

All discharges were calculated using the Rational Method and are summarized below:

PL23-OUT 6		
Drainage Area	**Peak Flow Rate (Total)**	
	2 Year	10 Year
Existing	0.16 cfs	0.21 cfs
Proposed	0.05 cfs	0.07 cfs
Net Change	**-0.11 cfs**	**-0.14 cfs**

Final Opinion:

Area of increased volume of sheet flow must be identified and evaluated for potential impacts. As this outfall demonstrates a decreased volume of sheet flow, no further calculations are necessary. It is therefore our opinion that this outfall is adequate.

Outfall PL23-OUT6: Outfall Point

Outfall PL23-OUT6: Outfall Point

Pre-Developed Outfall Map
PL23-6
I-495
Fairfax, VA

DRAINAGE AREA BOUNDARY

EXISTING CONTOURS

PL23-OUT 6
DA = 0.11 AC
C = 0.29

SCALE
0 50' 100'

Post-Developed Outfall Map
PL23-6
I-495
Fairfax, VA

DRAINAGE AREA BOUNDARY

EXISTING CONTOURS

PL23-OUT 6
DA = 0.03 AC
C = 0.30

SCALE
0 50' 100'

Name of Project:	495-NEXT			Designed By:	CT
State:	VA	**County:**	Fairfax County	Date:	03/14/22
Name of Culvert:	Pre Development			Checked By:	KB
NOAA Station:	Vienna Tysons 44-8737			Date:	03/14/22
LOCATION:	PL23-OUT 6				
				UNITS	**ENGLISH**

RATIONAL METHOD - DATA:

DRAINAGE BASIN

SUBSHED #	Land Use Description	Area Acres	C	C A
	Business: Industrial and Commercial (0.80-0.90)			
	Apartments and Townhomes (0.65-0.75)			
	Schools (0.50-0.60)			
	Residential - lots 10,000 sq. ft. (0.40-0.50)			
	- lots 12,000 sq. ft. (0.40-0.45)			
	- lots 17,000 sq. ft. (0.35-0.45)			
	- lots ½ acre or more (0.30-0.40)		0.35	
	Parks, Cemeteries and Unimproved Areas (0.20-0.35)			
	Paved and Roof Areas (0.90)	0.01	0.90	0.01
	Cultivated Areas (0.50-0.70)			
	Pasture (0.35-0.45)			
	Lawns (0.25-0.35)	0.01	0.30	0.00
	Forest (0.20-0.30)	0.10	0.25	0.02
	Steep Grass (2:1) (0.40-0.70)			
	Shoulder and Ditch Areas (0.35-0.50)			
	Totals =	**0.11 Acres**	**0.29**	**0.03**

Time of Concentration (Tc)

	Reach	Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Rational C		Tc (Minutes)
							Total Tc (Minutes) =	**5.00**

		2-Year	**5-Year**	**10-Year**	**25-Year**	**50-Year**	**100-Year**
Rainfall Intensity	Inches / Hour.	**5.18**	**6.00**	**6.76**	**7.64**	**8.28**	**8.89**
Aosorption Coefficient / Ground Saturation Correction Coefficient Cf		1.00	1.00	1.00	1.10	1.20	1.25
Peak Discharge	CFS.	**0.16**	**0.19**	**0.21**	**0.27**	**0.31**	**0.35**

Name of Project:	495-NEXT			Designed By:	JS
State:	VA	**County:**	Fairfax County	Date:	03/14/22
Name of Culvert:	Post Development			Checked By:	KB
NOAA Station:	Vienna Tysons 44-8737			Date:	03/14/22
LOCATION:	PL23-OUT 6				
				UNITS	**ENGLISH**

RATIONAL METHOD - DATA:

DRAINAGE BASIN

SUBSHED #	Land Use Description	Area Acres	C	C A
	Business: Industrial and Commercial (0.80-0.90)			
	Apartments and Townhomes (0.65-0.75)			
	Schools (0.50-0.60)			
	Residential - lots 10,000 sq. ft. (0.40-0.50)			
	- lots 12,000 sq. ft. (0.40-0.45)			
	- lots 17,000 sq. ft. (0.35-0.45)			
	- lots ½ acre or more (0.30-0.40)	0.00	0.35	
	Parks, Cemeteries and Unimproved Areas (0.20-0.35)			
	Paved and Roof Areas (0.90)	0.00	0.90	
	Cultivated Areas (0.50-0.70)			
	Pasture (0.35-0.45)			
	Lawns (0.25-0.35)	0.03	0.30	0.01
	Forest (0.20-0.30)	0.00	0.25	
	Steep Grass (2:1) (0.40-0.70)			
	Shoulder and Ditch Areas (0.35-0.50)			
	Totals =	**0.03 Acres**	**0.30**	**0.01**

Time of Concentration (Tc)

	Reach	Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Rational C		Tc (Minutes)
							Total Tc (Minutes) =	**5.00**

		2-Year	**5-Year**	**10-Year**	**25-Year**	**50-Year**	**100-Year**
Rainfall Intensity	Inches / Hour.	**5.18**	**6.00**	**6.76**	**7.64**	**8.28**	**8.89**
Aosorption Coefficient / Ground Saturation Correction Coefficient Cf		1.00	1.00	1.00	1.10	1.20	1.25
Peak Discharge	CFS.	**0.05**	**0.06**	**0.07**	**0.09**	**0.10**	**0.11**

APPENDIX C7
PL23-OUT7

Outfall PL23-OUT 7

Outfall PL23-OUT7 is an existing outfall at Interstate 495 station 612+56 right. The outfall consists of a natural channel flowing through a culvert and into Scotts Run. The total watershed drainage area at this outfall point is 3,238 acres (5.06 square miles).

In proposed conditions the project (site) area to the outfall will be 5.96 acres.

Drainage Area:

The drainage areas and resulting changes are summarized in the table below:

PL23-OUT 7			
Drainage Area	**Watershed Area**	**Site Area**	**% of Total Watershed**
Proposed	3238 ac	5.96 ac	0.184%

Limits of Study:

The location of the outfall is shown in the included outfall drainage map. The point of analysis is at the end of the culvert where it meets Scotts Run.

Easement Requirements:

No additional easements are required.

Channel and Flood Protection:

Under Section 11.7.5.1 and 11.7.5.2 of the VDOT drainage manual, channel and flood protection for an outfall must be analyzed to a point where the contributing site drainage area for the outfall is less than or equal to one percent of the total watershed area at that point. Outfall PL23-OUT7 is located where the contributing site area is 5.96 acres of the total watershed (3,238 acres) at the outfall limit, which represents 0.184% of the watershed. As adequacy of all drainage structures within the limits of construction has been provided and these structures outfall directly into Scott's Run, no further analysis is required.

Final Opinion:

This outfall is a natural stormwater conveyance system. We have shown compliance with the channel and flood protection criteria, by analyzing the system to the 1% point, which is located at Scotts Run. As the contributing site area is less than 1% of the total watershed area, it is our opinion that this outfall is adequate.

Outfall PL23-OUT7: Looking Downstream

Pre-Developed Outfall Map
PL23-7
I-495
Fairfax, VA

EXISTING CONTOURS

SITE AREA

PL23-OUT 7
SITE DA = 4.19 AC
WATERSHED DA = 3238 AC

SCALE
0 200' 400'

04/2022

Area 0

Post-Developed Outfall Map
PL23-7
I-495
Fairfax, VA

EXISTING CONTOURS

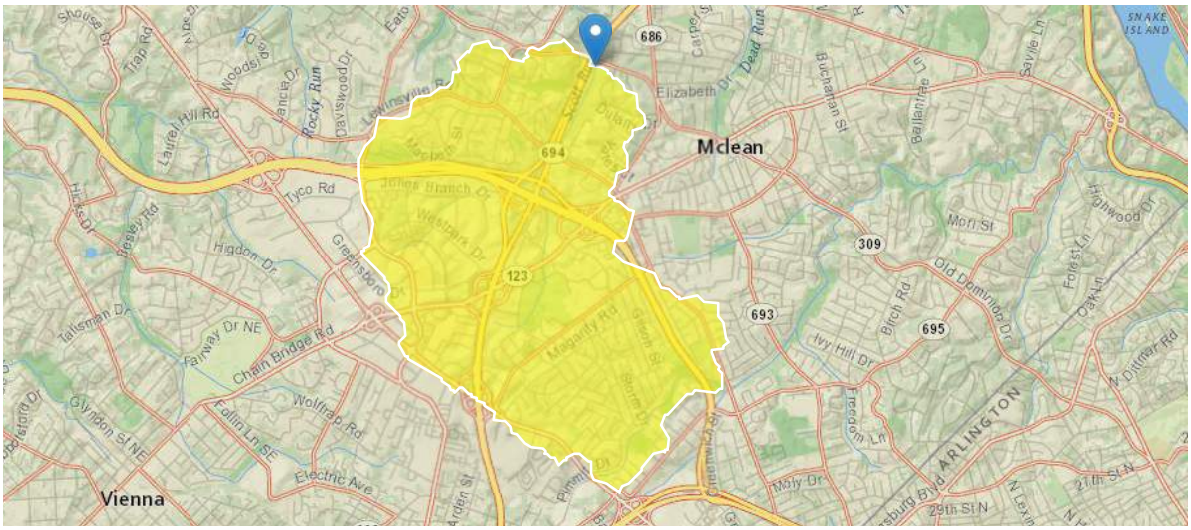
SITE AREA

PL23-OUT 7
SITE DA = 5.96 AC
WATERSHED DA = 3238 AC

SCALE
0 200' 400'

StreamStats Report

Region ID: VA
Workspace ID: VA20210910200441448000
Clicked Point (Latitude, Longitude): 38.94467, -77.20224
Time: 2021-09-10 16:05:01 -0400



Basin Characteristics

Parameter Code	Parameter Description	Value	Unit
DRNAREA	Area that drains to a point on a stream	5.06	square miles

USGS Data Disclaimer: Unless otherwise stated, all data, metadata and related materials are considered to satisfy the quality standards relative to the purpose for which the data were collected. Although these data and associated metadata have been reviewed for accuracy and completeness and approved for release by the U.S. Geological Survey (USGS), no warranty expressed or implied is made regarding the display or utility of the data for other purposes, nor on all computer systems, nor shall the act of distribution constitute any such warranty.

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Application Version: 4.6.2
StreamStats Services Version: 1.2.22
NSS Services Version: 2.1.2

Str. 9-03 - Preliminary Proposed Conditions

Culvert Computations

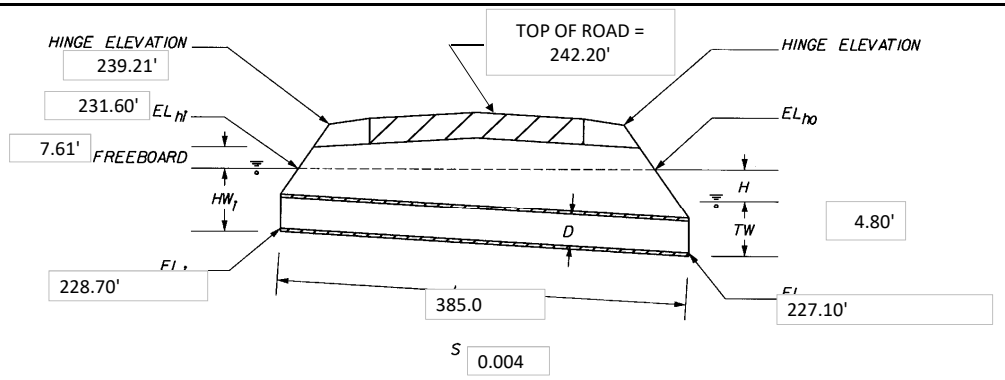
PROJECT: I-495 NEXT
DATE: 4-Mar-22
DESIGNER: JS
STATION: 612+25 495 NB
STRUCTURE: 9-31 to 9-03

HYDROLOGICAL DATA:

x	Method:	Anderson			
x	Drainage Area:	0.07 Sq. Miles	x	Stream Slope:	0.012 ft/ft
x	Channel Shape:	Trapezoidal			
	Routing:			Other:	

DESIGN FLOWS / TAILWATERS:

R.I. (years)	Flow (cfs)	TW (ft)
50 Year	103.34	4.8



Barrel	CULVERT DESCRIPTION: Material	Shape	Size	Entrance	Total Flow Q (cfs)	Flow Per Barrel Q/N	HEADWATER CALCULATIONS: INLET CONTROL HW_i/D	HW_i	FALL	EL_{hi}	OUTLET CONTROL TW	d_c	$(d_c+D)/2$	h_o	H	EL_{ho}	OUTLET: Control Headwater Elevation	VELOCITY C.M.	Conc.
1	Concrete	Box	7'x6'	Square edge with 45°wingwalls	103.34	103.34	0.48	2.90		231.60	4.80	1.89	3.95	4.80	0.47	232.37	232.37		3.08

TECHNICAL FOOTNOTES:

SUBSCRIPT DEFINITIONS:

hd	Design headwater
hi	Headwater in inlet control
ho	Headwater in outlet control
i	Inlet control section
o	Outlet
sf	Streambed at culvet face
tw	Tailwater

CULVERT BARREL SELECTED:

SIZE: 7'x6'
SHAPE: Box
MATERIAL: Concrete n: 0.013
ENTRANCE: Square edge with 45°wingwalls

COMMENTS: All computations have been performed using HY-8. This form is for informational purposes only and all values match those calculated in HY-8.

Str.9-03 Design Storm Headwater Elevations I-495 Fairfax,VA

PROPOSED 50-YEAR WSE = 231.60'
HW/D = 0.48
EXISTING R/W
PROPOSED R/W

SCALE
0 50' 100'

HEADWATER WSE = 231.60'

CAPITAL BELTWAY (I-495 SB)

CAPITAL BELTWAY (I-495 NB)

OLD DOMINION DR.

RETAINING WALL RW03

Ex. 25' Sanitary Sewer Esmt. DB 2496 PG 472

Ex. VEPCO Esmt. DB 1978 PG 343

Ex. Flood Plain Esmt. DB 4852 PG 815

APPENDIX C8
PL23-OUT8

Outfall PL23-OUT 8

Outfall PL23-OUT8 is an existing outfall at I-495 Northbound station 613+25 right which is adjacent to the existing Old Dominion Drive bridge. The outfall consists of an area of uncontrolled sheet flow. The drainage area to the outfall prior to development is 0.12 acres.

Development of this area will result in a reduced area to this outfall, due to the proposed roadway widening, addition of a retaining wall, and shifting alignment of the Old Dominion Drive bridge. The resulting drainage area to the outfall will be 0.07 acres.

Drainage Area:

The drainage areas and resulting changes are summarized in the table below:

PL23-OUT 8			
Drainage Area	**Total Area**	**C (Total)**	**Tc**
Existing	0.12 ac	0.28	5.00 min
Proposed	0.07 ac	0.30	5.00 min

Limits of Study:

The location of the outfall is shown in the included outfall drainage map. The point of analysis is at the site limits.

Easement Requirements:

No additional easements are required.

Outfall Discharge:

All discharges were calculated using the Rational Method and are summarized below:

PL23-OUT 8		
Drainage Area	**Peak Flow Rate (Total)**	
	2 Year	10 Year
Existing	0.18 cfs	0.23 cfs
Proposed	0.10 cfs	0.14 cfs
Net Change	**-0.08 cfs**	**-0.09 cfs**

Final Opinion:

Area of increased volume of sheet flow must be identified and evaluated for potential impacts. As this outfall demonstrates a decreased volume of sheet flow, no further calculations are necessary. It is therefore our opinion that this outfall is adequate.

Outfall PL23-OUT8: Outfall Point

Outfall PL23-OUT8: Outfall Point

Pre-Developed Outfall Map
PL23-8
I-495
Fairfax, VA

DRAINAGE AREA BOUNDARY

EXISTING CONTOURS

PL23-OUT 8
DA = 0.12 AC
C = 0.28

SCALE
0 50' 100'

Post-Developed Outfall Map
PL23-8
I-495
Fairfax, VA

DRAINAGE AREA BOUNDARY

EXISTING CONTOURS

PL23-OUT 8
DA = 0.07 AC
C = 0.30

SCALE
0 50' 100'

Name of Project:	495-NEXT			Designed By:	JS
State:	VA	**County:**	Fairfax County	Date:	03/14/22
Name of Culvert:	Pre Development			Checked By:	KB
NOAA Station:	Vienna Tysons 44-8737			Date:	03/14/22
LOCATION:	PL23-OUT 8				
				UNITS	**ENGLISH**

RATIONAL METHOD - DATA:

DRAINAGE BASIN

SUBSHED #	Land Use Description	Area Acres	C	C A
	Business: Industrial and Commercial (0.80-0.90)			
	Apartments and Townhomes (0.65-0.75)			
	Schools (0.50-0.60)			
	Residential - lots 10,000 sq. ft. (0.40-0.50)			
	- lots 12,000 sq. ft. (0.40-0.45)			
	- lots 17,000 sq. ft. (0.35-0.45)			
	- lots ½ acre or more (0.30-0.40)		0.35	
	Parks, Cemeteries and Unimproved Areas (0.20-0.35)			
	Paved and Roof Areas (0.90)		0.90	
	Cultivated Areas (0.50-0.70)			
	Pasture (0.35-0.45)			
	Lawns (0.25-0.35)	0.06	0.30	0.02
	Forest (0.20-0.30)	0.06	0.25	0.02
	Steep Grass (2:1) (0.40-0.70)			
	Shoulder and Ditch Areas (0.35-0.50)			
	Totals =	**0.12 Acres**	**0.28**	**0.03**

Time of Concentration (Tc)

	Reach	Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Rational C		Tc (Minutes)
							Total Tc (Minutes) =	**5.00**

		2-Year	**5-Year**	**10-Year**	**25-Year**	**50-Year**	**100-Year**
Rainfall Intensity	Inches / Hour.	**5.18**	**6.00**	**6.76**	**7.64**	**8.28**	**8.89**
Aosorption Coefficient / Ground Saturation Correction Coefficient Cf		1.00	1.00	1.00	1.10	1.20	1.25
Peak Discharge	CFS.	**0.18**	**0.20**	**0.23**	**0.28**	**0.34**	**0.38**

Name of Project:	495-NEXT			Designed By:	CT
State:	VA	**County:**	Fairfax County	Date:	03/14/22
Name of Culvert:	Post Development			Checked By:	KB
NOAA Station:	Vienna Tysons 44-8737			Date:	03/14/22
LOCATION:	PL23-OUT 8				
				UNITS	**ENGLISH**

RATIONAL METHOD - DATA:

DRAINAGE BASIN

SUBSHED #	Land Use Description	Area Acres	C	C A
	Business: Industrial and Commercial (0.80-0.90)			
	Apartments and Townhomes (0.65-0.75)			
	Schools (0.50-0.60)			
	Residential - lots 10,000 sq. ft. (0.40-0.50)			
	- lots 12,000 sq. ft. (0.40-0.45)			
	- lots 17,000 sq. ft. (0.35-0.45)			
	- lots ½ acre or more (0.30-0.40)	0.00	0.35	
	Parks, Cemeteries and Unimproved Areas (0.20-0.35)			
	Paved and Roof Areas (0.90)	0.00	0.90	
	Cultivated Areas (0.50-0.70)			
	Pasture (0.35-0.45)			
	Lawns (0.25-0.35)	0.07	0.30	0.02
	Forest (0.20-0.30)	0.00	0.25	
	Steep Grass (2:1) (0.40-0.70)			
	Shoulder and Ditch Areas (0.35-0.50)			
	Totals =	**0.07 Acres**	**0.30**	**0.02**

Time of Concentration (Tc)

	Reach	Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Rational C		Tc (Minutes)
							Total Tc (Minutes) =	**5.00**

		2-Year	**5-Year**	**10-Year**	**25-Year**	**50-Year**	**100-Year**
Rainfall Intensity	Inches / Hour.	**5.18**	**6.00**	**6.76**	**7.64**	**8.28**	**8.89**
Aosorption Coefficient / Ground Saturation Correction Coefficient Cf		1.00	1.00	1.00	1.10	1.20	1.25
Peak Discharge	CFS.	**0.10**	**0.12**	**0.14**	**0.17**	**0.20**	**0.22**

APPENDIX C9
PL23-OUT9

Outfall PL23-OUT 9

Outfall PL23-OUT9 is an existing outfall at Old Dominion Drive station 24+35 right. The outfall consists of flow from Old Dominion Drive and the surrounding properties being conveyed to Scott's Run. The total watershed drainage area at this outfall point is 3,245 acres (5.07 square miles).

In proposed conditions the project (site) area to the outfall will be 2.00 acres. The site area is conveyed by existing and proposed storm sewer and lined ditches.

Drainage Area:

The drainage areas and resulting changes are summarized in the table below:

PL23-OUT 9			
Drainage Area	**Watershed Area**	**Site Area**	**% of Total Watershed**
Proposed	3245 ac	2.00 ac	0.062%

Limits of Study:

The location of the outfall is shown in the included outfall drainage map. The point of analysis is where the conveyance ditch outfalls into Scott's Run.

Easement Requirements:

No additional easements are required.

Channel and Flood Protection:

Under Section 11.7.5.1 and 11.7.5.2 of the VDOT drainage manual, channel and flood protection for an outfall must be analyzed to a point where the contributing site drainage area for the outfall is less than or equal to one percent of the total watershed area at that point. Outfall PL23-OUT9 is located where the contributing site area is 2.00 acres of the total watershed (3,245 acres) at the outfall limit, which represents 0.062% of the watershed. As adequacy of all drainage structures and conveyance within the limits of construction has been provided, no further analysis is required.

Final Opinion:

This outfall is a natural stormwater conveyance system. We have shown compliance with the channel and flood protection criteria, by analyzing the system to the 1% point, which is located at Scotts Run. As the contributing site area is less than 1% of the total watershed area, it is our opinion that this outfall is adequate.

PL23-OUT9: Outfall Point

PL23-OUT9: Looking downstream into Scott Run

PL23-OUT9: Looking downstream of Outfall 9

Pre-Developed Outfall Map
PL23-9
I-495
Fairfax, VA

EXISTING CONTOURS

SITE AREA

PL23-OUT 9
SITE DA = 1.12 AC
WATERSHED DA = 3245 AC

SCALE 0 100' 200'

Post-Developed Outfall Map
PL23-9
I-495
Fairfax, VA

EXISTING CONTOURS

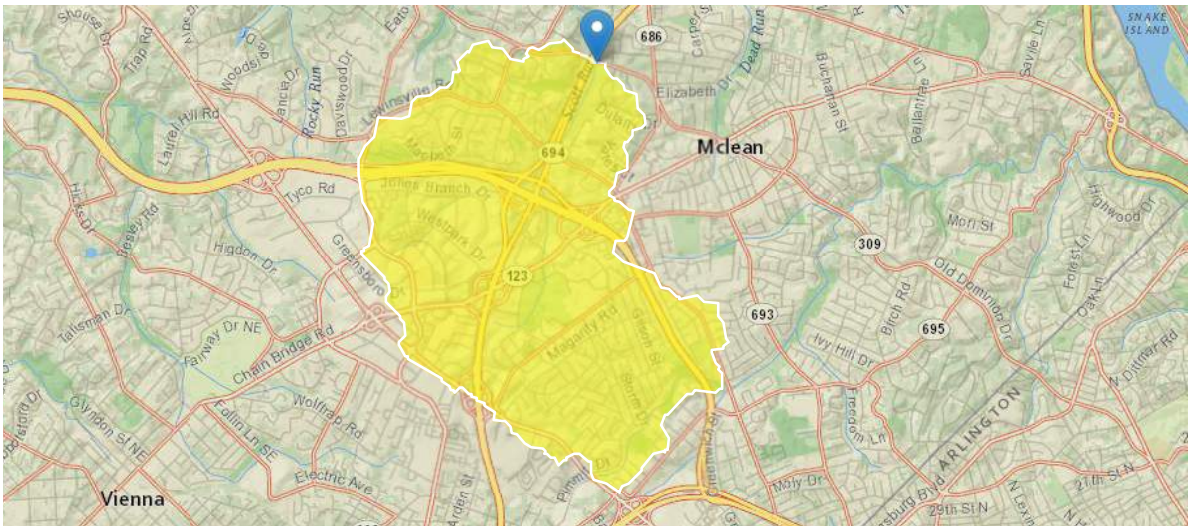
SITE AREA

PL23-OUT 9
SITE DA = 2.00 AC
WATERSHED DA = 3245 AC

SCALE
0 150' 300'

StreamStats Report

Region ID: VA
Workspace ID: VA20210910201255270000
Clicked Point (Latitude, Longitude): 38.94506, -77.20198
Time: 2021-09-10 16:13:15 -0400



Basin Characteristics

Parameter Code	Parameter Description	Value	Unit
DRNAREA	Area that drains to a point on a stream	5.07	square miles

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Application Version: 4.6.2
StreamStats Services Version: 1.2.22
NSS Services Version: 2.1.2

APPENDIX C10
PL23-OUT10

Outfall PL23-OUT 10

Outfall PL23-OUT10 is an existing outfall at Old Dominion Drive station 24+32 left. In existing conditions, the outfall collects runoff from the north side of the existing bridge. The drainage area to the outfall prior to development is 0.40 acres.

Development of this area will result in a reduced area to this outfall, due to the shifting alignment of the Old Dominion Drive bridge. The outfall in proposed conditions consists of uncontrolled sheet flow. The resulting drainage area to the outfall will be 0.08 acres.

Drainage Area:

The drainage areas and resulting changes are summarized in the table below:

PL23-OUT 10			
Drainage Area	**Total Area**	**C (Total)**	**Tc**
Existing	0.40 ac	0.55	5.00 min
Proposed	0.08 ac	0.30	5.00 min

Limits of Study:

The location of the outfall is shown in the included outfall drainage map. The point of analysis is at the site limits.

Easement Requirements:

No additional easements are required.

Outfall Discharge:

All discharges were calculated using the Rational Method and are summarized below:

PL23-OUT 10		
Drainage Area	**Peak Flow Rate (Total)**	
	2 Year	10 Year
Existing	1.14 cfs	1.49 cfs
Proposed	0.12 cfs	0.16 cfs
Net Change	**-1.02 cfs**	**-1.33 cfs**

Final Opinion:

Area of increased volume of sheet flow must be identified and evaluated for potential impacts. As this outfall demonstrates a decreased volume of sheet flow, no further calculations are necessary. It is therefore our opinion that this outfall is adequate.

Outfall PL23-OUT10: Looking Downstream

Outfall PL23-OUT10: Looking Downstream

Pre-Developed Outfall Map
PL23-10
I-495
Fairfax, VA

DRAINAGE AREA BOUNDARY

EXISTING CONTOURS

PL23-OUT 10
DA = 0.40 AC
C = 0.55

Prop. R/W

SCALE
0 50' 100'

Post-Developed Outfall Map
PL23-10
I-495
Fairfax, VA

DRAINAGE AREA BOUNDARY

EXISTING CONTOURS

PL23-OUT 10
DA = 0.08 AC
C = 0.30

SCALE
0 50' 100'

Name of Project:	495-NEXT			Designed By:	JS
State:	VA	**County:**	Fairfax County	Date:	03/14/22
Name of Culvert:	Pre Development			Checked By:	KB
NOAA Station:	Vienna Tysons 44-8737			Date:	03/14/22
LOCATION:	PL23-OUT 10				
				UNITS	**ENGLISH**

RATIONAL METHOD - DATA:

DRAINAGE BASIN

SUBSHED #	Land Use Description	Area Acres	C	C A
	Business: Industrial and Commercial (0.80-0.90)			
	Apartments and Townhomes (0.65-0.75)			
	Schools (0.50-0.60)			
	Residential - lots 10,000 sq. ft. (0.40-0.50)			
	- lots 12,000 sq. ft. (0.40-0.45)			
	- lots 17,000 sq. ft. (0.35-0.45)			
	- lots ½ acre or more (0.30-0.40)		0.35	
	Parks, Cemeteries and Unimproved Areas (0.20-0.35)			
	Paved and Roof Areas (0.90)	0.18	0.90	0.17
	Cultivated Areas (0.50-0.70)			
	Pasture (0.35-0.45)			
	Lawns (0.25-0.35)	0.01	0.30	0.00
	Forest (0.20-0.30)	0.20	0.25	0.05
	Steep Grass (2:1) (0.40-0.70)			
	Shoulder and Ditch Areas (0.35-0.50)			
	Totals =	**0.40 Acres**	**0.55**	**0.22**

Time of Concentration (Tc)

	Reach	Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Rational C		Tc (Minutes)
							Total Tc (Minutes) =	**5.00**

		2-Year	**5-Year**	**10-Year**	**25-Year**	**50-Year**	**100-Year**
Rainfall Intensity	Inches / Hour.	**5.18**	**6.00**	**6.76**	**7.64**	**8.28**	**8.89**
Aosorption Coefficient / Ground Saturation Correction Coefficient Cf		1.00	1.00	1.00	1.10	1.20	1.25
Peak Discharge	CFS.	**1.14**	**1.32**	**1.49**	**1.85**	**2.19**	**2.45**

Name of Project:	495-NEXT			Designed By:	JS
State:	VA	**County:**	Fairfax County	Date:	03/14/22
Name of Culvert:	Post Development			Checked By:	KB
NOAA Station:	Vienna Tysons 44-8737			Date:	03/14/22
LOCATION:	PL23-OUT 10				
				UNITS	**ENGLISH**

RATIONAL METHOD - DATA:

DRAINAGE BASIN

SUBSHED #	Land Use Description	Area Acres	C	C A
	Business: Industrial and Commercial (0.80-0.90)			
	Apartments and Townhomes (0.65-0.75)			
	Schools (0.50-0.60)			
	Residential - lots 10,000 sq. ft. (0.40-0.50)			
	- lots 12,000 sq. ft. (0.40-0.45)			
	- lots 17,000 sq. ft. (0.35-0.45)			
	- lots ½ acre or more (0.30-0.40)	0.00	0.35	
	Parks, Cemeteries and Unimproved Areas (0.20-0.35)			
	Paved and Roof Areas (0.90)	0.00	0.90	
	Cultivated Areas (0.50-0.70)			
	Pasture (0.35-0.45)			
	Lawns (0.25-0.35)	0.08	0.30	0.02
	Forest (0.20-0.30)	0.00	0.25	
	Steep Grass (2:1) (0.40-0.70)			
	Shoulder and Ditch Areas (0.35-0.50)			
	Totals =	**0.08 Acres**	**0.30**	**0.02**

Time of Concentration (Tc)

	Reach	Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Rational C		Tc (Minutes)
							Total Tc (Minutes) =	**5.00**

		2-Year	**5-Year**	**10-Year**	**25-Year**	**50-Year**	**100-Year**
Rainfall Intensity	Inches / Hour.	**5.18**	**6.00**	**6.76**	**7.64**	**8.28**	**8.89**
Aosorption Coefficient / Ground Saturation Correction Coefficient Cf		1.00	1.00	1.00	1.10	1.20	1.25
Peak Discharge	CFS.	**0.12**	**0.14**	**0.16**	**0.20**	**0.24**	**0.26**

APPENDIX C11
PL23-OUT11

Outfall PL23-OUT 11

Outfall PL23-OUT11 is an existing outfall at Old Dominion Drive 24+34 left. The outfall consists of a natural channel flowing into Scotts Run. The total watershed drainage area at this point is 3,302 acres (5.16 square miles).

In proposed conditions the project (site) area to the outfall will be 0.99 acres. The site area is conveyed through the natural channel into Scotts Run.

Drainage Area:

The drainage areas and resulting changes are summarized in the table below:

PL23-OUT 11			
Drainage Area	**Watershed Area**	**Site Area**	**% of Total Watershed**
Proposed	3302 ac	0.99 ac	0.030%

Limits of Study:

The location of the outfall is shown in the included outfall drainage map. The point of analysis is at the end of the natural channel where it meets Scotts Run.

Easement Requirements:

No additional easements are required.

Channel and Flood Protection:

Under Section 11.7.5.1 and 11.7.5.2 of the VDOT drainage manual, channel and flood protection for an outfall must be analyzed to a point where the contributing site drainage area for the outfall is less than or equal to one percent of the total watershed area at that point. Outfall PL23-OUT11 is located where the contributing site area is 0.99 acres of the total watershed (3,302 acres) at the outfall limit, which represents 0.030% of the watershed. As adequacy of all drainage structures within the limits of construction has been provided and flow has been reduced to natural conveyance systems within the outfall, no further analysis is required.

Final Opinion:

This outfall is a natural stormwater conveyance system. We have shown compliance with the channel and flood protection criteria, by analyzing the system to the 1% point, which is located at Scotts Run. As the contributing site area is less than 1% of the total watershed area, it is our opinion that this outfall is adequate.

Outfall PL23-OUT11: Looking Upstream

Outfall PL23-OUT11: Looking Downstream

Pre-Developed Outfall Map
PL23-II
I-495
Fairfax, VA

SITE AREA

EXISTING CONTOURS

PL23-OUT 11
SITE DA = 1.70 AC
WATERSHED DA = 3302 AC

SCALE
0 200' 400'

Post-Developed Outfall Map
PL23-II
I-495
Fairfax, VA

SITE AREA

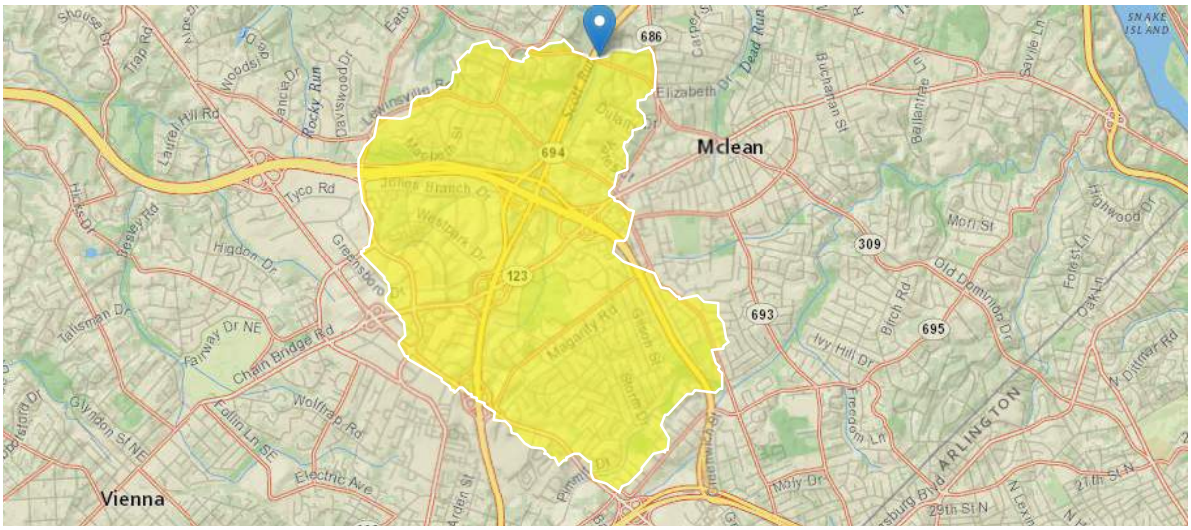
EXISTING CONTOURS

PL23-OUT 11
SITE DA = 0.99 AC
WATERSHED DA = 3302 AC

SCALE
0 100' 200'

StreamStats Report

Region ID: VA
Workspace ID: VA20210910201852434000
Clicked Point (Latitude, Longitude): 38.94571, -77.20174
Time: 2021-09-10 16:19:12 -0400



Basin Characteristics

Parameter Code	Parameter Description	Value	Unit
DRNAREA	Area that drains to a point on a stream	5.16	square miles

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Application Version: 4.6.2
StreamStats Services Version: 1.2.22
NSS Services Version: 2.1.2

APPENDIX C12
PL23-OUT12

Outfall PL23-OUT 12

Outfall PL23-OUT12 is an existing outfall at I-495 NB station 614+79 right. In existing conditions, the outfall collects runoff from northbound I-495. The drainage area to the outfall prior to development is 3.34 acres.

Development of this area will result in a reduced area to this outfall, due to additional drainage structures and re-routing of flow. The outfall in proposed conditions consists of uncontrolled sheet flow. The resulting drainage area to the outfall will be 0.07 acres.

Drainage Area:

The drainage areas and resulting changes are summarized in the table below:

PL23-OUT 12			
Drainage Area	**Total Area**	**C (Total)**	**Tc**
Existing	3.34 ac	0.85	10.31 min
Proposed	0.07 ac	0.36	5.00 min

Limits of Study:

The location of the outfall is shown in the included outfall drainage map. The point of analysis is at the site limits.

Easement Requirements:

No additional easements are required.

Outfall Discharge:

All discharges were calculated using the Rational Method and are summarized below:

PL23-OUT 12		
Drainage Area	**Peak Flow Rate (Total)**	
	2 Year	10 Year
Existing	11.70 cfs	15.45 cfs
Proposed	0.12 cfs	0.16 cfs
Net Change	**-11.58 cfs**	**-15.29 cfs**

Final Opinion:

Area of increased volume of sheet flow must be identified and evaluated for potential impacts. As this outfall demonstrates a decreased volume of sheet flow, no further calculations are necessary. It is therefore our opinion that this outfall is adequate.

Outfall PL23-OUT12: Looking Downstream into Scott Run

Outfall PL23-OUT12: Outfall Point

Pre-Developed Outfall Map
PL23-12
I-495
Fairfax, VA

DRAINAGE AREA BOUNDARY

EXISTING CONTOURS

TIME OF CONCENTRATION

PL23-OUT 12
DA = 3.34 AC
C = 0.85

A

B

C

D

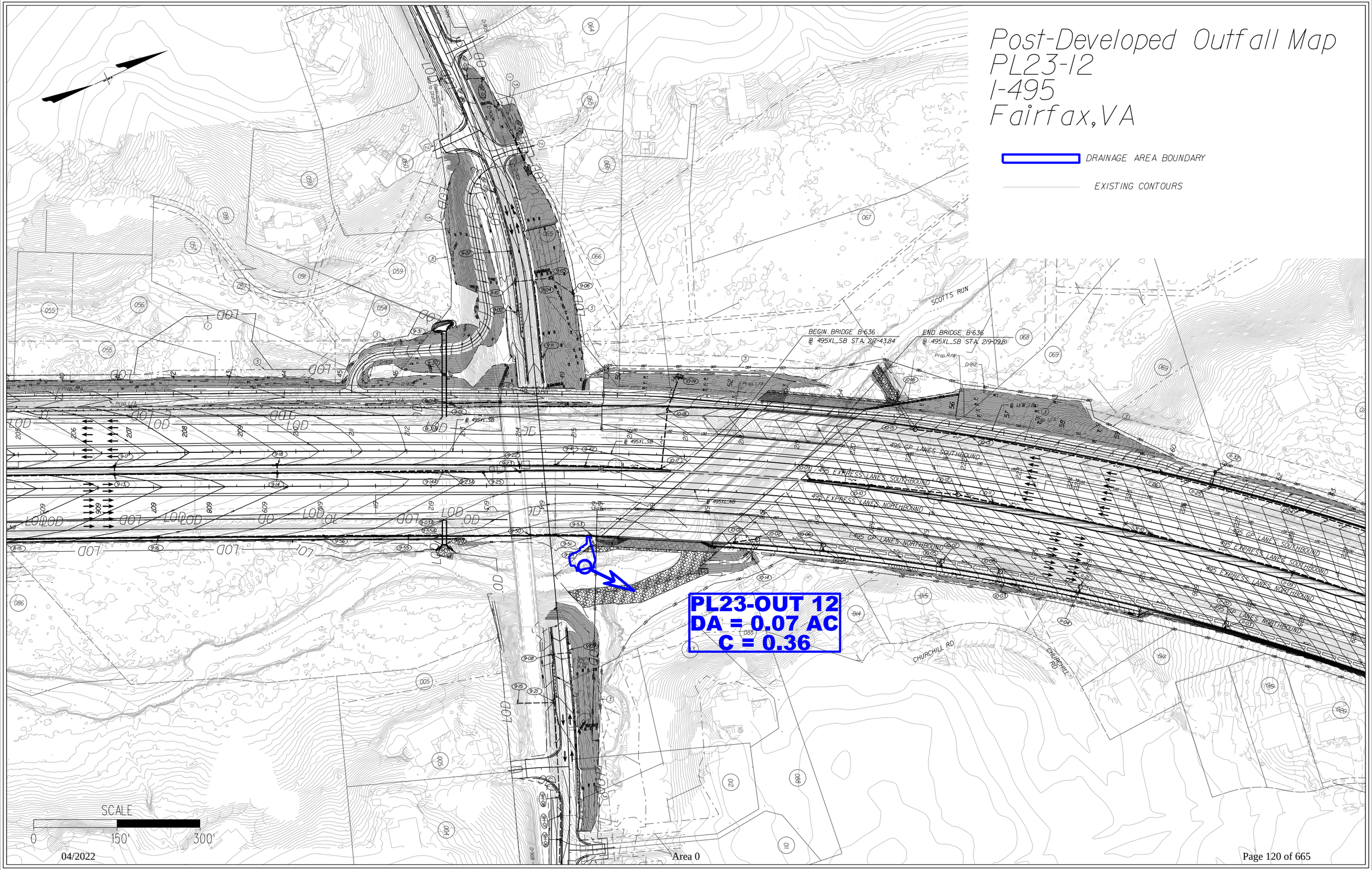
E

SCALE
0 150' 300'

Post-Developed Outfall Map
PL23-12
I-495
Fairfax, VA

DRAINAGE AREA BOUNDARY

EXISTING CONTOURS



Name of Project:	495-NEXT			Designed By:	CT
State:	VA	**County:**	Fairfax County	Date:	03/14/22
Name of Culvert:	Pre Development			Checked By:	KB
NOAA Station:	Vienna Tysons 44-8737			Date:	03/14/22
LOCATION:	PL23-OUT 12				
				UNITS	**ENGLISH**

RATIONAL METHOD - DATA:

DRAINAGE BASIN

SUBSHED #	Land Use Description	Onsite Area Acres	Area Acres	C	C A
	Business: Industrial and Commercial (0.80-0.90)				
	Apartments and Townhomes (0.65-0.75)				
	Schools (0.50-0.60)				
	Residential - lots 10,000 sq. ft. (0.40-0.50)				
	- lots 12,000 sq. ft. (0.40-0.45)				
	- lots 17,000 sq. ft. (0.35-0.45)				
	- lots ½ acre or more (0.30-0.40)			0.35	
	Parks, Cemeteries and Unimproved Areas (0.20-0.35)				
	Paved and Roof Areas (0.90)	0.13	3.09	0.90	2.78
	Cultivated Areas (0.50-0.70)				
	Pasture (0.35-0.45)				
	Lawns (0.25-0.35)	0.23	0.23	0.30	0.07
	Forest (0.20-0.30)	0.02	0.02	0.25	0.01
	Steep Grass (2:1) (0.40-0.70)				
	Shoulder and Ditch Areas (0.35-0.50)				
	Totals =	**0.38**	**3.34**	**7.56**	**2.86**

Time of Concentration (Tc)

		Reach	Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Rational C		Tc (Minutes)
Overland Flow (E.E. Seelye - VDOT Modified)									
	Soil / Surface Type/Land Cover		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Rational C		
	Paved	A-B	165.91	269.50	264.55	0.030	0.90		4.17
Shallow Concentrated Flow			Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Intercept Coeff.		
Paved		B-C	1067.25	264.55	240.67	0.022	0.619		5.86
Pipe Flow			Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Ex232 to 230		C-D	104.42	233.71	230.51	0.031	0.013	12.61	0.14
	Pipe Diameter (in) =		24	Area =	3.14		Wetted P =	6.28	
Channel Flow			Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Grass ditch		D-E	46.81	230.51	228.80	0.037	0.050	5.47	0.14
				Area =	12.00		Wetted P =	12.70	
								Total Tc (Minutes) =	**10.31**

		2-Year	**5-Year**	**10-Year**	**25-Year**	**50-Year**	**100-Year**
Rainfall Intensity	Inches / Hour.	**4.10**	**4.78**	**5.41**	**6.14**	**6.66**	**7.15**
Aosorption Coefficient / Ground Saturation Correction Coefficient Cf		1.00	1.00	1.00	1.10	1.20	1.25
Peak Discharge	CFS.	**11.70**	**13.65**	**15.45**	**19.27**	**22.82**	**25.52**

Name of Project:	495-NEXT			Designed By:	CT
State:	VA	**County:**	Fairfax County	Date:	03/14/22
Name of Culvert:	Post Development			Checked By:	KB
NOAA Station:	Vienna Tysons 44-8737			Date:	03/14/22
LOCATION:	PL23-OUT 12				
				UNITS	**ENGLISH**

RATIONAL METHOD - DATA:

DRAINAGE BASIN

SUBSHED #	Land Use Description	Onsite Area Acres	Total Area Acres	C	C A
	Business: Industrial and Commercial (0.80-0.90)				
	Apartments and Townhomes (0.65-0.75)				
	Schools (0.50-0.60)				
	Residential - lots 10,000 sq. ft. (0.40-0.50)				
	- lots 12,000 sq. ft. (0.40-0.45)				
	- lots 17,000 sq. ft. (0.35-0.45)				
	- lots ½ acre or more (0.30-0.40)	0.00		0.35	
	Parks, Cemeteries and Unimproved Areas (0.20-0.35)				
	Paved and Roof Areas (0.90)	0.02	0.03	0.90	0.02
	Cultivated Areas (0.50-0.70)				
	Pasture (0.35-0.45)				
	Lawns (0.25-0.35)	0.01	0.01	0.30	0.00
	Forest (0.20-0.30)	0.00		0.25	
	Steep Grass (2:1) (0.40-0.70)				
	Shoulder and Ditch Areas (0.35-0.50)				
	Totals =	**0.07**	**Acres**	**0.36**	**0.02**

Time of Concentration (Tc)

		Reach	Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Rational C		Tc (Minutes)
Overland Flow (E.E. Seelye - VDOT Modified)									
	Soil / Surface Type/Land Cover		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Rational C		
	Paved	A-B	0.00	249.65	242.45		0.90		0.00
Shallow Concentrated Flow			Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Intercept Coeff.		
Paved		B-C	0.00	242.45	239.40		0.619		0.00
Pipe Flow			Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
8-53 to 8-54		C-D	0.00	231.19	231.00		0.013	0.00	0.00
	Pipe Diameter (in) =		24	Area =	3.14		Wetted P =	6.28	
Channel Flow			Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Rip rap		D-E	0.00	231.00	225.00		0.072	0.00	0.00
				Area =	12.00		Wetted P =	12.70	
								Total Tc (Minutes) =	**5.00**

		2-Year	5-Year	10-Year	25-Year	50-Year	100-Year
Rainfall Intensity	Inches / Hour.	**5.18**	**6.00**	**6.76**	**7.64**	**8.28**	**8.89**
Aosorption Coefficient / Ground Saturation Correction Coefficient	Cf	1.00	1.00	1.00	1.10	1.20	1.25
Peak Discharge	CFS.	**0.12**	**0.14**	**0.16**	**0.20**	**0.24**	**0.27**

Site Contributing Drainage Area to Outfall: 0.07 acres

Total (Watershed) Drainage Area to Outfall: 3309 acres

Site Percentage of Total (Watershed) Drainage Area: **0.002%**

APPENDIX C13
PL23-OUT13

Outfall PL23-OUT 13

Outfall PL23-OUT13 is an existing outfall at I-495 NB station 614+62 right. In existing conditions, the outfall sheet flows into Scott's Run. The drainage area to the outfall prior to development is 0.07 acres.

Development of this area will result in a reduced area to this outfall, due to the shifting alignment of the Old Dominion Drive bridge. The outfall in proposed conditions consists of uncontrolled sheet flow. The resulting drainage area to the outfall will be 0.02 acres.

Drainage Area:

The drainage areas and resulting changes are summarized in the table below:

PL23-OUT 13			
Drainage Area	**Total Area**	**C (Total)**	**Tc**
Existing	0.07 ac	0.28	5.00 min
Proposed	0.02 ac	0.48	5.00 min

Limits of Study:

The location of the outfall is shown in the included outfall drainage map. The point of analysis is at the site limits.

Easement Requirements:

No additional easements are required.

Outfall Discharge:

All discharges were calculated using the Rational Method and are summarized below:

PL23-OUT 13		
Drainage Area	**Peak Flow Rate (Total)**	
	2 Year	10 Year
Existing	0.10 cfs	0.13 cfs
Proposed	0.05 cfs	0.07 cfs
Net Change	**-0.05 cfs**	**-0.06 cfs**

Final Opinion:

Area of increased volume of sheet flow must be identified and evaluated for potential impacts. As this outfall demonstrates a decreased volume of sheet flow, no further calculations are necessary. It is therefore our opinion that this outfall is adequate.

Outfall PL23-OUT13: Outfall Point

Pre-Developed Outfall Map
PL23-13
I-495
Fairfax, VA

DRAINAGE AREA BOUNDARY

EXISTING CONTOURS

PL23-OUT 13
DA = 0.07 AC
C = 0.28

SCALE
0 50' 100'

Post-Developed Outfall Map
PL23-13
I-495
Fairfax, VA

DRAINAGE AREA BOUNDARY

EXISTING CONTOURS

PL23-OUT 13
DA = 0.02 AC
C = 0.48

SCALE
0 50' 100'

Name of Project:	495-NEXT			Designed By:	JS
State:	VA	**County:**	Fairfax County	Date:	03/14/22
Name of Culvert:	Pre Development			Checked By:	KB
NOAA Station:	Vienna Tysons 44-8737			Date:	03/14/22
LOCATION:	PL23-OUT 13				
				UNITS	**ENGLISH**

RATIONAL METHOD - DATA:

DRAINAGE BASIN

SUBSHED #	Land Use Description	Area Acres	C	C A
	Business: Industrial and Commercial (0.80-0.90)			
	Apartments and Townhomes (0.65-0.75)			
	Schools (0.50-0.60)			
	Residential - lots 10,000 sq. ft. (0.40-0.50)			
	- lots 12,000 sq. ft. (0.40-0.45)			
	- lots 17,000 sq. ft. (0.35-0.45)			
	- lots ½ acre or more (0.30-0.40)		0.35	
	Parks, Cemeteries and Unimproved Areas (0.20-0.35)			
	Paved and Roof Areas (0.90)		0.90	
	Cultivated Areas (0.50-0.70)			
	Pasture (0.35-0.45)			
	Lawns (0.25-0.35)	0.04	0.30	0.01
	Forest (0.20-0.30)	0.03	0.25	0.01
	Steep Grass (2:1) (0.40-0.70)			
	Shoulder and Ditch Areas (0.35-0.50)			
	Totals =	**0.07 Acres**	**0.28**	**0.02**

Time of Concentration (Tc)

	Reach	Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Rational C		Tc (Minutes)
							Total Tc (Minutes) =	**5.00**

		2-Year	**5-Year**	**10-Year**	**25-Year**	**50-Year**	**100-Year**
Rainfall Intensity	Inches / Hour.	**5.18**	**6.00**	**6.76**	**7.64**	**8.28**	**8.89**
Aosorption Coefficient / Ground Saturation Correction Coefficient Cf		1.00	1.00	1.00	1.10	1.20	1.25
Peak Discharge	CFS.	**0.10**	**0.11**	**0.13**	**0.16**	**0.19**	**0.21**

Name of Project:	495-NEXT			Designed By:	CT
State:	VA	**County:**	Fairfax County	Date:	03/14/22
Name of Culvert:	Post Development			Checked By:	KB
NOAA Station:	Vienna Tysons 44-8737			Date:	03/14/22
LOCATION:	PL23-OUT 13				
				UNITS	**ENGLISH**

RATIONAL METHOD - DATA:

DRAINAGE BASIN

SUBSHED #	Land Use Description	Area Acres	C	C A
	Business: Industrial and Commercial (0.80-0.90)			
	Apartments and Townhomes (0.65-0.75)			
	Schools (0.50-0.60)			
	Residential - lots 10,000 sq. ft. (0.40-0.50)			
	- lots 12,000 sq. ft. (0.40-0.45)			
	- lots 17,000 sq. ft. (0.35-0.45)			
	- lots ½ acre or more (0.30-0.40)	0.00	0.35	
	Parks, Cemeteries and Unimproved Areas (0.20-0.35)			
	Paved and Roof Areas (0.90)	0.01	0.90	0.01
	Cultivated Areas (0.50-0.70)			
	Pasture (0.35-0.45)			
	Lawns (0.25-0.35)	0.01	0.30	0.00
	Forest (0.20-0.30)	0.00	0.25	
	Steep Grass (2:1) (0.40-0.70)			
	Shoulder and Ditch Areas (0.35-0.50)			
	Totals =	**0.02 Acres**	**0.48**	**0.01**

Time of Concentration (Tc)

	Reach	Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Rational C		Tc (Minutes)
							Total Tc (Minutes) =	**5.00**

		2-Year	**5-Year**	**10-Year**	**25-Year**	**50-Year**	**100-Year**
Rainfall Intensity	Inches / Hour.	**5.18**	**6.00**	**6.76**	**7.64**	**8.28**	**8.89**
Aosorption Coefficient / Ground Saturation Correction Coefficient Cf		1.00	1.00	1.00	1.10	1.20	1.25
Peak Discharge	CFS.	**0.05**	**0.06**	**0.07**	**0.09**	**0.10**	**0.11**

APPENDIX C14
PL23-OUT14

Outfall PL23-OUT 14

Outfall PL23-OUT14 is an existing outfall at Interstate 495 NB station 615+41 right. The outfall in existing conditions contains a small area flowing into Scotts Run. The total watershed drainage area at this outfall point is 3,302 acres (5.16 square miles).

In proposed conditions the project (site) area to the outfall will be 0.69 acres. The site area is conveyed by a proposed storm sewer system to Scotts Run.

Drainage Area:

The drainage areas and resulting changes are summarized in the table below:

PL23-OUT 14			
Drainage Area	**Watershed Area**	**Site Area**	**% of Total Watershed**
Proposed	3302 ac	0.69 ac	0.021%

Limits of Study:

The location of the outfall is shown in the included outfall drainage map. The point of analysis is at the storm sewer outfall where it meets Scotts Run.

Easement Requirements:

No additional easements are required.

Channel and Flood Protection:

Under Section 11.7.5.1 and 11.7.5.2 of the VDOT drainage manual, channel and flood protection for an outfall must be analyzed to a point where the contributing site drainage area for the outfall is less than or equal to one percent of the total watershed area at that point. Outfall PL23-OUT14 is located where the contributing site area is 0.69 acres of the total watershed (2,797 acres) at the outfall limit, which represents 0.021% of the watershed. As adequacy of all drainage structures within the limits of construction has been provided, and these structures outfall directly into Scott's Run, no further analysis is required.

Final Opinion:

This outfall is a natural stormwater conveyance system. We have shown compliance with the channel and flood protection criteria, by analyzing the system to the 1% point, which is located at Scotts Run. As the contributing site area is less than 1% of the total watershed area, it is our opinion that this outfall is adequate.

Outfall PL23-OUT14: Outfall Point

Outfall PL23-OUT14: Looking Downstream

Pre-Developed Outfall Map
PL23-14
I-495
Fairfax, VA

EXISTING CONTOURS

SITE AREA

PL23-OUT 14
SITE DA = 0.15 AC
WATERSHED DA = 3,302 AC

SCALE
0 25' 50'

Post-Developed Outfall Map
PL23-14
I-495
Fairfax, VA

EXISTING CONTOURS

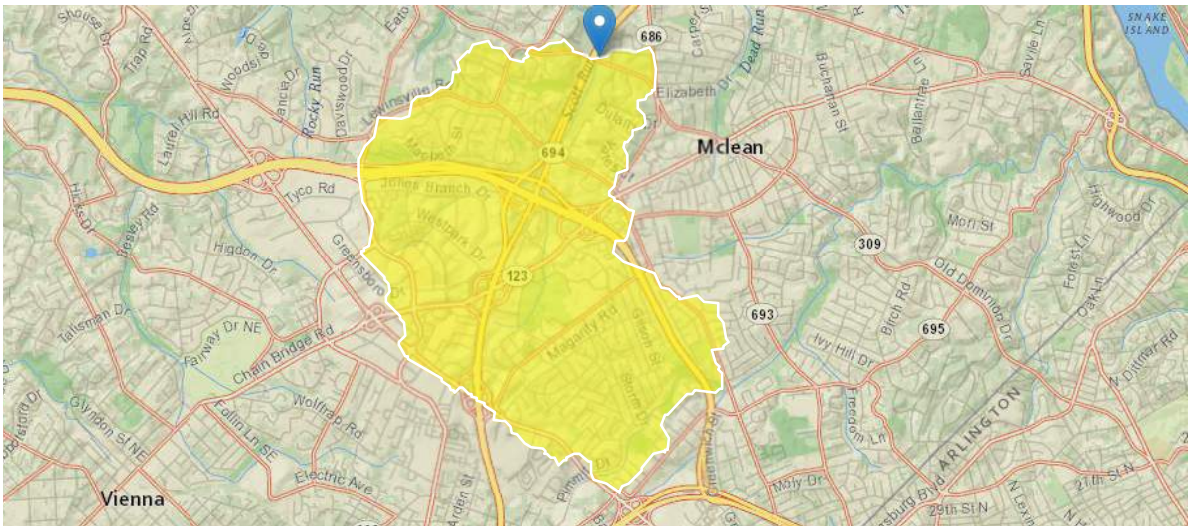
SITE AREA

PL23-OUT 14
SITE DA = 0.69 AC
WATERSHED DA = 3,302 AC

SCALE
0 50' 100

StreamStats Report

Region ID: VA
Workspace ID: VA20210910201852434000
Clicked Point (Latitude, Longitude): 38.94571, -77.20174
Time: 2021-09-10 16:19:12 -0400



Basin Characteristics

Parameter Code	Parameter Description	Value	Unit
DRNAREA	Area that drains to a point on a stream	5.16	square miles

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Application Version: 4.6.2
StreamStats Services Version: 1.2.22
NSS Services Version: 2.1.2

APPENDIX C15
PL23-OUT15

Outfall PL23-OUT 15

Outfall PL23-OUT15 is an existing outfall at Interstate 495 SB station 218+93 left. The outfall consists of a natural stormwater conveyance system. In existing conditions, flow is conveyed through existing culverts and natural channels to the point of analysis. The total watershed drainage area at this outfall point is 3,366 acres (5.26 square miles).

In proposed conditions the project (site) area to the outfall will be 2.61 acres. The site area is conveyed by the existing culverts and natural channels, as well as manmade ditches formed by the proposed grading.

Drainage Area:

The drainage areas and resulting changes are summarized in the table below:

PL23-OUT 15			
Drainage Area	**Watershed Area**	**Site Area**	**% of Total Watershed**
Proposed	3366 ac	2.61 ac	0.078%

Limits of Study:

The location of the outfall is shown in the included outfall drainage map. The point of analysis is where the conveyance ditch outfalls into Scott's Run.

Easement Requirements:

No additional easements are required.

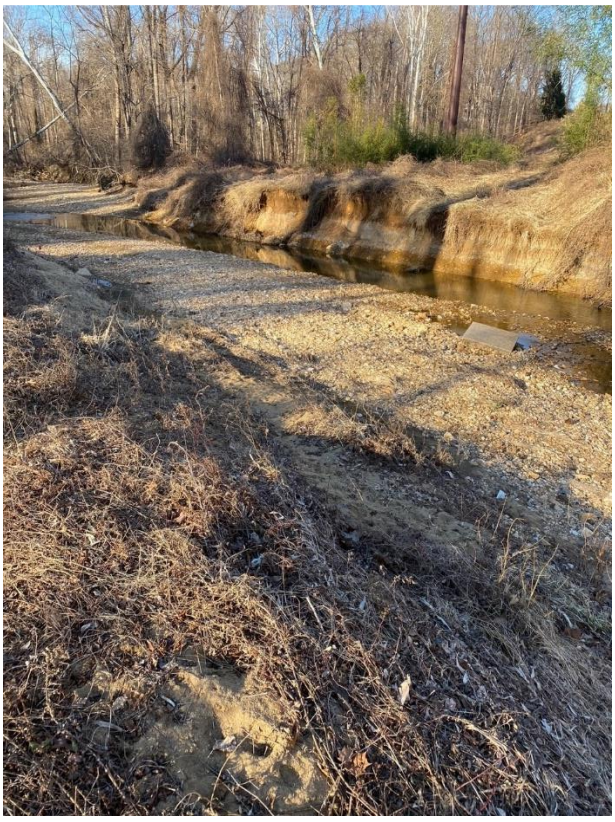
Channel and Flood Protection:

Under Section 11.7.5.1 and 11.7.5.2 of the VDOT drainage manual, channel and flood protection for an outfall must be analyzed to a point where the contributing site drainage area for the outfall is less than or equal to one percent of the total watershed area at that point. Outfall PL23-OUT15 is located where the contributing site area is 2.73 acres of the total watershed (3,366 acres) at the outfall limit, which represents 0.081% of the watershed. As adequacy of all drainage structures and conveyance within the limits of construction has been provided, no further analysis is required.

Final Opinion:

This outfall is a natural stormwater conveyance system. We have shown compliance with the channel and flood protection criteria, by analyzing the system to the 1% point, which is located at Scotts Run. As the contributing site area is less than 1% of the total watershed area, it is our opinion that this outfall is adequate.

Outfall PL23-OUT15: Looking Upstream



Outfall PL23-OUT15: Looking Downstream

Outfall PL23-OUT15: Looking Upstream between existing TC nodes L&M

Pre-Developed Outfall Map
PL23-15
I-495
Fairfax, VA

EXISTING CONTOURS

SITE AREA

PL23-OUT 15
SITE DA = 2.20 AC
WATERSHED DA = 3366 AC

SCALE
0 150' 300'

Post-Developed Outfall Map
PL23-15
I-495
Fairfax, VA

EXISTING CONTOURS

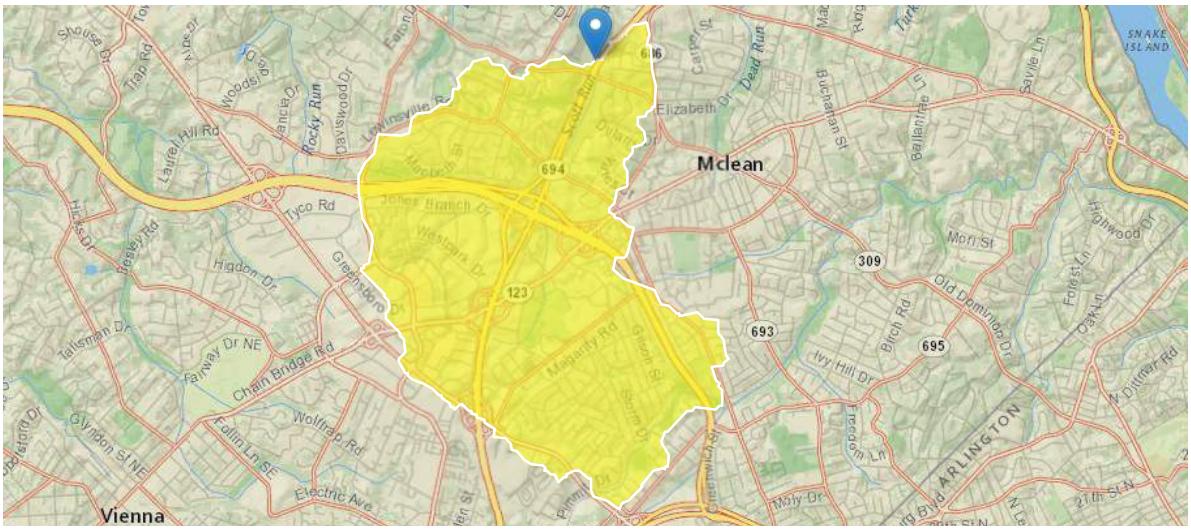
SITE AREA

PL23-OUT 15
SITE DA = 2.61 AC
WATERSHED DA = 3366 AC

SCALE
0 150' 300'

StreamStats Report

Region ID: VA
Workspace ID: VA20210910202449495000
Clicked Point (Latitude, Longitude): 38.94701, -77.20215
Time: 2021-09-10 16:25:09 -0400



Basin Characteristics

Parameter Code	Parameter Description	Value	Unit
DRNAREA	Area that drains to a point on a stream	5.26	square miles

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Application Version: 4.6.2
StreamStats Services Version: 1.2.22
NSS Services Version: 2.1.2

APPENDIX C16
PL23-OUT16

Outfall PL23-OUT 16

Outfall PL23-OUT16 is an existing outfall at Interstate 495 station 617+11 right. The outfall consists of a natural channel flowing into Scotts Run. In existing conditions, the channel receives 0.82 acres of project (site) area. The total watershed drainage area at this outfall point is 3,309 acres (5.17 square miles).

Development of this area will result in an increased area to this outfall, due to the proposed grading, installation of a storm sewer system and roadway design. The resulting project (site) area to the outfall will be 4.61 acres.

Drainage Area:

The drainage areas and resulting changes are summarized in the table below:

PL23-OUT 16				
Drainage Area	**Watershed Area**	**Site Area**	**C (Site)**	**% of Total Watershed**
Existing	3309 ac	0.82 ac	0.27	0.025%
Proposed	3309 ac	4.61 ac	0.67	0.139%

Limits of Study:

The location of the outfall is shown in the included outfall drainage map. The point of analysis is at the end of the natural channel where it meets Scotts Run.

Easement Requirements:

No additional easements are required.

Channel and Flood Protection:

Under Section 11.7.5.1 and 11.7.5.2 of the VDOT drainage manual, channel and flood protection for an outfall must be analyzed to a point where the contributing site drainage area for the outfall is less than or equal to one percent of the total watershed area at that point. Outfall PL23-OUT16 is located where the contributing site area is 4.61 acres of the total watershed (3,309 acres) at the outfall limit, which represents 0.139% of the watershed. As adequacy of all drainage structures within the limits of construction has been provided, no further analysis is required.

Final Opinion:

This outfall is a natural stormwater conveyance system. We have shown compliance with the channel and flood protection criteria, by analyzing the system to the 1% point, which is located at Scotts Run. As the contributing site area is less than 1% of the total watershed area, it is our opinion that this outfall is adequate.

Pre-Developed Outfall Map
PL23-16
I-495
Fairfax, VA

EXISTING CONTOURS

SITE AREA

PL23-OUT 16
SITE DA = 0.82 AC
WATERSHED DA = 3,309 AC

SCALE
0 250' 500'

Post-Developed Outfall Map
PL23-16
I-495
Fairfax, VA

EXISTING CONTOURS

SITE AREA

PL23-OUT 16
SITE DA = 4.61 AC
WATERSHED DA = 3,309 AC

SCALE
0 250' 500'

Name of Project:	495-NEXT			Designed By:	KRI
State:	VA	**County:**	Fairfax County	Date:	03/07/22
Name of Culvert:	Pre Development			Checked By:	NVD
NOAA Station:	Vienna Tysons 44-8737			Date:	03/07/22
LOCATION:	PL23-OUT 16				
				UNITS	**ENGLISH**

RATIONAL METHOD - DATA:

DRAINAGE BASIN

SUBSHED #	Land Use Description	Onsite Area Acres	C	C A
	Business: Industrial and Commercial (0.80-0.90)			
	Apartments and Townhomes (0.65-0.75)			
	Schools (0.50-0.60)			
	Residential - lots 10,000 sq. ft. (0.40-0.50)			
	- lots 12,000 sq. ft. (0.40-0.45)			
	- lots 17,000 sq. ft. (0.35-0.45)			
	- lots ½ acre or more (0.30-0.40)			
	Parks, Cemeteries and Unimproved Areas (0.20-0.35)			
	Paved and Roof Areas (0.90)	0.01	0.90	0.01
	Cultivated Areas (0.50-0.70)			
	Pasture (0.35-0.45)			
	Lawns (0.25-0.35)	0.24	0.30	0.07
	Forest (0.20-0.30)	0.57	0.25	0.14
	Steep Grass (2:1) (0.40-0.70)			
	Shoulder and Ditch Areas (0.35-0.50)			
	Totals =	**0.82 Ac.**	**0.27**	**0.22**

Site Contributing Drainage Area to Outfall:	0.82	acres
Total (Watershed) Drainage Area to Outfall:	3309	acres
Site Percentage of Total (Watershed) Drainage Area:	**0.025%**	

Name of Project:	495-NEXT			Designed By:	JMON
State:	VA	**County:**	Fairfax County	Date:	03/07/22
Name of Culvert:	Post Development			Checked By:	NVD
NOAA Station:	Vienna Tysons 44-8737			Date:	03/07/22
LOCATION:	PL23-OUT 16				
				UNITS	**ENGLISH**

RATIONAL METHOD - DATA:

		DRAINAGE BASIN		
SUBSHED #	Land Use Description	Onsite Area Acres	C	C A
	Business: Industrial and Commercial (0.80-0.90)			
	Apartments and Townhomes (0.65-0.75)			
	Schools (0.50-0.60)			
	Residential - lots 10,000 sq. ft. (0.40-0.50)			
	- lots 12,000 sq. ft. (0.40-0.45)			
	- lots 17,000 sq. ft. (0.35-0.45)			
	- lots ½ acre or more (0.30-0.40)	0.06	0.35	0.02
	Parks, Cemeteries and Unimproved Areas (0.20-0.35)			
	Paved and Roof Areas (0.90)	2.86	0.90	2.58
	Cultivated Areas (0.50-0.70)			
	Pasture (0.35-0.45)			
	Lawns (0.25-0.35)	1.68	0.30	0.51
	Forest (0.20-0.30)	0.00	0.25	
	Steep Grass (2:1) (0.40-0.70)			
	Shoulder and Ditch Areas (0.35-0.50)			
	Totals =	**4.61 Ac.**	**0.67**	**3.10**

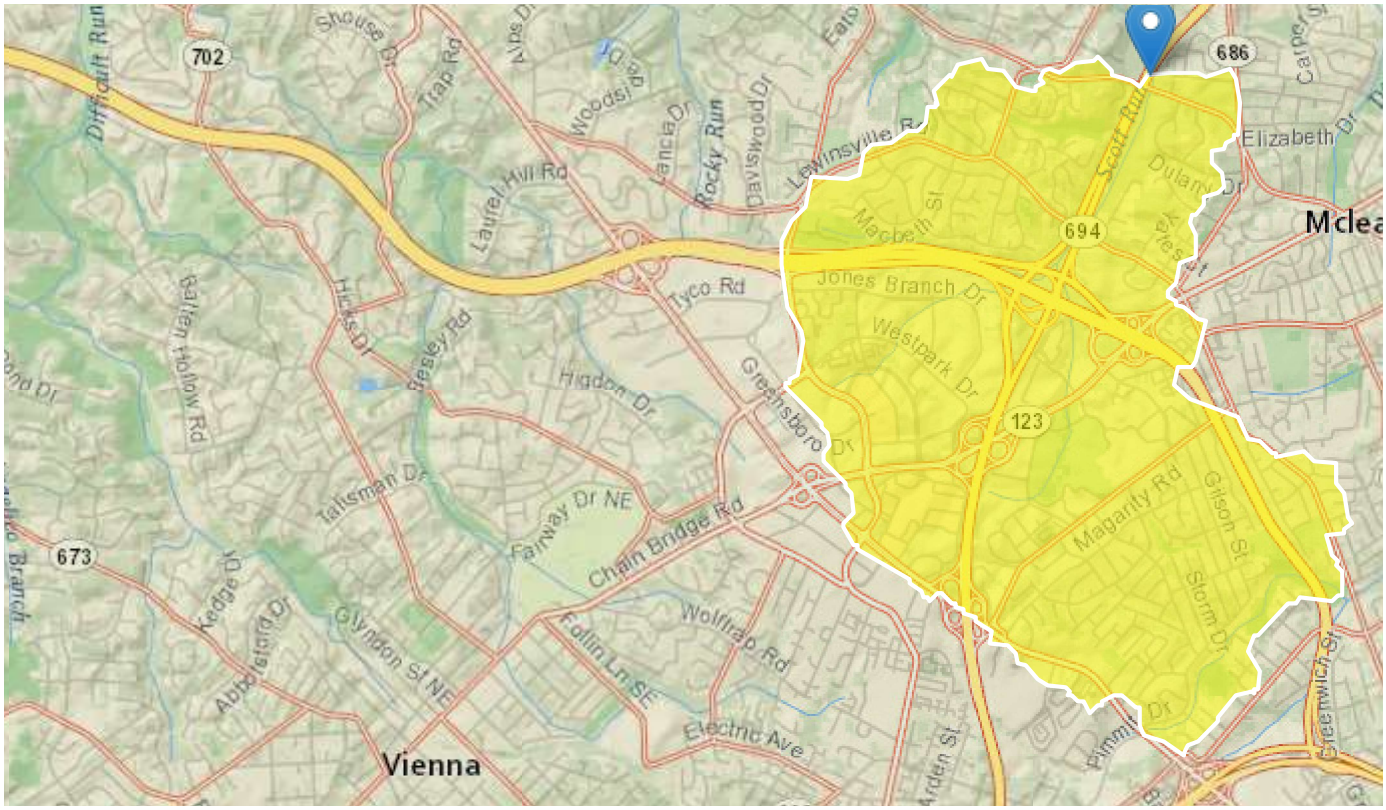
Site Contributing Drainage Area to Outfall: 4.61 acres

Total (Watershed) Drainage Area to Outfall: 3309 acres

Site Percentage of Total (Watershed) Drainage Area: **0.139%**

StreamStats Report

Region ID: VA
Workspace ID: VA20210818171243766000
Clicked Point (Latitude, Longitude): 38.94626, -77.20194
Time: 2021-08-18 13:13:04 -0400



Basin Characteristics

Parameter Code	Parameter Description	Value	Unit
DRNAREA	Area that drains to a point on a stream	5.17	square miles

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Application Version: 4.6.2
StreamStats Services Version: 1.2.22
NSS Services Version: 2.1.2

APPENDIX C17
PL23-OUT17

Outfall PL23-OUT 17

Outfall PL23-OUT17 is an existing outfall at I-495 SB station 217+86 left. The outfall consists of sheet flow runoff flowing away from the roadway and into Scott's Run. In existing conditions, the channel receives approximately 0.62 acres of drainage.

Development of this area will result in this outfall being eliminated, due to the proposed roadway and drainage design. The drainage associated with this outfall will be conveyed to outfall PL23-OUT15. The resulting area to the outfall will be 0.00 acres.

Drainage Area:

The drainage areas and resulting changes are summarized in the table below:

PL23-OUT 17			
Drainage Area	**Total Area**	**C (Total)**	**Tc**
Existing	0.62 ac	0.26	5.00 min
Proposed	0.00 ac	0.00	5.00 min

Limits of Study:

The location of the outfall is shown in the included outfall drainage map. It has been removed in proposed conditions.

Easement Requirements:

No additional easements are required.

Outfall Discharge:

All discharges were calculated using the Rational Method and are summarized below:

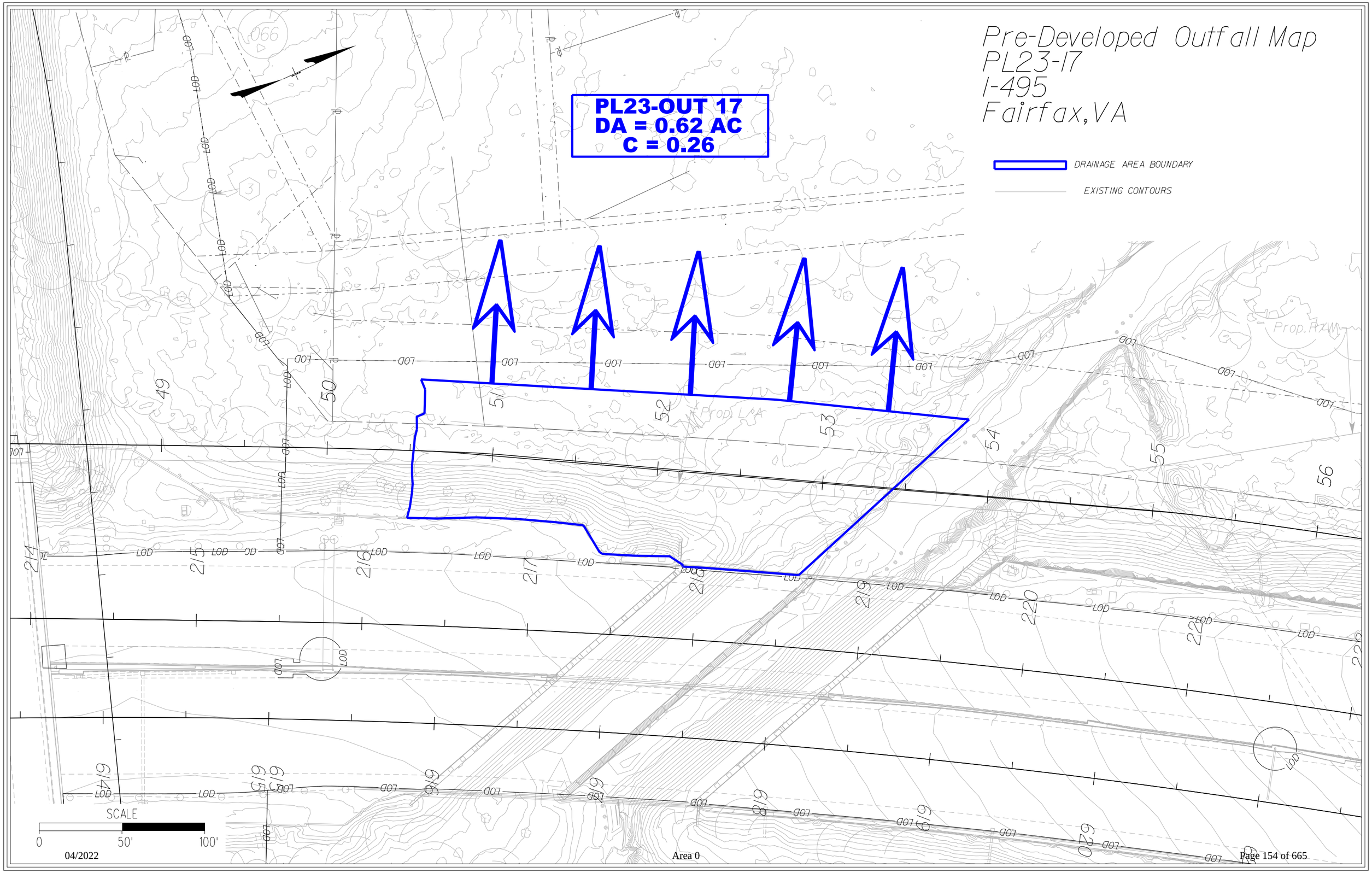
PL23-OUT 17		
Drainage Area	**Peak Flow Rate (Total)**	
	2 Year	10 Year
Existing	0.84 cfs	1.09 cfs
Proposed	0.00 cfs	0.00 cfs
Net Change	**-0.84 cfs**	**-1.09 cfs**

Final Opinion:

Area of increased volume of sheet flow must be identified and evaluated for potential impacts. Since we have demonstrated that the outfall will be eliminated in the post-development condition, it is therefore our opinion that this outfall is adequate.

Outfall PL23-OUT17: Looking Upstream

Outfall PL23-OUT17: Looking Downstream toward Scott's Run


Pre-Developed Outfall Map
PL23-17
I-495
Fairfax, VA
PL23-OUT 17
DA = 0.62 AC
C = 0.26
DRAINAGE AREA BOUNDARY
EXISTING CONTOURS
SCALE
0
50'
100'

Name of Project:	495-NEXT			Designed By:	CT
State:	VA	**County:**	Fairfax County	Date:	03/14/22
Name of Culvert:	Pre Development			Checked By:	KB
NOAA Station:	Vienna Tysons 44-8737			Date:	03/14/22
LOCATION:	PL23-OUT 17				
				UNITS	**ENGLISH**

RATIONAL METHOD - DATA:

DRAINAGE BASIN

SUBSHED #	Land Use Description	Area Acres	C	C A
	Business: Industrial and Commercial (0.80-0.90)			
	Apartments and Townhomes (0.65-0.75)			
	Schools (0.50-0.60)			
	Residential - lots 10,000 sq. ft. (0.40-0.50)			
	- lots 12,000 sq. ft. (0.40-0.45)			
	- lots 17,000 sq. ft. (0.35-0.45)			
	- lots ½ acre or more (0.30-0.40)		0.35	
	Parks, Cemeteries and Unimproved Areas (0.20-0.35)			
	Paved and Roof Areas (0.90)	0.00	0.90	0.00
	Cultivated Areas (0.50-0.70)			
	Pasture (0.35-0.45)			
	Lawns (0.25-0.35)	0.10	0.30	0.03
	Forest (0.20-0.30)	0.51	0.25	0.13
	Steep Grass (2:1) (0.40-0.70)			
	Shoulder and Ditch Areas (0.35-0.50)			
	Totals =	**0.62 Acres**	**0.26**	**0.16**

Time of Concentration (Tc)

	Reach	Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Rational C		Tc (Minutes)
							Total Tc (Minutes) =	**5.00**

		2-Year	**5-Year**	**10-Year**	**25-Year**	**50-Year**	**100-Year**
Rainfall Intensity	Inches / Hour.	**5.18**	**6.00**	**6.76**	**7.64**	**8.28**	**8.89**
Aosorption Coefficient / Ground Saturation Correction Coefficient Cf		1.00	1.00	1.00	1.10	1.20	1.25
Peak Discharge	CFS.	**0.84**	**0.97**	**1.09**	**1.36**	**1.60**	**1.79**

Name of Project:	495-NEXT			Designed By:	JS
State:	VA	**County:**	Fairfax County	Date:	03/14/22
Name of Culvert:	Post Development			Checked By:	KB
NOAA Station:	Vienna Tysons 44-8737			Date:	03/14/22
LOCATION:	PL23-OUT 17				
				UNITS	**ENGLISH**

RATIONAL METHOD - DATA:

DRAINAGE BASIN

SUBSHED #	Land Use Description	Onsite Area Acres	Total Area Acres	Total C	Total C A
	Business: Industrial and Commercial (0.80-0.90)				
	Apartments and Townhomes (0.65-0.75)				
	Schools (0.50-0.60)				
	Residential - lots 10,000 sq. ft. (0.40-0.50)				
	- lots 12,000 sq. ft. (0.40-0.45)				
	- lots 17,000 sq. ft. (0.35-0.45)				
	- lots ½ acre or more (0.30-0.40)			0.35	
	Parks, Cemeteries and Unimproved Areas (0.20-0.35)				
	Paved and Roof Areas (0.90)			0.90	
	Cultivated Areas (0.50-0.70)				
	Pasture (0.35-0.45)				
	Lawns (0.25-0.35)			0.30	
	Forest (0.20-0.30)			0.25	
	Steep Grass (2:1) (0.40-0.70)				
	Shoulder and Ditch Areas (0.35-0.50)				
	Totals =	**0.00 Ac.**	**0.00 Ac.**	**0.00**	**0.00**

Site Contributing Drainage Area to Outfall: 0.00 acres

Total (Watershed) Drainage Area to Outfall: 3373 acres

Site Percentage of Total (Watershed) Drainage Area: **0.000%**

APPENDIX C18
PL23-OUT18

Outfall PL23-OUT 18

Outfall PL23-OUT18 is an existing outfall at I-495 Southbound station 219+85 left. The outfall consists of a manmade channel flowing into Scotts Run. In existing conditions, the channel receives 0.09 acres of project (site) area. The total watershed drainage area at this outfall point is 3,373 acres (5.27 square miles).

Development of this area will result in this outfall being eliminated, due to the proposed roadway widening and drainage design. The drainage associated with this outfall will be conveyed to outfalls PL23-OUT7 and PL23-OUT15. The resulting project (site) area to the outfall will be 0.00 acres.

Drainage Area:

The drainage areas and resulting changes are summarized in the table below:

PL23-OUT 18				
Drainage Area	**Watershed Area**	**Site Area**	**C (Site)**	**% of Total Watershed**
Existing	3373 ac	0.09 ac	0.30	0.003%
Proposed	3373 ac	0.00 ac	NA	NA

Limits of Study:

The location of the outfall is shown in the included outfall drainage map. The point of analysis is downstream of existing structure 229.

Easement Requirements:

No additional easements are required.

Channel Protection:

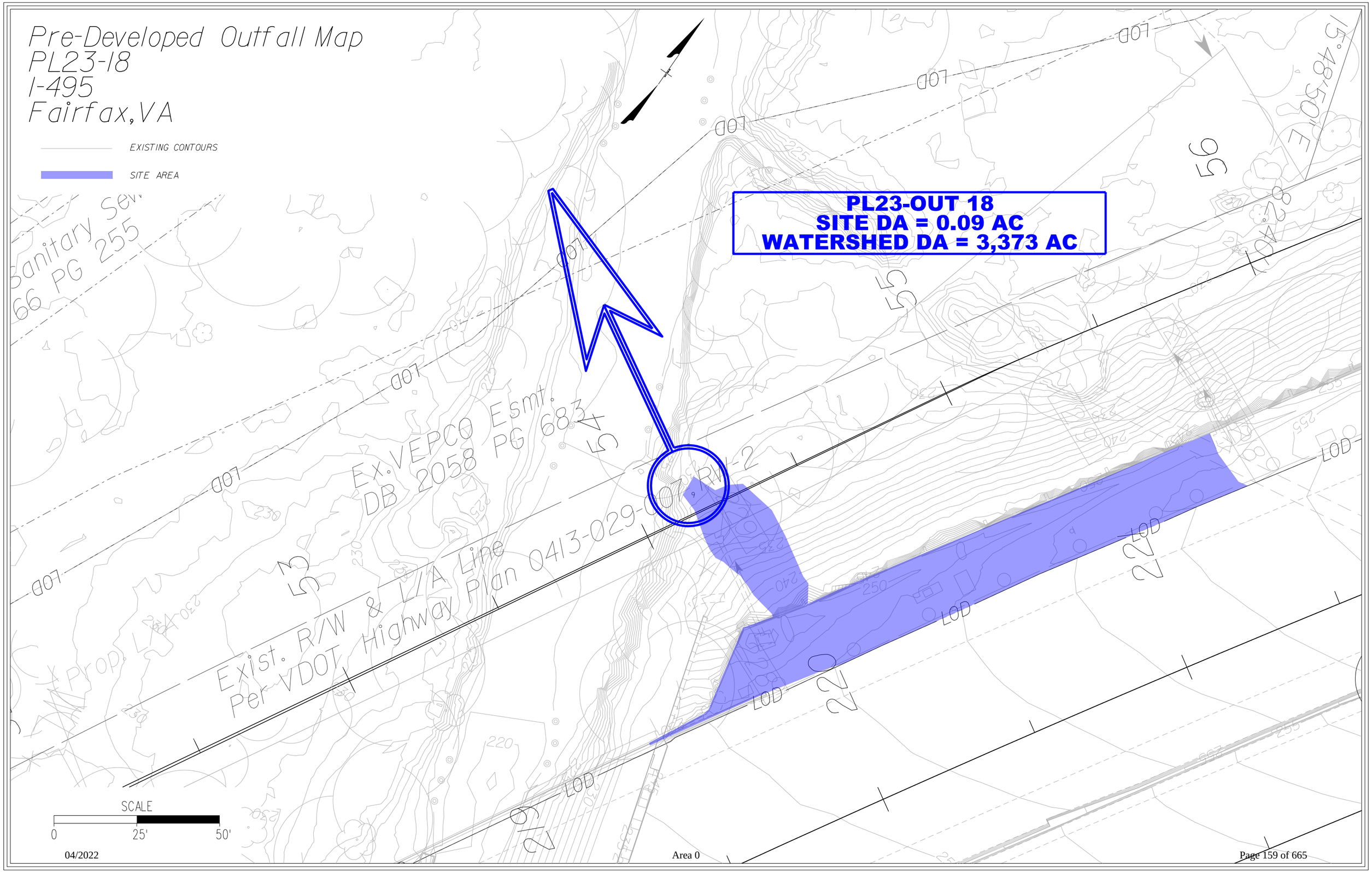
Under Section 11.7.5.1 of the VDOT drainage manual, areas draining to a manmade stormwater conveyance channel shall satisfy the channel protection criteria by providing conveyance of the 2 year storm without causing erosion of the system. As this outfall is eliminated in the post-development condition, no additional analysis is required.

Flood Protection:

Under Section 11.7.5.2 of the VDOT drainage manual, areas draining to a manmade stormwater conveyance channel shall satisfy the flood protection criteria by demonstrating that the peak flow rate from a 10 year storm will be contained within the system. As this outfall is eliminated in the post-development condition, no additional analysis is required.

Final Opinion:

This outfall is a manmade stormwater conveyance system. We have shown compliance with the channel and flood protection criteria, by providing calculations demonstrating that the outfall will be eliminated in the post-development condition. It is therefore our opinion that this outfall is adequate.


Pre-Developed Outfall Map
PL23-18
I-495
Fairfax, VA
EXISTING CONTOURS
SITE AREA
PL23-OUT 18
SITE DA = 0.09 AC
WATERSHED DA = 3,373 AC
Sanitary Sew
66 PG 255
Ex. VEPCO Esmt.
DB 2058 PG 683
Exist. R/W & L/A Line
Per VDOT Highway Plan 0413-029-007, RW-2
Prop. L/A
LOD
SCALE
0
25'
50'

Name of Project:	495-NEXT			Designed By:	KRI
State:	VA	**County:**	Fairfax County	Date:	03/07/22
Name of Culvert:	Pre Development			Checked By:	NVD
NOAA Station:	Vienna Tysons 44-8737			Date:	03/07/22
LOCATION:	PL23-OUT 18				
				UNITS	**ENGLISH**

RATIONAL METHOD - DATA:

		DRAINAGE BASIN		
SUBSHED #	Land Use Description	Onsite Area Acres	C	C A
	Business: Industrial and Commercial (0.80-0.90)			
	Apartments and Townhomes (0.65-0.75)			
	Schools (0.50-0.60)			
	Residential - lots 10,000 sq. ft. (0.40-0.50)			
	- lots 12,000 sq. ft. (0.40-0.45)			
	- lots 17,000 sq. ft. (0.35-0.45)			
	- lots ½ acre or more (0.30-0.40)		0.35	
	Parks, Cemeteries and Unimproved Areas (0.20-0.35)			
	Paved and Roof Areas (0.90)		0.90	
	Cultivated Areas (0.50-0.70)			
	Pasture (0.35-0.45)			
	Lawns (0.25-0.35)	0.09	0.30	0.03
	Forest (0.20-0.30)	0.00	0.25	0.00
	Steep Grass (2:1) (0.40-0.70)			
	Shoulder and Ditch Areas (0.35-0.50)			
	Totals =	**0.09 Ac.**	**0.30**	**0.03**

Site Contributing Drainage Area to Outfall: 0.09 acres

Total (Watershed) Drainage Area to Outfall: 3373 acres

Site Percentage of Total (Watershed) Drainage Area: **0.003%**

Name of Project:	495-NEXT			Designed By:	JMON
State:	VA	**County:**	Fairfax County	Date:	03/07/22
Name of Culvert:	Post Development			Checked By:	NVD
NOAA Station:	Vienna Tysons 44-8737			Date:	03/07/22
LOCATION:	PL23-OUT 18				
				UNITS	**ENGLISH**

RATIONAL METHOD - DATA:

DRAINAGE BASIN

SUBSHED #	Land Use Description	Onsite Area Acres	C	C A
	Business: Industrial and Commercial (0.80-0.90)			
	Apartments and Townhomes (0.65-0.75)			
	Schools (0.50-0.60)			
	Residential - lots 10,000 sq. ft. (0.40-0.50)			
	- lots 12,000 sq. ft. (0.40-0.45)			
	- lots 17,000 sq. ft. (0.35-0.45)			
	- lots ½ acre or more (0.30-0.40)		0.35	
	Parks, Cemeteries and Unimproved Areas (0.20-0.35)			
	Paved and Roof Areas (0.90)		0.90	
	Cultivated Areas (0.50-0.70)			
	Pasture (0.35-0.45)			
	Lawns (0.25-0.35)		0.30	
	Forest (0.20-0.30)		0.25	
	Steep Grass (2:1) (0.40-0.70)			
	Shoulder and Ditch Areas (0.35-0.50)			
	Totals =	**0.00 Ac.**	**0.00**	**0.00**

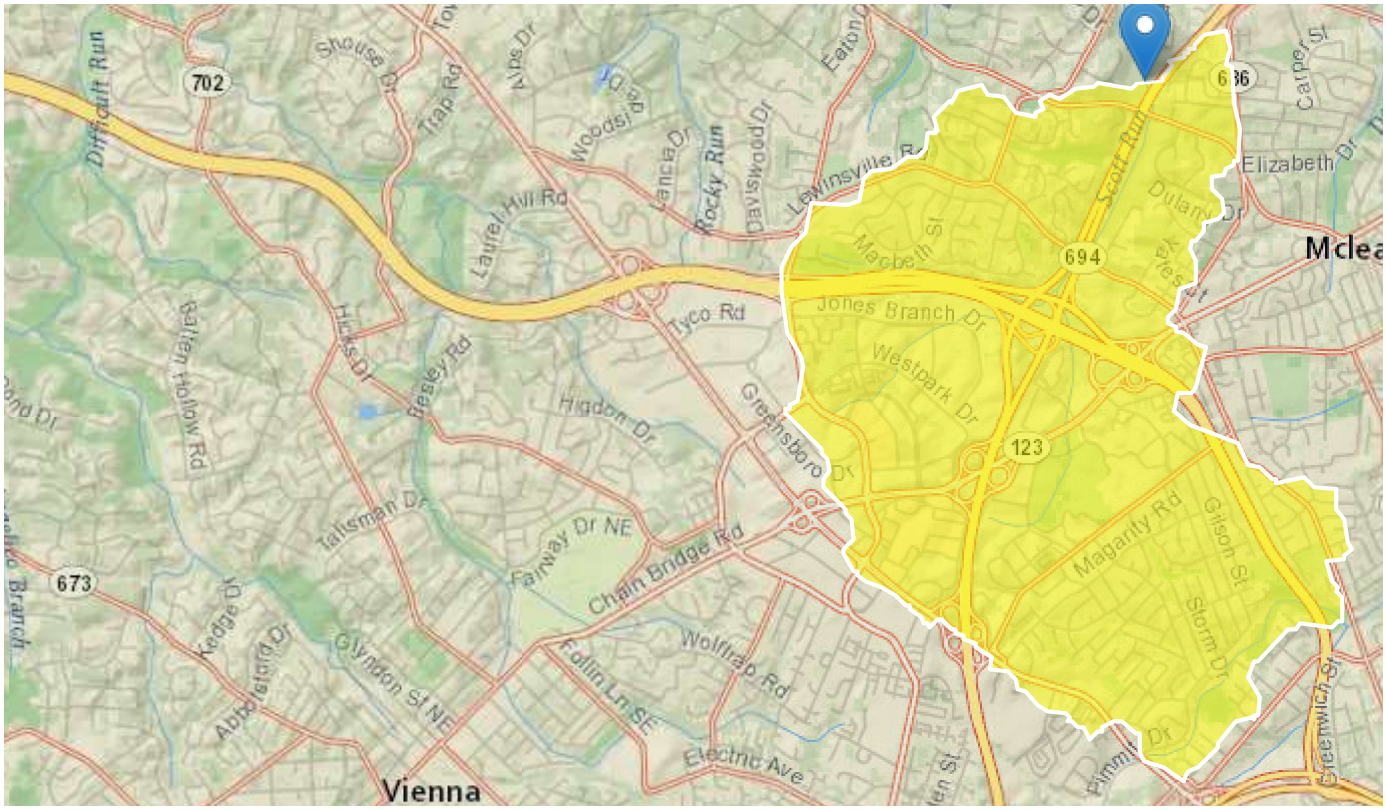
Site Contributing Drainage Area to Outfall: 0.00 acres

Total (Watershed) Drainage Area to Outfall: 3373 acres

Site Percentage of Total (Watershed) Drainage Area: **0.000%**

StreamStats Report

Region ID: VA
Workspace ID: VA20210818171719542000
Clicked Point (Latitude, Longitude): 38.94759, -77.20240
Time: 2021-08-18 13:17:41 -0400



Basin Characteristics

Parameter Code	Parameter Description	Value	Unit
DRNAREA	Area that drains to a point on a stream	5.27	square miles

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Application Version: 4.6.2
StreamStats Services Version: 1.2.22
NSS Services Version: 2.1.2

APPENDIX C19
PL23-OUT19

Outfall PL23-OUT 19

Outfall PL23-OUT19 is an existing outfall at Interstate 495 station 54+30 left. The outfall consists of a natural channel flowing into Scotts Run. In existing conditions, the channel receives 0.04 acres of project (site) area. The total watershed drainage area at this outfall point is 3,373 acres (5.27 square miles).

Development of this area will result in a decreased area to this outfall, due to the proposed grading and roadway design. The resulting project (site) area to the outfall will be 0.03 acres.

Drainage Area:

The drainage areas and resulting changes are summarized in the table below:

PL23-OUT 19				
Drainage Area	**Watershed Area**	**Site Area**	**C (Site)**	**% of Total Watershed**
Existing	3373 ac	0.04 ac	0.27	0.0013%
Proposed	3373 ac	0.03 ac	0.30	0.0008%

Limits of Study:

The location of the outfall is shown in the included outfall drainage map. The point of analysis is at the end of the existing channel where it meets Scotts Run.

Easement Requirements:

No additional easements are required.

Channel and Flood Protection:

Under Section 11.7.5.1 and 11.7.5.2 of the VDOT drainage manual, channel and flood protection for an outfall must be analyzed to a point where the contributing site drainage area for the outfall is less than or equal to one percent of the total watershed area at that point. Outfall PL23-OUT19 is located where the contributing site area is 0.03 acres of the total watershed (3,373 acres) at the outfall limit, which represents 0.0008% of the watershed. As adequacy of all drainage structures within the limits of construction has been provided, no further analysis is required.

Final Opinion:

This outfall is a natural stormwater conveyance system. We have shown compliance with the channel and flood protection criteria, by analyzing the system to the 1% point, which is located at Scotts Run. As the contributing site area is less than 1% of the total watershed area, it is our opinion that this outfall is adequate.

Pre-Developed Outfall Map
PL23-19
I-495
Fairfax, VA

EXISTING CONTOURS

SITE AREA

PL23-OUT 19
SITE DA = 0.04 AC
WATERSHED DA = 3,373 AC

EX. Public Riding Trails Esmt.
DB 2766 PG 255

EX. 25' Sanitary Sewer Esmt.
DB 2766 PG 255

EX. VEPCO Esmt.
DB 2058 PG 683

Exist. R/W & L/A Line
VDOT, Highway Plan 0413-029-007, RW-2

Prop. R/W

LOD

SCALE
0 25' 50'

Post-Developed Outfall Map
PL23-19
I-495
Fairfax, VA

EXISTING CONTOURS

SITE AREA

PL23-OUT 19
SITE DA = 0.03 AC
WATERSHED DA = 3,373 AC

SCALE
0 25' 50'

Name of Project:	495-NEXT			Designed By:	KRI
State:	VA	**County:**	Fairfax County	Date:	03/07/22
Name of Culvert:	Pre Development			Checked By:	NVD
NOAA Station:	Vienna Tysons 44-8737			Date:	03/07/22
LOCATION:	PL23-OUT 19				
				UNITS	**ENGLISH**

RATIONAL METHOD - DATA:

		DRAINAGE BASIN		
SUBSHED #	Land Use Description	Onsite Area Acres	C	C A
	Business: Industrial and Commercial (0.80-0.90)			
	Apartments and Townhomes (0.65-0.75)			
	Schools (0.50-0.60)			
	Residential - lots 10,000 sq. ft. (0.40-0.50)			
	- lots 12,000 sq. ft. (0.40-0.45)			
	- lots 17,000 sq. ft. (0.35-0.45)			
	- lots ½ acre or more (0.30-0.40)		0.35	
	Parks, Cemeteries and Unimproved Areas (0.20-0.35)			
	Paved and Roof Areas (0.90)		0.90	
	Cultivated Areas (0.50-0.70)			
	Pasture (0.35-0.45)			
	Lawns (0.25-0.35)	0.02	0.30	0.01
	Forest (0.20-0.30)	0.02	0.25	0.01
	Steep Grass (2:1) (0.40-0.70)			
	Shoulder and Ditch Areas (0.35-0.50)			
	Totals =	**0.04 Ac.**	**0.27**	**0.01**

Site Contributing Drainage Area to Outfall: 0.04 acres

Total (Watershed) Drainage Area to Outfall: 3373 acres

Site Percentage of Total (Watershed) Drainage Area: **0.0013%**

Name of Project:	495-NEXT			Designed By:	JMON
State:	VA	**County:**	Fairfax County	Date:	03/07/22
Name of Culvert:	Post Development			Checked By:	NVD
NOAA Station:	Vienna Tysons 44-8737			Date:	03/07/22
LOCATION:	PL23-OUT 19				
				UNITS	**ENGLISH**

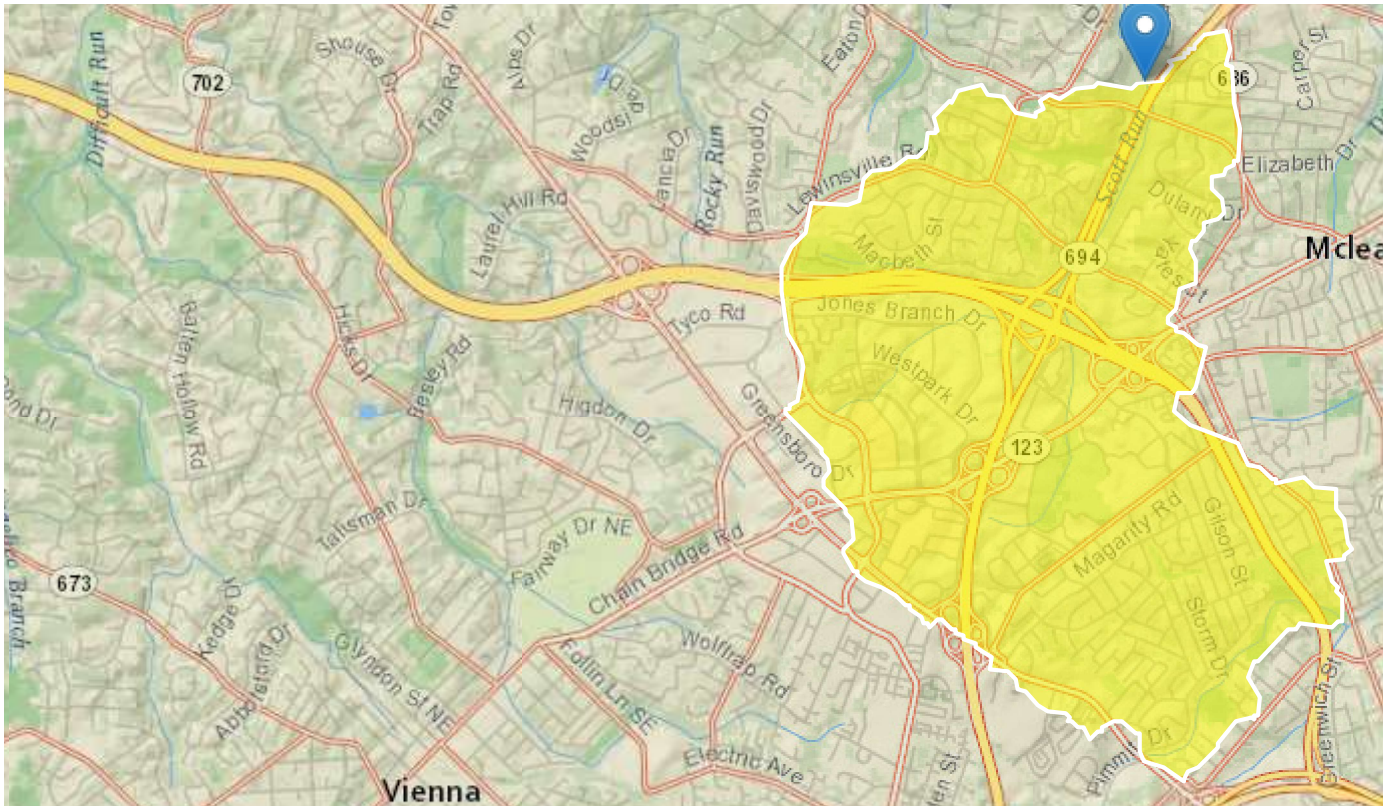
RATIONAL METHOD - DATA:

		DRAINAGE BASIN		
SUBSHED #	Land Use Description	Onsite Area Acres	C	C A
	Business: Industrial and Commercial (0.80-0.90)			
	Apartments and Townhomes (0.65-0.75)			
	Schools (0.50-0.60)			
	Residential - lots 10,000 sq. ft. (0.40-0.50)			
	- lots 12,000 sq. ft. (0.40-0.45)			
	- lots 17,000 sq. ft. (0.35-0.45)			
	- lots ½ acre or more (0.30-0.40)	0.00	0.35	
	Parks, Cemeteries and Unimproved Areas (0.20-0.35)			
	Paved and Roof Areas (0.90)	0.00	0.90	
	Cultivated Areas (0.50-0.70)			
	Pasture (0.35-0.45)			
	Lawns (0.25-0.35)	0.03	0.30	0.01
	Forest (0.20-0.30)	0.00	0.25	
	Steep Grass (2:1) (0.40-0.70)			
	Shoulder and Ditch Areas (0.35-0.50)			
	Totals =	**0.03 Ac.**	**0.30**	**0.01**

Site Contributing Drainage Area to Outfall:	0.03	acres
Total (Watershed) Drainage Area to Outfall:	3373	acres
Site Percentage of Total (Watershed) Drainage Area:	**0.0008%**	

StreamStats Report

Region ID: VA
Workspace ID: VA20210818171719542000
Clicked Point (Latitude, Longitude): 38.94759, -77.20240
Time: 2021-08-18 13:17:41 -0400



Basin Characteristics

Parameter Code	Parameter Description	Value	Unit
DRNAREA	Area that drains to a point on a stream	5.27	square miles

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Application Version: 4.6.2
StreamStats Services Version: 1.2.22
NSS Services Version: 2.1.2

APPENDIX C20
PL23-OUT20

Outfall PL23-OUT 20

Outfall PL23-OUT20 is an existing outfall at Interstate 495 station 54+60 left. The outfall consists of a natural channel flowing into Scotts Run. In existing conditions, the channel receives 2.35 acres of project (site) area. The total watershed drainage area at this outfall point is 3,373 acres (5.27 square miles).

Development of this area will result in an increased project (site) area to this outfall, due to the proposed grading, installation of a storm sewer system and roadway design. The resulting project (site) area to the outfall will be 4.38 acres.

Drainage Area:

The drainage areas and resulting changes are summarized in the table below:

PL23-OUT 20				
Drainage Area	**Watershed Area**	**Site Area**	**C (Site)**	**% of Total Watershed**
Existing	3373 ac	2.35 ac	0.28	0.07%
Proposed	3373 ac	4.38 ac	0.80	0.13%

Limits of Study:

The location of the outfall is shown in the included outfall drainage map. The point of analysis is at the end of the existing channel where it meets Scotts Run.

Easement Requirements:

No additional easements are required.

Channel and Flood Protection:

Under Section 11.7.5.1 and 11.7.5.2 of the VDOT drainage manual, channel and flood protection for an outfall must be analyzed to a point where the contributing site drainage area for the outfall is less than or equal to one percent of the total watershed area at that point. Outfall PL23-OUT20 is located where the contributing site area is 4.38 acres of the total watershed (3,373 acres) at the outfall limit, which represents 0.13% of the watershed. As adequacy of all drainage structures within the limits of construction has been provided, no further analysis is required.

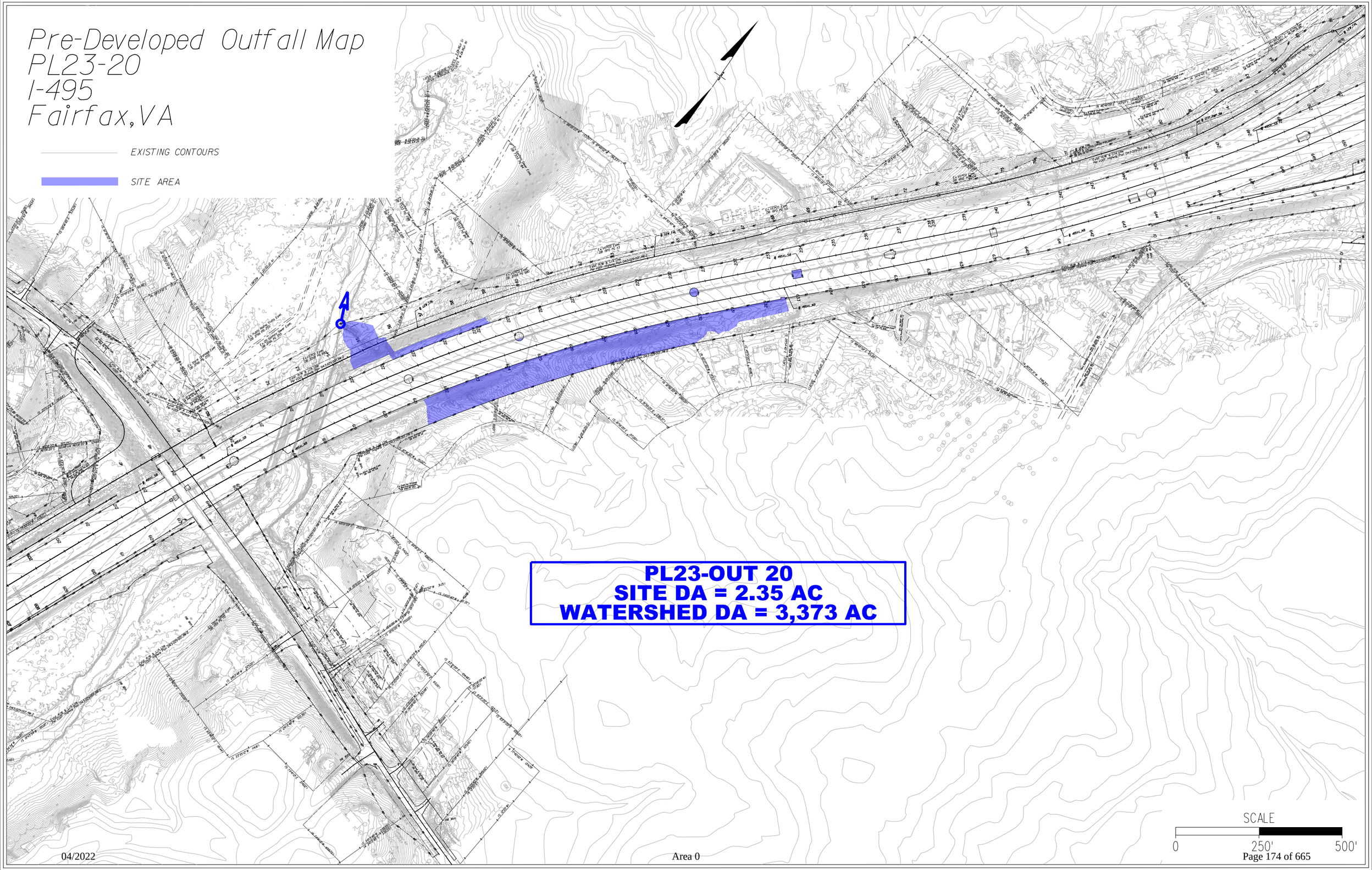
Final Opinion:

This outfall is a natural stormwater conveyance system. We have shown compliance with the channel and flood protection criteria, by analyzing the system to the 1% point, which is located at Scotts Run. As the contributing site area is less than 1% of the total watershed area, it is our opinion that this outfall is adequate.

Pre-Developed Outfall Map
PL23-20
I-495
Fairfax, VA

EXISTING CONTOURS

SITE AREA



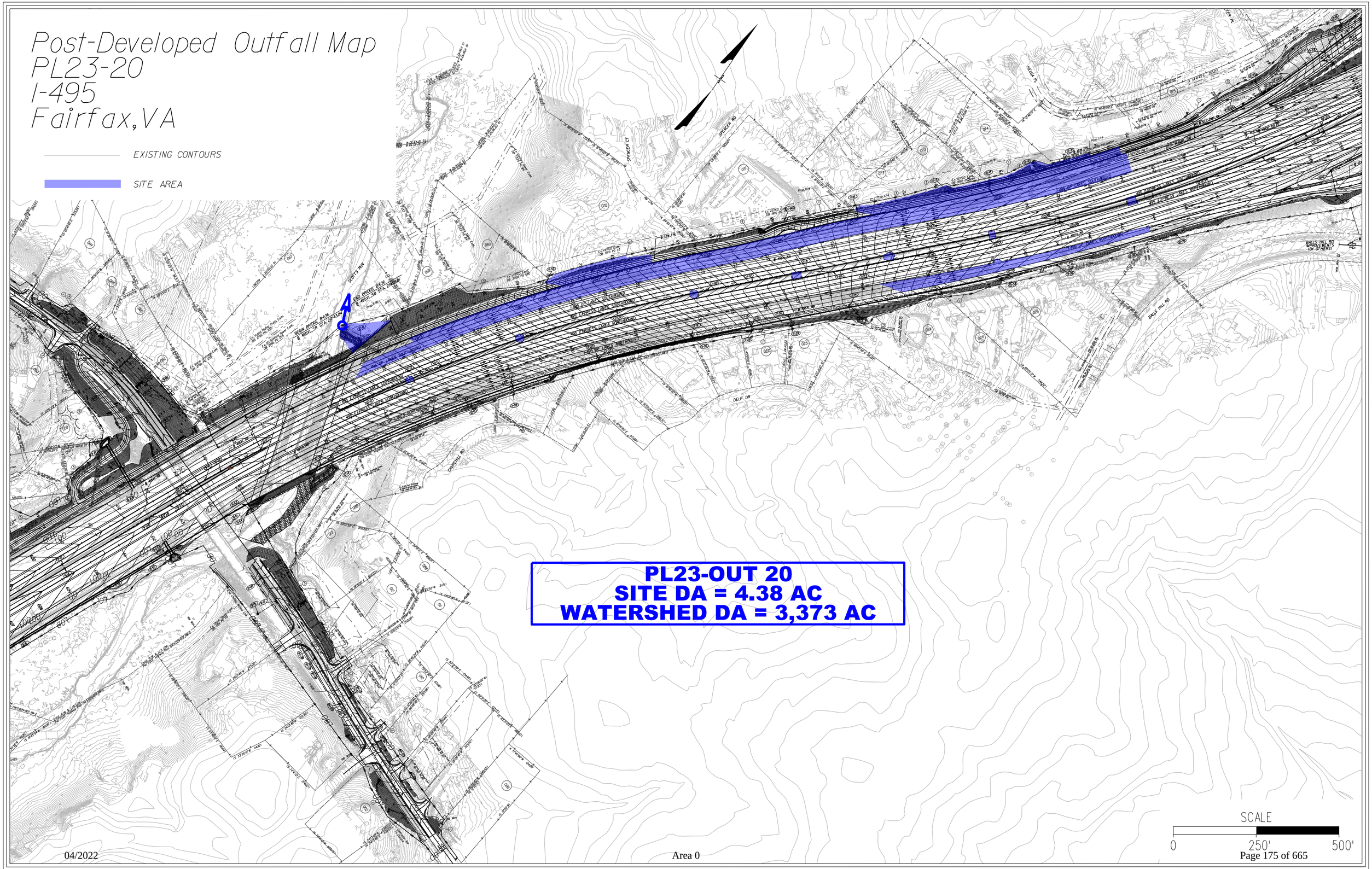
PL23-OUT 20
SITE DA = 2.35 AC
WATERSHED DA = 3,373 AC

SCALE
0 250' 500'

Post-Developed Outfall Map
PL23-20
I-495
Fairfax, VA

EXISTING CONTOURS

SITE AREA



PL23-OUT 20
SITE DA = 4.38 AC
WATERSHED DA = 3,373 AC

SCALE
0 250' 500'

Name of Project:	495-NEXT			Designed By:	KRI
State:	VA	**County:**	Fairfax County	Date:	03/07/22
Name of Culvert:	Pre Development			Checked By:	NVD
NOAA Station:	Vienna Tysons 44-8737			Date:	03/07/22
LOCATION:	PL23-OUT 20				
				UNITS	**ENGLISH**

RATIONAL METHOD - DATA:

DRAINAGE BASIN

SUBSHED #	Land Use Description	Onsite Area Acres	C	C A
	Business: Industrial and Commercial (0.80-0.90)			
	Apartments and Townhomes (0.65-0.75)			
	Schools (0.50-0.60)			
	Residential - lots 10,000 sq. ft. (0.40-0.50)			
	- lots 12,000 sq. ft. (0.40-0.45)			
	- lots 17,000 sq. ft. (0.35-0.45)			
	- lots ½ acre or more (0.30-0.40)		0.35	
	Parks, Cemeteries and Unimproved Areas (0.20-0.35)			
	Paved and Roof Areas (0.90)	0.06	0.90	0.05
	Cultivated Areas (0.50-0.70)			
	Pasture (0.35-0.45)			
	Lawns (0.25-0.35)	0.77	0.30	0.23
	Forest (0.20-0.30)	1.52	0.25	0.38
	Steep Grass (2:1) (0.40-0.70)			
	Shoulder and Ditch Areas (0.35-0.50)			
	Totals =	**2.35 Ac.**	**0.28**	**0.66**

Site Contributing Drainage Area to Outfall:	2.35	acres
Total (Watershed) Drainage Area to Outfall:	3373	acres
Site Percentage of Total (Watershed) Drainage Area:	**0.07%**	

Name of Project:	495-NEXT			Designed By:	JMON
State:	VA	**County:**	Fairfax County	Date:	03/07/22
Name of Culvert:	Post Development			Checked By:	NVD
NOAA Station:	Vienna Tysons 44-8737			Date:	03/07/22
LOCATION:	PL23-OUT 20				
				UNITS	**ENGLISH**

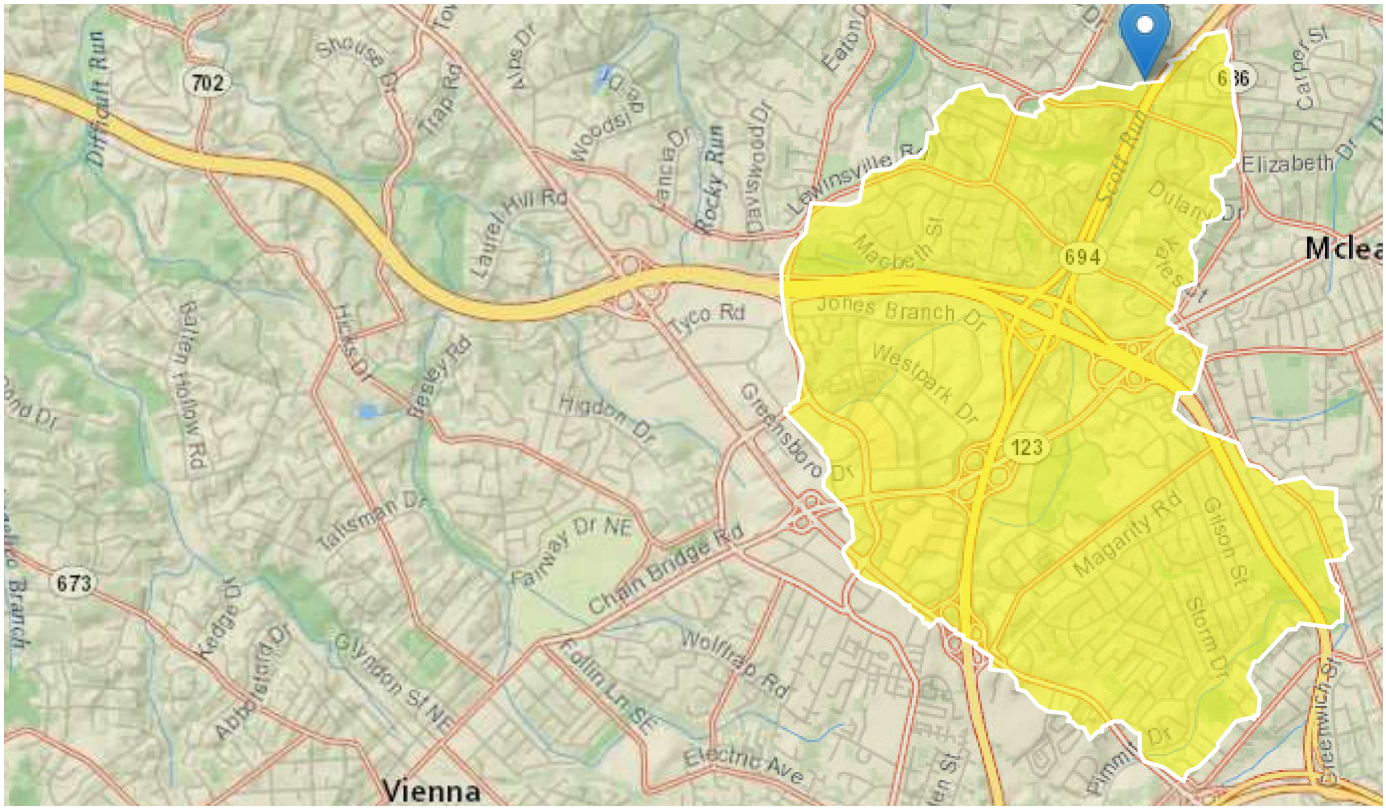
RATIONAL METHOD - DATA:

		DRAINAGE BASIN		
SUBSHED #	Land Use Description	Onsite Area Acres	C	C A
	Business: Industrial and Commercial (0.80-0.90)			
	Apartments and Townhomes (0.65-0.75)			
	Schools (0.50-0.60)			
	Residential - lots 10,000 sq. ft. (0.40-0.50)			
	- lots 12,000 sq. ft. (0.40-0.45)			
	- lots 17,000 sq. ft. (0.35-0.45)			
	- lots ½ acre or more (0.30-0.40)			
	Parks, Cemeteries and Unimproved Areas (0.20-0.35)			
	Paved and Roof Areas (0.90)	3.62	0.90	3.26
	Cultivated Areas (0.50-0.70)			
	Pasture (0.35-0.45)			
	Lawns (0.25-0.35)	0.76	0.30	0.23
	Forest (0.20-0.30)			
	Steep Grass (2:1) (0.40-0.70)			
	Shoulder and Ditch Areas (0.35-0.50)			
	Totals =	**4.38 Ac.**	**0.80**	**3.49**

Site Contributing Drainage Area to Outfall:	4.38	acres
Total (Watershed) Drainage Area to Outfall:	3373	acres
Site Percentage of Total (Watershed) Drainage Area:	**0.13%**	

StreamStats Report

Region ID: VA
Workspace ID: VA20210818171719542000
Clicked Point (Latitude, Longitude): 38.94759, -77.20240
Time: 2021-08-18 13:17:41 -0400



Basin Characteristics

Parameter Code	Parameter Description	Value	Unit
DRNAREA	Area that drains to a point on a stream	5.27	square miles

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Application Version: 4.6.2
StreamStats Services Version: 1.2.22
NSS Services Version: 2.1.2

APPENDIX C21
PL23-OUT21

Outfall PL23-OUT 21

Outfall PL23-OUT21 is an existing outfall at I-495 Southbound station 225+81 left. The outfall consists of an area of uncontrolled sheet flow. The outfall prior to development is 2.30 acres.

Development of this area will result in a reduced area to this outfall, due to the proposed roadway widening. The resulting area to the outfall will be 0.96 acres.

Drainage Area:

The drainage areas and resulting changes are summarized in the table below:

PL23-OUT 21			
Drainage Area	**Total Area**	**C (Total)**	**Tc**
Existing	2.30 ac	0.35	5.00 min
Proposed	0.96 ac	0.41	5.00 min

Limits of Study:

The location of the outfall is shown in the included outfall drainage map. The point of analysis is at the site limits.

Easement Requirements:

No additional easements are required.

Outfall Discharge:

All discharges were calculated using the Rational Method and are summarized below:

PL23-OUT 21		
Drainage Area	**Peak Flow Rate (Total)**	
	2 Year	10 Year
Existing	4.19 cfs	5.47 cfs
Proposed	2.04 cfs	2.66 cfs
Net Change	**-2.15 cfs**	**-2.81 cfs**

Final Opinion:

Area of increased volume of sheet flow must be identified and evaluated for potential impacts. As this outfall demonstrates a decreased volume of sheet flow, no further calculations are necessary. It is therefore our opinion that this outfall is adequate.

Pre-Developed Outfall Map
PL23-21
I-495
Fairfax, VA

DRAINAGE AREA BOUNDARY

EXISTING CONTOURS

TIME OF CONCENTRATION

PL23-OUT 21
DA = 2.30 AC
C = 0.35

SCALE
0 100' 200'

Post-Developed Outfall Map
PL23-21
I-495
Fairfax, VA

DRAINAGE AREA BOUNDARY

EXISTING CONTOURS

TIME OF CONCENTRATION

PL23-OUT 21
DA = 0.96 AC
C = 0.41

SCALE
0 100' 200'

Name of Project:	495-NEXT			Designed By:	KRI
State:	VA	**County:**	Fairfax County	Date:	09/27/21
Name of Culvert:	Pre Development			Checked By:	NVD
NOAA Station:	Vienna Tysons 44-8737			Date:	09/27/21
LOCATION:	PL23-OUT 21				
				UNITS	**ENGLISH**

RATIONAL METHOD - DATA:

DRAINAGE BASIN

SUBSHED #	Land Use Description	Area Acres	C	C A
	Business: Industrial and Commercial (0.80-0.90)			
	Apartments and Townhomes (0.65-0.75)			
	Schools (0.50-0.60)			
	Residential - lots 10,000 sq. ft. (0.40-0.50)			
	- lots 12,000 sq. ft. (0.40-0.45)			
	- lots 17,000 sq. ft. (0.35-0.45)			
	- lots ½ acre or more (0.30-0.40)		0.35	
	Parks, Cemeteries and Unimproved Areas (0.20-0.35)			
	Paved and Roof Areas (0.90)	0.27	0.90	0.24
	Cultivated Areas (0.50-0.70)			
	Pasture (0.35-0.45)			
	Lawns (0.25-0.35)	1.19	0.30	0.36
	Forest (0.20-0.30)	0.84	0.25	0.21
	Steep Grass (2:1) (0.40-0.70)			
	Shoulder and Ditch Areas (0.35-0.50)			
	Totals =	**2.30 Acres**	**0.35**	**0.81**

Time of Concentration (Tc)

	Reach	Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Rational C		Tc (Minutes)
							Total Tc (Minutes) =	**5.00**

		2-Year	**5-Year**	**10-Year**	**25-Year**	**50-Year**	**100-Year**
Rainfall Intensity	Inches / Hour.	**5.18**	**6.00**	**6.76**	**7.64**	**8.28**	**8.89**
Aosorption Coefficient / Ground Saturation Correction Coefficient Cf		1.00	1.00	1.00	1.10	1.20	1.25
Peak Discharge	CFS.	**4.19**	**4.85**	**5.47**	**6.80**	**8.04**	**8.99**

Name of Project:	495-NEXT			Designed By:	JMON
State:	VA	**County:**	Fairfax County	Date:	11/17/21
Name of Culvert:	Post Development			Checked By:	NVD
NOAA Station:	Vienna Tysons 44-8737			Date:	11/17/21
LOCATION:	PL23-OUT 21				
				UNITS	**ENGLISH**

RATIONAL METHOD - DATA:

DRAINAGE BASIN

SUBSHED #	Land Use Description	Area Acres	C	C A
	Business: Industrial and Commercial (0.80-0.90)			
	Apartments and Townhomes (0.65-0.75)			
	Schools (0.50-0.60)		0.50	
	Residential - lots 10,000 sq. ft. (0.40-0.50)			
	- lots 12,000 sq. ft. (0.40-0.45)			
	- lots 17,000 sq. ft. (0.35-0.45)			
	- lots ½ acre or more (0.30-0.40)		0.35	
	Parks, Cemeteries and Unimproved Areas (0.20-0.35)			
	Paved and Roof Areas (0.90)	0.18	0.90	0.16
	Cultivated Areas (0.50-0.70)			
	Pasture (0.35-0.45)			
	Lawns (0.25-0.35)	0.78	0.30	0.23
	Forest (0.20-0.30)		0.25	
	Steep Grass (2:1) (0.40-0.70)			
	Shoulder and Ditch Areas (0.35-0.50)			
	Totals =	**0.96 Acres**	**0.41**	**0.39**

Time of Concentration (Tc)

	Reach	Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Rational C		Tc (Minutes)
							Total Tc (Minutes) =	**5.00**

	2-Year	**5-Year**	**10-Year**	**25-Year**	**50-Year**	**100-Year**
Rainfall Intensity Inches / Hour.	**5.18**	**6.00**	**6.76**	**7.64**	**8.28**	**8.89**
Aosorption Coefficient / Ground Saturation Correction Coefficient Cf	1.00	1.00	1.00	1.10	1.20	1.25
Peak Discharge CFS.	**2.04**	**2.36**	**2.66**	**3.31**	**3.91**	**4.37**

Outfall PL23-OUT21 Directly Downstream of Outfall Limits: Looking Upstream

Outfall PL23-OUT21 Directly Downstream of Outfall Limits: Looking Downstream

APPENDIX C22
PL23-OUT22

Outfall PL23-OUT 22

Outfall PL23-OUT22 is an existing outfall at I-495 Southbound station 233+72 left. The outfall consists of a manmade stormwater conveyance system. In existing conditions, flow is conveyed through existing channels, culverts and sheet flow to the point of analysis. The outfall prior to development is 21.23 acres.

Development of this area will result in decreased area to this outfall, due to the roadway widening and proposed storm sewer design directing drainage to adjacent outfalls. The resulting area to the outfall will be 1.31 acres.

Drainage Area:

The drainage areas and resulting changes are summarized in the table below:

PL23-OUT 22			
Drainage Area	**Total Area**	**C (Total)**	**Tc**
Existing	21.23 ac	0.48	14.37 min
Proposed	1.31 ac	0.41	13.38 min

Limits of Study:

The location of the outfall is shown in the included outfall drainage map. The point of analysis is at existing structure 660.

Easement Requirements:

No additional easements are required.

Outfall Discharge:

All discharges were calculated using the Rational Method and are summarized below:

PL23-OUT 22		
Drainage Area	**Peak Flow Rate (Total)**	
	2 Year	10 Year
Existing	36.29 cfs	48.28 cfs
Proposed	1.97 cfs	2.61 cfs
Net Change	**-34.32 cfs**	**-45.67 cfs**

Channel Protection:

Under Section 11.7.5.1 of the VDOT drainage manual, areas draining to a manmade stormwater conveyance system shall satisfy the channel protection criteria by providing conveyance of the 2 year storm without causing erosion of the system. As this outfall is concrete storm sewer, there is no maximum erosive velocity.

Pipe Run	Channel Protection - 2 Year Velocity			Outfall Adequate?
	Pipe Material	Max Permissible Velocity (ft/s)	Proposed Velocity (ft/s)	
EX660 to EX661	Concrete	No Max	3.58	Yes
EX661 to EX662	Concrete	No Max	4.49	Yes

Flood Protection:

Under Section 11.7.5.2 of the VDOT drainage manual, areas draining to a manmade stormwater conveyance system shall satisfy the flood protection criteria by demonstrating that the peak flow rate from a 10 year storm will be contained within the existing channel. The post developed flows to the channel have been analyzed and yield the following results:

Pipe Run	Flood Protection - 10 Year Capacity		Outfall Adequate?
	Max Pipe Discharge (cfs)	Pipe Discharge (cfs)	
EX660 to EX661	82.54	2.61	Yes
EX661 to EX662	114.01	2.61	Yes

Final Opinion:

This outfall is a manmade stormwater conveyance system. We have shown compliance with the channel protection criteria by providing calculations demonstrating non-erosive velocities. We have shown compliance with the flood protection criteria, by demonstrating the peak discharge from a 10 year storm will be contained within the system. It is therefore our opinion that this outfall is adequate.

Pre-Developed Outfall Map
PL23-22
I-495
Fairfax, VA

PL23-OUT 22
DA=21.23 AC
C = 0.48

DRAINAGE AREA BOUNDARY

EXISTING CONTOURS

TIME OF CONCENTRATION

F

E

D

C

B

A

SCALE
0 150' 300'

04/2022

Area 0

Post-Developed Outfall Map
PL23-22
I-495
Fairfax, VA

PL23-OUT 22
DA = 1.31 AC
C = 0.41

DRAINAGE AREA BOUNDARY

EXISTING CONTOURS

TIME OF CONCENTRATION

A

B

C

SCALE
0 150' 300'

Name of Project:	495-NEXT		Designed By: KRI
State:	VA	**County:** Fairfax County	Date: 10/05/21
Name of Culvert:	Pre Development		Checked By: NVD
NOAA Station:	Vienna Tysons 44-8737		Date: 10/05/21
LOCATION:	PL23-OUT 22		
			UNITS **ENGLISH**

RATIONAL METHOD - DATA:

DRAINAGE BASIN

SUBSHED #	Land Use Description	Area Acres	C	C A
	Business: Industrial and Commercial (0.80-0.90)			
	Apartments and Townhomes (0.65-0.75)			
	Schools (0.50-0.60)			
	Residential - lots 10,000 sq. ft. (0.40-0.50)			
	- lots 12,000 sq. ft. (0.40-0.45)			
	- lots 17,000 sq. ft. (0.35-0.45)			
	- lots ½ acre or more (0.30-0.40)	8.53	0.35	2.99
	Parks, Cemeteries and Unimproved Areas (0.20-0.35)			
	Paved and Roof Areas (0.90)	6.07	0.90	5.46
	Cultivated Areas (0.50-0.70)			
	Pasture (0.35-0.45)			
	Lawns (0.25-0.35)	2.26	0.30	0.68
	Forest (0.20-0.30)	4.37	0.25	1.09
	Steep Grass (2:1) (0.40-0.70)			
	Shoulder and Ditch Areas (0.35-0.50)			
	Totals =	**21.23 Acres**	**0.48**	**10.22**

Time of Concentration (Tc)

	Reach		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Rational C		Tc (Minutes)
Overland Flow (E.E. Seelye - VDOT Modified)									
	Soil / Surface Type/Land Cover		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Rational C		
	Residential	A-B	200.00	332.50	316.00	0.083	0.35		9.56
Shallow Concentrated Flow			Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Intercept Coeff.		
Short grass pasture		B-C	406.98	316.00	286.00	0.074	0.213		3.58
Channel Flow			Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Natural Channel		C-D	278.55	286.00	270.60	0.055	0.050	6.73	0.69
				Area =	12.00		Wetted P =	12.70	
Pipe Flow			Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
EX Culvert 200		D-E	238.83	270.60	266.30	0.018	0.013	16.59	0.24
	Pipe Diameter (in) =		54	Area =	15.90		Wetted P =	14.14	
Channel Flow			Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Natural Channel		E-F	70.25	266.30	265.02	0.018	0.050	3.86	0.30
				Area =	12.00		Wetted P =	12.70	
								Total Tc (Minutes) =	**14.37**

	2-Year	5-Year	10-Year	25-Year	50-Year	100-Year
Rainfall Intensity Inches / Hour.	**3.55**	**4.16**	**4.72**	**5.37**	**5.84**	**6.28**
Aosorption Coefficient / Ground Saturation Correction Coefficient Cf	1.00	1.00	1.00	1.10	1.20	1.25
Peak Discharge CFS.	**36.29**	**42.54**	**48.28**	**60.41**	**71.62**	**80.25**

Name of Project:	495-NEXT			Designed By:	JMON
State:	VA	**County:**	Fairfax County	Date:	11/19/21
Name of Culvert:	Post Development			Checked By:	NVD
NOAA Station:	Vienna Tysons 44-8737			Date:	11/19/21
LOCATION:	PL23-OUT 22				
				UNITS	**ENGLISH**

RATIONAL METHOD - DATA:

DRAINAGE BASIN

SUBSHED #	Land Use Description	Area Acres	C	C A
	Business: Industrial and Commercial (0.80-0.90)			
	Apartments and Townhomes (0.65-0.75)			
	Schools (0.50-0.60)			
	Residential - lots 10,000 sq. ft. (0.40-0.50)			
	- lots 12,000 sq. ft. (0.40-0.45)			
	- lots 17,000 sq. ft. (0.35-0.45)			
	- lots ½ acre or more (0.30-0.40)	0.00	0.35	
	Parks, Cemeteries and Unimproved Areas (0.20-0.35)			
	Paved and Roof Areas (0.90)	0.26	0.90	0.24
	Cultivated Areas (0.50-0.70)			
	Pasture (0.35-0.45)			
	Lawns (0.25-0.35)	0.76	0.30	0.23
	Forest (0.20-0.30)	0.29	0.25	0.07
	Steep Grass (2:1) (0.40-0.70)			
	Shoulder and Ditch Areas (0.35-0.50)			
	Totals =	**1.31 Acres**	**0.41**	**0.54**

Time of Concentration (Tc)

		Reach	Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Rational C		Tc (Minutes)
Overland Flow (E.E. Seelye - VDOT Modified)									
	Soil / Surface Type/Land Cover		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Rational C		
	Lawns	A-B	200.00	285.50	273.75	0.059	0.30		11.90
Channel Flow			Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Grass Channel		B-C	324.65	273.75	265.02	0.027	0.050	4.69	1.15
				Area =	12.00		Wetted P =	12.70	
Pipe Flow			Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
EX 660 to EX 661		C-D	200.58	265.02	263.68	0.007	0.013	10.11	0.33
	Pipe Diameter (in) =		54	Area =	15.90		Wetted P =	14.14	
								Total Tc (Minutes) =	**13.38**

		2-Year	5-Year	10-Year	25-Year	50-Year	100-Year
Rainfall Intensity	Inches / Hour.	**3.67**	**4.30**	**4.87**	**5.54**	**6.02**	**6.47**
Aosorption Coefficient / Ground Saturation Correction Coefficient Cf		1.00	1.00	1.00	1.10	1.20	1.25
Peak Discharge	CFS.	**1.97**	**2.30**	**2.61**	**3.27**	**3.87**	**4.34**

Post-Developed Storm Drain Inlet Map
PL23-OUT22
I-495 NEXT
Fairfax, VA

DRAINAGE AREA BOUNDARY

EXISTING CONTOURS

TIME OF CONCENTRATION

SCALE
0 60' 120'

SPENCER RD

SPENCER

Ex 660
DA=1.31
C=0.41

Ex 661
DA=0.00

A

B

C

EX-660

11-16
11-15
11-17
11-27
11-22
11-31
11-07
11-06
11-23
IV-24

24"

LOD

04/2022

LD-229
STORM SEWER DESIGN COMPUTATIONS

PROJECT: I-495 NEXT
LOCATION:
COUNTY: Vienna Tysons Corner

Designed by: JMON
Checked by: NVD

STORM FREQUENCY **2**

UNITS **ENGLISH**

PIPE NO.	FROM POINT REFERENCE	FROM POINT STA.	TO POINT REFERENCE	TO POINT STA.	DRAIN. AREA "A" Acre	RUNOFF COEFF. "C"	CA INCRE-MENT	CA ACCUM-ULATED	INLET TIME Minutes	RAIN FALL In/Hr	RUNOFF Lateral CFS	RUNOFF Total Q CFS	INVERT ELEVATIONS UPPER END	INVERT ELEVATIONS LOWER END	LENGTH of Pipe Ft.	SLOPE Ft./Ft.	SIZE (Dia. Or Span/Rise) In.	SHAPE	Number of Pipes	Capacity CFS	Friction Slope Ft./Ft.	NORMAL FLOW Depth of Flow, dn Ft.	NORMAL FLOW Area of Flow, An SqFt	NORMAL FLOW Hrn Ft.	NORMAL FLOW Vn Ft/Sec	NORMAL FLOW En Ft.	FLOW TIME INCRE-MENT Minutes	FLOW TIME ACCUMU-LATED Minutes	REMARKS
	(1)		(2)		(3)	(4)	(5)	(6)	(7)	(8)		(9)	(10)	(11)	(12)	(13)	(14)			(15)					(16)		(17)	(17)	(18)
EX660EX661	EX660		EX661		1.31	0.41	0.54	0.54	13.38	3.67	0.00	1.97	265.02	263.68	199.17	0.00673	42	Circular	1	82.54	0.00000	0.37	0.55	0.24	3.58	0.57	0.93	14.31	
EX661EX662	EX661		EX662		0.00		0.00	0.54	14.31	3.56	0.00	1.97	263.63	262.30	103.60	0.01284	42	Circular	1	114.01	0.00000	0.32	0.44	0.20	4.49	0.63	0.39	14.69	

*Enters existing structure 662 which is a Stormwater Management Structure.

LD-229
STORM SEWER DESIGN COMPUTATIONS

PROJECT: I-495 NEXT
LOCATION:
COUNTY: Vienna Tysons Corner

Designed by: JMON
Checked by: NVD

STORM FREQUENCY **10**

UNITS **ENGLISH**

PIPE NO.	FROM POINT REFERENCE	FROM POINT STA.	TO POINT REFERENCE	TO POINT STA.	DRAIN. AREA "A" Acre	RUNOFF COEFF. "C"	CA INCRE-MENT	CA ACCUM-ULATED	INLET TIME Minutes	RAIN FALL In/Hr	RUNOFF Lateral CFS	RUNOFF Total Q CFS	INVERT ELEVATIONS UPPER END	INVERT ELEVATIONS LOWER END	LENGTH of Pipe Ft.	SLOPE Ft./Ft.	SIZE (Dia. Or Span/Rise) In.	SHAPE	Number of Pipes	Capacity CFS	Friction Slope Ft./Ft.	NORMAL FLOW Depth of Flow, dn Ft.	NORMAL FLOW Area of Flow, An SqFt	NORMAL FLOW Hrn Ft.	NORMAL FLOW Vn Ft/Sec	NORMAL FLOW En Ft.	FLOW TIME INCRE-MENT Minutes	FLOW TIME ACCUMU-LATED Minutes	REMARKS
	(1)		(2)		(3)	(4)	(5)	(6)	(7)	(8)		(9)	(10)	(11)	(12)	(13)	(14)			(15)					(16)		(17)	(17)	(18)
EX660EX661	EX660		EX661		1.31	0.41	0.54	0.54	13.38	4.87	0.00	2.61	265.02	263.68	199.17	0.00673	42	Circular	1	82.54	0.00000	0.43	0.67	0.27	3.90	0.66	0.85	14.23	
EX661EX662	EX661		EX662		0.00		0.00	0.54	14.23	4.75	0.00	2.61	263.63	262.30	103.60	0.01284	42	Circular	1	114.01	0.00000	0.37	0.53	0.23	4.89	0.74	0.35	14.58	

*Enters existing structure 662 which is a Stormwater Management Structure.

APPENDIX C23
PL23-OUT23

Outfall PL23-OUT 23

Outfall PL23-OUT23 is an existing outfall at I-495 Southbound station 241+00 left. The outfall consists of an area of uncontrolled sheet flow. The outfall prior to development is 0.13 acres.

Development of this area will result in a reduced area to this outfall, due to the proposed ditches directing drainage to adjacent outfalls. The resulting area to the outfall will be 0.06 acres.

Drainage Area:

The drainage areas and resulting changes are summarized in the table below:

PL23-OUT 23			
Drainage Area	**Total Area**	**C (Total)**	**Tc**
Existing	0.13 ac	0.27	5.00 min
Proposed	0.06 ac	0.30	5.00 min

Limits of Study:

The location of the outfall is shown in the included outfall drainage map. The point of analysis is at the site limits.

Easement Requirements:

No additional easements are required.

Outfall Discharge:

All discharges were calculated using the Rational Method and are summarized below:

PL23-OUT 23		
Drainage Area	**Peak Flow Rate (Total)**	
	2 Year	10 Year
Existing	0.19 cfs	0.24 cfs
Proposed	0.09 cfs	0.11 cfs
Net Change	**-0.10 cfs**	**-0.13 cfs**

Final Opinion:

Area of increased volume of sheet flow must be identified and evaluated for potential impacts. As this outfall demonstrates a decreased volume of sheet flow, no further calculations are necessary. It is therefore our opinion that this outfall is adequate.

Pre-Developed Outfall Map
PL23-23
I-495
Fairfax, VA

DRAINAGE AREA BOUNDARY

EXISTING CONTOURS

TIME OF CONCENTRATION

PL23-OUT 23
DA = 0.13 AC
C = 0.27

SCALE
0 50' 100'

Post-Developed Outfall Map
PL23-23
I-495
Fairfax, VA

DRAINAGE AREA BOUNDARY

EXISTING CONTOURS

TIME OF CONCENTRATION

PL23-OUT 23
DA = 0.06 AC
C = 0.30

Name of Project:	495-NEXT			Designed By:	KRI
State:	VA	**County:**	Fairfax County	Date:	01/24/22
Name of Culvert:	Pre Development			Checked By:	NVD
NOAA Station:	Vienna Tysons 44-8737			Date:	01/24/22
LOCATION:	PL23-OUT 23				
				UNITS	**ENGLISH**

RATIONAL METHOD - DATA:

DRAINAGE BASIN

SUBSHED #	Land Use Description	Area Acres	C	C A
	Business: Industrial and Commercial (0.80-0.90)			
	Apartments and Townhomes (0.65-0.75)			
	Schools (0.50-0.60)			
	Residential - lots 10,000 sq. ft. (0.40-0.50)			
	- lots 12,000 sq. ft. (0.40-0.45)			
	- lots 17,000 sq. ft. (0.35-0.45)			
	- lots ½ acre or more (0.30-0.40)			
	Parks, Cemeteries and Unimproved Areas (0.20-0.35)			
	Paved and Roof Areas (0.90)			
	Cultivated Areas (0.50-0.70)			
	Pasture (0.35-0.45)			
	Lawns (0.25-0.35)	0.06	0.30	0.02
	Forest (0.20-0.30)	0.07	0.25	0.02
	Steep Grass (2:1) (0.40-0.70)			
	Shoulder and Ditch Areas (0.35-0.50)			
	Totals =	**0.13 Acres**	**0.27**	**0.04**

Time of Concentration (Tc)

	Reach	Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Rational C		Tc (Minutes)
							Total Tc (Minutes) =	**5.00**

		2-Year	**5-Year**	**10-Year**	**25-Year**	**50-Year**	**100-Year**
Rainfall Intensity	Inches / Hour.	**5.18**	**6.00**	**6.76**	**7.64**	**8.28**	**8.89**
Aosorption Coefficient / Ground Saturation Correction Coefficient Cf		1.00	1.00	1.00	1.10	1.20	1.25
Peak Discharge	CFS.	**0.19**	**0.22**	**0.24**	**0.30**	**0.36**	**0.40**

Name of Project:	495-NEXT			Designed By:	JMON
State:	VA	**County:**	Fairfax County	Date:	01/24/22
Name of Culvert:	Post Development			Checked By:	NVD
NOAA Station:	Vienna Tysons 44-8737			Date:	01/24/22
LOCATION:	PL23-OUT 23				
				UNITS	**ENGLISH**

RATIONAL METHOD - DATA:

DRAINAGE BASIN

SUBSHED #	Land Use Description	Area Acres	C	C A
	Business: Industrial and Commercial (0.80-0.90)			
	Apartments and Townhomes (0.65-0.75)			
	Schools (0.50-0.60)			
	Residential - lots 10,000 sq. ft. (0.40-0.50)			
	- lots 12,000 sq. ft. (0.40-0.45)			
	- lots 17,000 sq. ft. (0.35-0.45)			
	- lots ½ acre or more (0.30-0.40)			
	Parks, Cemeteries and Unimproved Areas (0.20-0.35)			
	Paved and Roof Areas (0.90)			
	Cultivated Areas (0.50-0.70)			
	Pasture (0.35-0.45)			
	Lawns (0.25-0.35)	0.06	0.30	0.02
	Forest (0.20-0.30)			
	Steep Grass (2:1) (0.40-0.70)			
	Shoulder and Ditch Areas (0.35-0.50)			
	Totals =	**0.06 Acres**	**0.30**	**0.02**

Time of Concentration (Tc)

	Reach	Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Rational C		Tc (Minutes)
							Total Tc (Minutes) =	**5.00**

		2-Year	**5-Year**	**10-Year**	**25-Year**	**50-Year**	**100-Year**
Rainfall Intensity	Inches / Hour.	**5.18**	**6.00**	**6.76**	**7.64**	**8.28**	**8.89**
Aosorption Coefficient / Ground Saturation Correction Coefficient Cf		1.00	1.00	1.00	1.10	1.20	1.25
Peak Discharge	CFS.	**0.09**	**0.10**	**0.11**	**0.14**	**0.17**	**0.19**

APPENDIX C24
PL23-OUT24

Outfall PL23-OUT 24

Outfall PL23-OUT24 is an existing outfall at I-495 Southbound station 245+19 left. The outfall consists of manmade stormwater conveyance system. In existing conditions, flow is conveyed through existing storm sewer and existing channel to the point of analysis. The outfall prior to development is 11.66 acres.

Development of this area will result in this outfall being eliminated. The drainage associated with this outfall will be conveyed to outfalls PL23-OUT20 and PL23-OUT35 due to the proposed roadway widening, the installation of storm sewer and ditches. The resulting area to the outfall will be 0.00 acres.

Drainage Area:

The drainage areas and resulting changes are summarized in the table below:

PL23-OUT 24			
Drainage Area	**Total Area**	**C (Total)**	**Tc**
Existing	11.66 ac	0.59	8.21 min
Proposed	0.00 ac	NA	NA

Limits of Study:

The location of the outfall is shown in the included outfall drainage map. The point of analysis is downstream of existing structure 181.

Easement Requirements:

No additional easements are required.

Outfall Discharge:

All discharges were calculated using the Rational Method and are summarized below:

PL23-OUT 24		
Drainage Area	**Peak Flow Rate (Total)**	
	2 Year	10 Year
Existing	30.62 cfs	40.24 cfs
Proposed	0.00 cfs	0.00 cfs
Net Change	**-30.62 cfs**	**-40.24 cfs**

Channel Protection:

Under Section 11.7.5.1 of the VDOT drainage manual, areas draining to a manmade stormwater conveyance channel shall satisfy the channel protection criteria by providing conveyance of the 2 year storm without causing erosion of the system. As this outfall is eliminated in the post-development condition, no additional analysis is required.

Flood Protection:

Under Section 11.7.5.2 of the VDOT drainage manual, areas draining to a manmade stormwater conveyance channel shall satisfy the flood protection criteria by demonstrating that the peak flow rate from a 10 year storm will be contained within the system. As this outfall is eliminated in the post-development condition, no additional analysis is required.

Final Opinion:

This outfall is a manmade stormwater conveyance system. We have shown compliance with the channel and flood protection criteria, by providing calculations demonstrating that the outfall will be eliminated in the post-development condition. It is therefore our opinion that this outfall is adequate.

Pre-Developed Outfall Map
PL23-24
I-495
Fairfax, VA

DRAINAGE AREA BOUNDARY

EXISTING CONTOURS

TIME OF CONCENTRATION

PL23-OUT 24
DA = 11.66 AC
C = 0.59

A

B

C

D

E

SCALE
0 125' 300'

Name of Project:	495-NEXT			Designed By:	KRI
State:	VA	**County:**	Fairfax County	Date:	09/02/21
Name of Culvert:	Pre Development			Checked By:	NVD
NOAA Station:	Vienna Tysons 44-8737			Date:	09/02/21
LOCATION:	PL23-OUT 24				
				UNITS	**ENGLISH**

RATIONAL METHOD - DATA:

DRAINAGE BASIN

SUBSHED #	Land Use Description	Area Acres	C	C A
	Business: Industrial and Commercial (0.80-0.90)			
	Apartments and Townhomes (0.65-0.75)			
	Schools (0.50-0.60)			
	Residential - lots 10,000 sq. ft. (0.40-0.50)			
	- lots 12,000 sq. ft. (0.40-0.45)			
	- lots 17,000 sq. ft. (0.35-0.45)			
	- lots ½ acre or more (0.30-0.40)			
	Parks, Cemeteries and Unimproved Areas (0.20-0.35)			
	Paved and Roof Areas (0.90)	5.73	0.90	5.16
	Cultivated Areas (0.50-0.70)			
	Pasture (0.35-0.45)			
	Lawns (0.25-0.35)	4.50	0.30	1.35
	Forest (0.20-0.30)	1.43	0.25	0.36
	Steep Grass (2:1) (0.40-0.70)			
	Shoulder and Ditch Areas (0.35-0.50)			
	Totals =	**11.66 Acres**	**0.59**	**6.86**

Time of Concentration (Tc)

	Reach		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Rational C		Tc (Minutes)
Overland Flow (E.E. Seelye - VDOT Modified)									
	Soil / Surface Type/Land Cover		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Rational C		
	Lawn	A-B	24.76	313.14	312.43	0.029	0.30		5.67
Channel Flow			Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Roadside Ditch		B-C	797.39	312.43	299.91	0.016	0.030	5.98	2.22
				Area =	12.00		Wetted P =	12.70	
Pipe Flow			Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
EX182 to EX181		C-D	245.70	299.91	281.17	0.076	0.013	19.89	0.21
	Pipe Diameter (in) =		24	Area =	3.14		Wetted P =	6.28	
Channel Flow			Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Natural Channel		D-E	21.58	281.17	280.91	0.012	0.050	3.14	0.11
				Area =	12.00		Wetted P =	12.70	
								Total Tc (Minutes) =	**8.21**

	2-Year	**5-Year**	**10-Year**	**25-Year**	**50-Year**	**100-Year**
Rainfall Intensity Inches / Hour.	**4.46**	**5.19**	**5.86**	**6.64**	**7.20**	**7.73**
Aosorption Coefficient / Ground Saturation Correction Coefficient Cf	1.00	1.00	1.00	1.10	1.20	1.25
Peak Discharge CFS.	**30.62**	**35.63**	**40.24**	**50.13**	**59.31**	**66.32**

Name of Project:	495-NEXT			Designed By:	JMON
State:	VA	**County:**	Fairfax County	Date:	09/01/21
Name of Culvert:	Post Development			Checked By:	NVD
NOAA Station:	Vienna Tysons 44-8737			Date:	09/01/21
LOCATION:	PL23-OUT 24				
				UNITS	**ENGLISH**

RATIONAL METHOD - DATA:

DRAINAGE BASIN

SUBSHED #	Land Use Description	Area Acres	C	C A
	Business: Industrial and Commercial (0.80-0.90)			
	Apartments and Townhomes (0.65-0.75)			
	Schools (0.50-0.60)			
	Residential - lots 10,000 sq. ft. (0.40-0.50)			
	- lots 12,000 sq. ft. (0.40-0.45)			
	- lots 17,000 sq. ft. (0.35-0.45)			
	- lots ½ acre or more (0.30-0.40)			
	Parks, Cemeteries and Unimproved Areas (0.20-0.35)			
	Paved and Roof Areas (0.90)	0.00	0.90	
	Cultivated Areas (0.50-0.70)			
	Pasture (0.35-0.45)			
	Lawns (0.25-0.35)	0.00	0.30	
	Forest (0.20-0.30)	0.00	0.25	
	Steep Grass (2:1) (0.40-0.70)			
	Shoulder and Ditch Areas (0.35-0.50)			
	Totals =	**0.00 Acres**	**0.00**	**0.00**

Time of Concentration (Tc)

	Reach	Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Rational C		Tc (Minutes)
							Total Tc (Minutes) =	**0.00**

		2-Year	**5-Year**	**10-Year**	**25-Year**	**50-Year**	**100-Year**
Rainfall Intensity	Inches / Hour.	**7.02**	**8.03**	**9.01**	**10.18**	**11.08**	**11.95**
Aosorption Coefficient / Ground Saturation Correction Coefficient Cf		1.00	1.00	1.00	1.10	1.20	1.25
Peak Discharge	CFS.	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**

APPENDIX C25
PL23-OUT25

Outfall PL23-OUT 25

Outfall PL23-OUT25 is an existing outfall at I-495 Southbound station 245+50 left. The outfall consists of an area of uncontrolled sheet flow. The outfall prior to development is 0.51 acres.

Development of this area will result in a reduced area to this outfall, due to the proposed roadway widening. The resulting area to the outfall will be 0.17 acres.

Drainage Area:

The drainage areas and resulting changes are summarized in the table below:

PL23-OUT 25			
Drainage Area	**Total Area**	**C (Total)**	**Tc**
Existing	0.51 ac	0.29	5.00 min
Proposed	0.17 ac	0.32	5.00 min

Limits of Study:

The location of the outfall is shown in the included outfall drainage map. The point of analysis is at the site limits.

Easement Requirements:

No additional easements are required.

Outfall Discharge:

All discharges were calculated using the Rational Method and are summarized below:

PL23-OUT 25		
Drainage Area	**Peak Flow Rate (Total)**	
	2 Year	10 Year
Existing	0.78 cfs	1.01 cfs
Proposed	0.28 cfs	0.37 cfs
Net Change	**-0.50 cfs**	**-0.64 cfs**

Final Opinion:

Area of increased volume of sheet flow must be identified and evaluated for potential impacts. As this outfall demonstrates a decreased volume of sheet flow, no further calculations are necessary. It is therefore our opinion that this outfall is adequate.

Pre-Developed Outfall Map
PL23-25
I-495
Fairfax, VA

DRAINAGE AREA BOUNDARY

EXISTING CONTOURS

TIME OF CONCENTRATION

PL23-OUT 25
DA = 0.51 AC
C = 0.29

SCALE
0 75' 150'

Post-Developed Outfall Map
PL23-25
I-495
Fairfax, VA

DRAINAGE AREA BOUNDARY

EXISTING CONTOURS

TIME OF CONCENTRATION

PL23-OUT 25
DA = 0.17 AC
C = 0.32

SCALE
0 75' 150'

Name of Project:	495-NEXT			Designed By:	KRI
State:	VA	**County:**	Fairfax County	Date:	09/07/21
Name of Culvert:	Pre Development			Checked By:	NVD
NOAA Station:	Vienna Tysons 44-8737			Date:	09/07/21
LOCATION:	PL23-OUT 25				
				UNITS	**ENGLISH**

RATIONAL METHOD - DATA:

DRAINAGE BASIN

SUBSHED #	Land Use Description	Area Acres	C	C A
	Business: Industrial and Commercial (0.80-0.90)			
	Apartments and Townhomes (0.65-0.75)			
	Schools (0.50-0.60)			
	Residential - lots 10,000 sq. ft. (0.40-0.50)			
	- lots 12,000 sq. ft. (0.40-0.45)			
	- lots 17,000 sq. ft. (0.35-0.45)			
	- lots ½ acre or more (0.30-0.40)		0.35	
	Parks, Cemeteries and Unimproved Areas (0.20-0.35)			
	Paved and Roof Areas (0.90)		0.90	
	Cultivated Areas (0.50-0.70)			
	Pasture (0.35-0.45)			
	Lawns (0.25-0.35)	0.44	0.30	0.13
	Forest (0.20-0.30)	0.07	0.25	0.02
	Steep Grass (2:1) (0.40-0.70)			
	Shoulder and Ditch Areas (0.35-0.50)			
	Totals =	**0.51 Acres**	**0.29**	**0.15**

Time of Concentration (Tc)

	Reach	Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Rational C		Tc (Minutes)
							Total Tc (Minutes) =	**5.00**

		2-Year	**5-Year**	**10-Year**	**25-Year**	**50-Year**	**100-Year**
Rainfall Intensity	Inches / Hour.	**5.18**	**6.00**	**6.76**	**7.64**	**8.28**	**8.89**
Aosorption Coefficient / Ground Saturation Correction Coefficient Cf		1.00	1.00	1.00	1.10	1.20	1.25
Peak Discharge	CFS.	**0.78**	**0.90**	**1.01**	**1.26**	**1.49**	**1.67**

Name of Project:	495-NEXT			Designed By:	JMON
State:	VA	**County:**	Fairfax County	Date:	01/21/22
Name of Culvert:	Post Development			Checked By:	NVD
NOAA Station:	Vienna Tysons 44-8737			Date:	01/21/22
LOCATION:	PL23-OUT 25				
				UNITS	**ENGLISH**

RATIONAL METHOD - DATA:

DRAINAGE BASIN

SUBSHED #	Land Use Description	Area Acres	C	C A
	Business: Industrial and Commercial (0.80-0.90)			
	Apartments and Townhomes (0.65-0.75)			
	Schools (0.50-0.60)		0.50	
	Residential - lots 10,000 sq. ft. (0.40-0.50)			
	- lots 12,000 sq. ft. (0.40-0.45)			
	- lots 17,000 sq. ft. (0.35-0.45)			
	- lots ½ acre or more (0.30-0.40)		0.35	
	Parks, Cemeteries and Unimproved Areas (0.20-0.35)			
	Paved and Roof Areas (0.90)	0.01	0.90	0.01
	Cultivated Areas (0.50-0.70)			
	Pasture (0.35-0.45)			
	Lawns (0.25-0.35)	0.16	0.30	0.05
	Forest (0.20-0.30)		0.25	
	Steep Grass (2:1) (0.40-0.70)			
	Shoulder and Ditch Areas (0.35-0.50)			
	Totals =	**0.17 Acres**	**0.32**	**0.05**

Time of Concentration (Tc)

	Reach	Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Rational C		Tc (Minutes)
							Total Tc (Minutes) =	**5.00**

		2-Year	**5-Year**	**10-Year**	**25-Year**	**50-Year**	**100-Year**
Rainfall Intensity	Inches / Hour.	**5.18**	**6.00**	**6.76**	**7.64**	**8.28**	**8.89**
Aosorption Coefficient / Ground Saturation Correction Coefficient Cf		1.00	1.00	1.00	1.10	1.20	1.25
Peak Discharge	CFS.	**0.28**	**0.33**	**0.37**	**0.46**	**0.55**	**0.61**

APPENDIX C26
PL23-OUT26

Outfall PL23-OUT 26

Outfall PL23-OUT26 is an existing outfall at Georgetown Pike station 13+21 right. The outfall consists of a manmade stormwater conveyance system. In existing conditions, flow is conveyed through existing channels, storm sewer, culverts and sheet flow to the point of analysis. The outfall prior to development is 3.31 acres.

Development of this area will result in decreased area to this outfall, due to the proposed storm sewer design directing drainage to adjacent outfalls. The resulting area to the outfall will be 3.27 acres.

Drainage Area:

The drainage areas and resulting changes are summarized in the table below:

PL23-OUT 26			
Drainage Area	**Total Area**	**C (Total)**	**Tc**
Existing	3.31 ac	0.50	12.10 min
Proposed	3.27 ac	0.48	12.02 min

Limits of Study:

The location of the outfall is shown in the included outfall drainage map. The point of analysis is within the existing channel south of Georgetown Pike.

Easement Requirements:

No additional easements are required.

Outfall Discharge:

All discharges were calculated using the Rational Method and are summarized below:

PL23-OUT 26		
Drainage Area	**Peak Flow Rate (Total)**	
	2 Year	10 Year
Existing	6.29 cfs	8.33 cfs
Proposed	6.03 cfs	7.99 cfs
Net Change	**-0.26 cfs**	**-0.34 cfs**

Channel Description:

The channel at Outfall PL23-OUT 26 is a manmade channel. Cross Sections were prepared utilizing topography prepared by Rinker Design Associates, P.C. and Fairfax County GIS.

Channel Protection:

Under Section 11.7.5.1 of the VDOT drainage manual, areas draining to a manmade stormwater conveyance channel shall satisfy the channel protection criteria by providing conveyance of the 2 year storm without causing erosion of the system. Calculations have been provided below supporting the 2 year velocities in the system:

Cross Section	Channel Protection - 2 Year Velocity				Outfall Adequate?
	Channel Lining	Max Permissible Velocity (ft/s)	Existing Velocity (ft/s)	Proposed Velocity (ft/s)	
A-A	Meadowville Complex	2.3	4.05	4.01	Yes
B-B	Meadowville Complex	2.3	3.58	3.55	Yes
C-C	Meadowville Complex	2.3	3.81	3.78	Yes

As the velocities anticipated are not within the allowable range for this soil type, a site design has been developed to cause the pre-development rate from the 2 year storm to not increase (per Section 11.7.5.1). As there us a net 0.26 cfs reduction for the 2 year storm, requirements for channel protection have been met for this outfall.

Flood Protection:

Under Section 11.7.5.2 of the VDOT drainage manual, areas draining to a manmade stormwater conveyance channel shall satisfy the flood protection criteria by demonstrating that the peak flow rate from a 10 year storm will be contained within the existing channel. The post developed flows to the channel have been analyzed and yield the following results:

Cross Section	Flood Protection - 10 Year Capacity		Outfall Adequate?
	Channel Depth (ft)	Normal Depth (ft)	
A-A	1.70	0.70	Yes
B-B	1.00	0.60	Yes
C-C	1.65	0.60	Yes

Final Opinion:

This outfall is a manmade stormwater conveyance system. We have shown compliance with the channel protection criteria by providing calculations demonstrating a reduction in the 2 and 10 year peak flow rates. We have shown compliance with the flood protection criteria, by demonstrating the peak discharge from a 10 year storm will be contained within the existing channel. It is therefore our opinion that this outfall is adequate.

Pre-Developed Outfall Map
PL23-26
I-495
Fairfax, VA

PL23-OUT 26
DA = 3.31 AC
C = 0.50

DRAINAGE AREA BOUNDARY

EXISTING CONTOURS

TIME OF CONCENTRATION

SCALE
0 100' 200'

04/2022

Post-Developed Outfall Map
PL23-26
I-495
Fairfax, VA

PL23-OUT 26
DA = 3.27 AC
C = 0.48

DRAINAGE AREA BOUNDARY

EXISTING CONTOURS

TIME OF CONCENTRATION

SCALE
0 100' 200'

04/2022

Name of Project:	495-NEXT			Designed By:	KRI
State:	VA	**County:**	Fairfax County	Date:	11/29/21
Name of Culvert:	Pre Development			Checked By:	NVD
NOAA Station:	Vienna Tysons 44-8737			Date:	11/29/21
LOCATION:	PL23-OUT 26				
				UNITS	**ENGLISH**

RATIONAL METHOD - DATA:

DRAINAGE BASIN

SUBSHED #	Land Use Description	Area Acres	C	C A
	Business: Industrial and Commercial (0.80-0.90)			
	Apartments and Townhomes (0.65-0.75)			
	Schools (0.50-0.60)			
	Residential - lots 10,000 sq. ft. (0.40-0.50)			
	- lots 12,000 sq. ft. (0.40-0.45)			
	- lots 17,000 sq. ft. (0.35-0.45)			
	- lots ½ acre or more (0.30-0.40)	0.76	0.35	0.27
	Parks, Cemeteries and Unimproved Areas (0.20-0.35)			
	Paved and Roof Areas (0.90)	1.10	0.90	0.99
	Cultivated Areas (0.50-0.70)			
	Pasture (0.35-0.45)			
	Lawns (0.25-0.35)	0.44	0.30	0.13
	Forest (0.20-0.30)	1.00	0.25	0.25
	Steep Grass (2:1) (0.40-0.70)			
	Shoulder and Ditch Areas (0.35-0.50)			
	Totals =	**3.31 Acres**	**0.50**	**1.64**

Time of Concentration (Tc)

	Reach	Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Rational C		Tc (Minutes)
Overland Flow (E.E. Seelye - VDOT Modified)								
Soil / Surface Type/Land Cover		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Rational C		
Forest	A-B	97.86	326.13	320.80	0.054	0.25		10.73
Shallow Concentrated Flow		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Intercept Coeff.		
Grassed waterway	B-C	38.99	320.80	317.68	0.080	0.457		0.15
Channel Flow		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Roadside Ditch	C-D	177.71	317.68	314.07	0.020	0.025	8.16	0.36
			Area =	12.00		Wetted P =	12.70	
Channel Flow		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Roadside Ditch	D-E	57.25	314.07	312.12	0.034	0.013	20.31	0.05
			Area =	12.00		Wetted P =	12.70	
Pipe Flow		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
EX166 to EX169	E-F	262.05	306.52	297.57	0.034	0.013	10.99	0.40
Pipe Diameter (in) =		18	Area =	1.77		Wetted P =	4.71	
Channel Flow		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Roadside Ditch	F-G	75.53	297.57	294.00	0.047	0.040	7.78	0.16
			Area =	12.00		Wetted P =	12.70	
Pipe Flow		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Ex Culvert (Information Assumed)	G-H	30.34	294.00	293.00	0.033	0.013	10.79	0.05
Pipe Diameter (in) =		18	Area =	1.77		Wetted P =	4.71	
Channel Flow		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Roadside Ditch	H-I	115.95	293.00	285.00	0.069	0.040	9.40	0.21
			Area =	12.00		Wetted P =	12.70	
							Total Tc (Minutes) =	**12.10**

		2-Year	5-Year	10-Year	25-Year	50-Year	100-Year
Rainfall Intensity	Inches / Hour.	**3.84**	**4.48**	**5.08**	**5.77**	**6.27**	**6.73**
Aosorption Coefficient / Ground Saturation Correction Coefficient Cf		1.00	1.00	1.00	1.10	1.20	1.25
Peak Discharge	CFS.	**6.29**	**7.35**	**8.33**	**10.41**	**12.33**	**13.80**

Name of Project:	495-NEXT			Designed By:	JMON
State:	VA	**County:**	Fairfax County	Date:	11/29/21
Name of Culvert:	Post Development			Checked By:	NVD
NOAA Station:	Vienna Tysons 44-8737			Date:	11/29/21
LOCATION:	PL23-OUT 26				
				UNITS	**ENGLISH**

RATIONAL METHOD - DATA:

DRAINAGE BASIN

SUBSHED #	Land Use Description	Area Acres	C	C A
	Business: Industrial and Commercial (0.80-0.90)			
	Apartments and Townhomes (0.65-0.75)			
	Schools (0.50-0.60)		0.50	
	Residential - lots 10,000 sq. ft. (0.40-0.50)			
	- lots 12,000 sq. ft. (0.40-0.45)			
	- lots 17,000 sq. ft. (0.35-0.45)			
	- lots ½ acre or more (0.30-0.40)	0.76	0.35	0.27
	Parks, Cemeteries and Unimproved Areas (0.20-0.35)			
	Paved and Roof Areas (0.90)	0.99	0.90	0.89
	Cultivated Areas (0.50-0.70)			
	Pasture (0.35-0.45)			
	Lawns (0.25-0.35)	0.69	0.30	0.21
	Forest (0.20-0.30)	0.83	0.25	0.21
	Steep Grass (2:1) (0.40-0.70)			
	Shoulder and Ditch Areas (0.35-0.50)			
	Totals =	**3.27 Acres**	**0.48**	**1.57**

Time of Concentration (Tc)

	Reach	Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Rational C		Tc (Minutes)
Overland Flow (E.E. Seelye - VDOT Modified)								
Soil / Surface Type/Land Cover		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Rational C		
Lawn	A-B	129.16	326.44	321.00	0.042	0.30		10.55
Shallow Concentrated Flow		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Intercept Coeff.		
Grassed waterway	B-C	34.77	321.00	316.89	0.118	0.457		0.11
Channel Flow		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Roadside Ditch	C-D	211.41	316.89	312.12	0.023	0.030	7.16	0.49
			Area =	12.00		Wetted P =	12.70	
Pipe Flow		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
EX166 to EX168	D-E	238.43	306.52	297.93	0.036	0.013	9.99	0.40
Pipe Diameter (in) =		15	Area =	1.23		Wetted P =	3.93	
Pipe Flow		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
EX168 to EX169	E-F	25.73	297.93	297.57	0.014	0.013	7.03	0.06
Pipe Diameter (in) =		18	Area =	1.77		Wetted P =	4.71	
Channel Flow		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Roadside Ditch	F-G	75.53	297.57	294.00	0.047	0.040	7.78	0.16
			Area =	12.00		Wetted P =	12.70	
Pipe Flow		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Ex Culvert (Information Assumed)	G-H	30.34	294.00	293.00	0.033	0.013	10.79	0.05
Pipe Diameter (in) =		18	Area =	1.77		Wetted P =	4.71	
Channel Flow		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Roadside Ditch	H-I	115.95	293.00	285.00	0.069	0.040	9.40	0.21
			Area =	12.00		Wetted P =	12.70	
							Total Tc (Minutes) =	**12.02**

		2-Year	**5-Year**	**10-Year**	**25-Year**	**50-Year**	**100-Year**
Rainfall Intensity	Inches / Hour.	**3.85**	**4.50**	**5.10**	**5.79**	**6.28**	**6.75**
Aosorption Coefficient / Ground Saturation Correction Coefficient Cf		1.00	1.00	1.00	1.10	1.20	1.25
Peak Discharge	CFS.	**6.03**	**7.05**	**7.99**	**9.98**	**11.82**	**13.23**

Outfall PL23-OUT26 Sections A-A, B-B, C-C: Looking Upstream

Outfall PL23-OUT26 Sections A-A, B-B, C-C: Looking Downstream

PL23-OUT26 Cross Sections
I-495 NEXT
Fairfax,VA

DRAINAGE AREA BOUNDARY

EXISTING CONTOURS

TIME OF CONCENTRATION

SCALE

0 40' 80'

SECTION C-C

SECTION B-B

SECTION A-A

GEORGETOWN PIKE (VA RTE 193)

Iron Fence

Legend Ditch

Name of Project:	495-NEXT			Designed By:	JMON
State:	VA	**County:**	Fairfax County	Date:	11/29/21
Name of Culvert:	Pre Development			Checked By:	NVD
NOAA Station:	Vienna Tysons 44-8737			Date:	11/29/21
LOCATION:	PL23-OUT 26 A-A				
				UNITS	**ENGLISH**

RATIONAL METHOD - DATA:

DRAINAGE BASIN

SUBSHED #	Land Use Description	Area Acres	C	C A
	Business: Industrial and Commercial (0.80-0.90)			
	Apartments and Townhomes (0.65-0.75)			
	Schools (0.50-0.60)			
	Residential - lots 10,000 sq. ft. (0.40-0.50)			
	- lots 12,000 sq. ft. (0.40-0.45)			
	- lots 17,000 sq. ft. (0.35-0.45)			
	- lots ½ acre or more (0.30-0.40)	0.82	0.35	0.29
	Parks, Cemeteries and Unimproved Areas (0.20-0.35)			
	Paved and Roof Areas (0.90)	1.18	0.90	1.06
	Cultivated Areas (0.50-0.70)			
	Pasture (0.35-0.45)			
	Lawns (0.25-0.35)	0.45	0.30	0.13
	Forest (0.20-0.30)	1.00	0.25	0.25
	Steep Grass (2:1) (0.40-0.70)			
	Shoulder and Ditch Areas (0.35-0.50)			
	Totals =	**3.45 Acres**	**0.50**	**1.74**

Time of Concentration (Tc)

	Reach	Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Rational C		Tc (Minutes)
Overland Flow (E.E. Seelye - VDOT Modified)								
Soil / Surface Type/Land Cover		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Rational C		
Forest	A-B	97.86	326.13	320.80	0.054	0.25		10.73
Shallow Concentrated Flow		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Intercept Coeff.		
Grassed waterway	B-C	38.99	320.80	317.68	0.080	0.457		0.15
Channel Flow		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Roadside Ditch	C-D	177.71	317.68	314.07	0.020	0.025	8.16	0.36
			Area =	12.00		Wetted P =	12.70	
Channel Flow		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Roadside Ditch	D-E	57.25	314.07	312.12	0.034	0.013	20.31	0.05
			Area =	12.00		Wetted P =	12.70	
Pipe Flow		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
EX166 to EX169	E-F	262.05	306.52	297.57	0.034	0.013	10.99	0.40
Pipe Diameter (in) =		18	Area =	1.77		Wetted P =	4.71	
Channel Flow		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Roadside Ditch	F-G	75.53	297.57	294.00	0.047	0.040	7.78	0.16
			Area =	12.00		Wetted P =	12.70	
Pipe Flow		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Ex Culvert (Information Assumed)	G-H	30.34	294.00	293.00	0.033	0.013	10.79	0.05
Pipe Diameter (in) =		18	Area =	1.77		Wetted P =	4.71	
Channel Flow		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Roadside Ditch	H-I	165.95	293.00	281.32	0.070	0.040	9.49	0.29
			Area =	12.00		Wetted P =	12.70	
							Total Tc (Minutes) =	**12.19**

		2-Year	5-Year	10-Year	25-Year	50-Year	100-Year
Rainfall Intensity	Inches / Hour.	**3.82**	**4.47**	**5.07**	**5.75**	**6.25**	**6.71**
Aosorption Coefficient / Ground Saturation Correction Coefficient Cf		1.00	1.00	1.00	1.10	1.20	1.25
Peak Discharge	CFS.	**6.64**	**7.77**	**8.80**	**10.99**	**13.02**	**14.58**

Name of Project:	495-NEXT			Designed By:	JMON
State:	VA	**County:**	Fairfax County	Date:	11/29/21
Name of Culvert:	Post Development			Checked By:	NVD
NOAA Station:	Vienna Tysons 44-8737			Date:	11/29/21
LOCATION:	PL23-OUT 26 A-A				
				UNITS	**ENGLISH**

RATIONAL METHOD - DATA:

DRAINAGE BASIN

SUBSHED #	Land Use Description	Area Acres	C	C A
	Business: Industrial and Commercial (0.80-0.90)			
	Apartments and Townhomes (0.65-0.75)			
	Schools (0.50-0.60)		0.50	
	Residential - lots 10,000 sq. ft. (0.40-0.50)			
	- lots 12,000 sq. ft. (0.40-0.45)			
	- lots 17,000 sq. ft. (0.35-0.45)			
	- lots ½ acre or more (0.30-0.40)	0.82	0.35	0.29
	Parks, Cemeteries and Unimproved Areas (0.20-0.35)			
	Paved and Roof Areas (0.90)	1.07	0.90	0.96
	Cultivated Areas (0.50-0.70)			
	Pasture (0.35-0.45)			
	Lawns (0.25-0.35)	0.70	0.30	0.21
	Forest (0.20-0.30)	0.83	0.25	0.21
	Steep Grass (2:1) (0.40-0.70)			
	Shoulder and Ditch Areas (0.35-0.50)			
	Totals =	**3.41 Acres**	**0.49**	**1.67**

Time of Concentration (Tc)

	Reach	Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Rational C		Tc (Minutes)
Overland Flow (E.E. Seelye - VDOT Modified)								
Soil / Surface Type/Land Cover		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Rational C		
Lawn	A-B	129.16	326.44	321.00	0.042	0.30		10.55
Shallow Concentrated Flow		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Intercept Coeff.		
Grassed waterway	B-C	34.77	321.00	316.89	0.118	0.457		0.11
Channel Flow		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Roadside Ditch	C-D	211.41	316.89	312.12	0.023	0.030	7.16	0.49
			Area =	12.00		Wetted P =	12.70	
Pipe Flow		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
EX166 to EX168	D-E	238.43	306.52	297.93	0.036	0.013	9.99	0.40
Pipe Diameter (in) =		15	Area =	1.23		Wetted P =	3.93	
Pipe Flow		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
EX168 to EX169	E-F	25.73	297.93	297.57	0.014	0.013	7.03	0.06
Pipe Diameter (in) =		18	Area =	1.77		Wetted P =	4.71	
Channel Flow		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Roadside Ditch	F-G	75.53	297.57	294.00	0.047	0.040	7.78	0.16
			Area =	12.00		Wetted P =	12.70	
Pipe Flow		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Ex Culvert (Information Assumed)	G-H	30.34	294.00	293.00	0.033	0.013	10.79	0.05
Pipe Diameter (in) =		18	Area =	1.77		Wetted P =	4.71	
Channel Flow		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Roadside Ditch	H-I	165.95	293.00	281.32	0.070	0.040	9.49	0.29
			Area =	12.00		Wetted P =	12.70	
							Total Tc (Minutes) =	**12.11**

		2-Year	5-Year	10-Year	25-Year	50-Year	100-Year
Rainfall Intensity	Inches / Hour.	**3.83**	**4.48**	**5.08**	**5.77**	**6.26**	**6.73**
Aosorption Coefficient / Ground Saturation Correction Coefficient Cf		1.00	1.00	1.00	1.10	1.20	1.25
Peak Discharge	CFS.	**6.38**	**7.47**	**8.46**	**10.57**	**12.52**	**14.01**

PL23-OUT26 (A-A) Pre - 2yr

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Channel Slope	0.055 ft/ft
Discharge	6.64 cfs

Section Definitions

Station (ft)	Elevation (ft)
0+00	285.00
0+02	284.00
0+04	283.00
0+07	282.00
0+09	281.32
0+12	282.00
0+15	283.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 285.00)	(0+15, 283.00)	0.040

Options	
Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results	
Normal Depth	0.7 ft
Roughness Coefficient	0.040
Elevation	281.98 ft
Elevation Range	281.3 to 285.0 ft
Flow Area	1.6 ft²
Wetted Perimeter	5.2 ft
Hydraulic Radius	0.3 ft
Top Width	4.99 ft
Normal Depth	0.7 ft
Critical Depth	0.7 ft
Critical Slope	0.034 ft/ft
Velocity	4.05 ft/s
Velocity Head	0.26 ft
Specific Energy	0.91 ft

PL23-OUT26 (A-A) Pre - 2yr

Results	
Froude Number	1.247
Flow Type	Supercritical

GVF Input Data	
Downstream Depth	0.0 ft
Length	0.0 ft
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.0 ft
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	0.7 ft
Critical Depth	0.7 ft
Channel Slope	0.055 ft/ft
Critical Slope	0.034 ft/ft

PL23-OUT26 (A-A) Post - 2yr

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Channel Slope	0.055 ft/ft
Discharge	6.38 cfs

Section Definitions

Station (ft)	Elevation (ft)
0+00	285.00
0+02	284.00
0+04	283.00
0+07	282.00
0+09	281.32
0+12	282.00
0+15	283.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 285.00)	(0+15, 283.00)	0.040

Options	
Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results	
Normal Depth	0.6 ft
Roughness Coefficient	0.040
Elevation	281.97 ft
Elevation Range	281.3 to 285.0 ft
Flow Area	1.6 ft²
Wetted Perimeter	5.1 ft
Hydraulic Radius	0.3 ft
Top Width	4.91 ft
Normal Depth	0.6 ft
Critical Depth	0.7 ft
Critical Slope	0.034 ft/ft
Velocity	4.01 ft/s
Velocity Head	0.25 ft
Specific Energy	0.90 ft

PL23-OUT26 (A-A) Post - 2yr

Results	
Froude Number	1.244
Flow Type	Supercritical

GVF Input Data	
Downstream Depth	0.0 ft
Length	0.0 ft
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.0 ft
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	0.6 ft
Critical Depth	0.7 ft
Channel Slope	0.055 ft/ft
Critical Slope	0.034 ft/ft

PL23-OUT26 (A-A) Post - 10yr

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Channel Slope	0.055 ft/ft
Discharge	8.46 cfs

Section Definitions

Station (ft)	Elevation (ft)
0+00	285.00
0+02	284.00
0+04	283.00
0+07	282.00
0+09	281.32
0+12	282.00
0+15	283.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 285.00)	(0+15, 283.00)	0.040

Options	
Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results	
Normal Depth	0.7 ft
Roughness Coefficient	0.040
Elevation	282.04 ft
Elevation Range	281.3 to 285.0 ft
Flow Area	1.9 ft²
Wetted Perimeter	5.5 ft
Hydraulic Radius	0.4 ft
Top Width	5.34 ft
Normal Depth	0.7 ft
Critical Depth	0.8 ft
Critical Slope	0.033 ft/ft
Velocity	4.34 ft/s
Velocity Head	0.29 ft
Specific Energy	1.01 ft

PL23-OUT26 (A-A) Post - 10yr

Results	
Froude Number	1.268
Flow Type	Supercritical

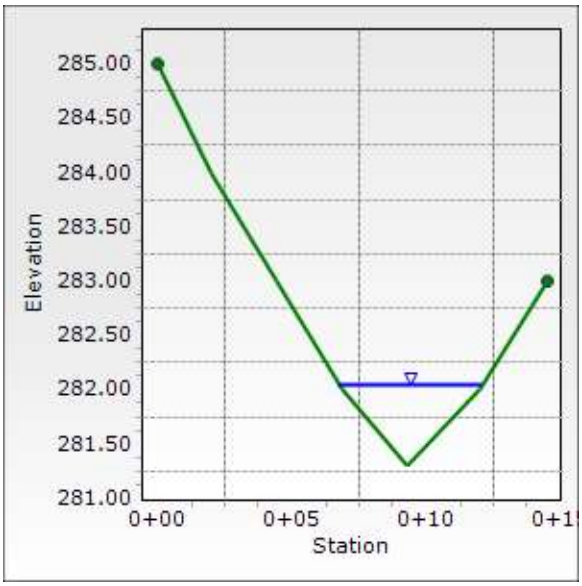
GVF Input Data	
Downstream Depth	0.0 ft
Length	0.0 ft
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.0 ft
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	0.7 ft
Critical Depth	0.8 ft
Channel Slope	0.055 ft/ft
Critical Slope	0.033 ft/ft

PL23-OUT26 (A-A) Post - 10yr

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Channel Slope	0.055 ft/ft
Normal Depth	0.7 ft
Discharge	8.46 cfs



Name of Project:	495-NEXT			Designed By:	JMON
State:	VA	**County:**	Fairfax County	Date:	11/29/21
Name of Culvert:	Pre Development			Checked By:	NVD
NOAA Station:	Vienna Tysons 44-8737			Date:	11/29/21
LOCATION:	PL23-OUT 26 B-B				
				UNITS	**ENGLISH**

RATIONAL METHOD - DATA:

DRAINAGE BASIN

SUBSHED #	Land Use Description	Area Acres	C	C A
	Business: Industrial and Commercial (0.80-0.90)			
	Apartments and Townhomes (0.65-0.75)			
	Schools (0.50-0.60)			
	Residential - lots 10,000 sq. ft. (0.40-0.50)			
	- lots 12,000 sq. ft. (0.40-0.45)			
	- lots 17,000 sq. ft. (0.35-0.45)			
	- lots ½ acre or more (0.30-0.40)	0.85	0.35	0.30
	Parks, Cemeteries and Unimproved Areas (0.20-0.35)			
	Paved and Roof Areas (0.90)	1.21	0.90	1.09
	Cultivated Areas (0.50-0.70)			
	Pasture (0.35-0.45)			
	Lawns (0.25-0.35)	0.45	0.30	0.14
	Forest (0.20-0.30)	1.00	0.25	0.25
	Steep Grass (2:1) (0.40-0.70)			
	Shoulder and Ditch Areas (0.35-0.50)			
	Totals =	**3.51 Acres**	**0.50**	**1.77**

Time of Concentration (Tc)

	Reach	Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Rational C		Tc (Minutes)
Overland Flow (E.E. Seelye - VDOT Modified)								
Soil / Surface Type/Land Cover		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Rational C		
Forest	A-B	97.86	326.13	320.80	0.054	0.25		10.73
Shallow Concentrated Flow		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Intercept Coeff.		
Grassed waterway	B-C	38.99	320.80	317.68	0.080	0.457		0.15
Channel Flow		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Roadside Ditch	C-D	177.71	317.68	314.07	0.020	0.025	8.16	0.36
			Area =	12.00		Wetted P =	12.70	
Channel Flow		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Roadside Ditch	D-E	57.25	314.07	312.12	0.034	0.013	20.31	0.05
			Area =	12.00		Wetted P =	12.70	
Pipe Flow		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
EX166 to EX169	E-F	262.05	306.52	297.57	0.034	0.013	10.99	0.40
Pipe Diameter (in) =		18	Area =	1.77		Wetted P =	4.71	
Channel Flow		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Roadside Ditch	F-G	75.53	297.57	294.00	0.047	0.040	7.78	0.16
			Area =	12.00		Wetted P =	12.70	
Pipe Flow		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Ex Culvert (Information Assumed)	G-H	30.34	294.00	293.00	0.033	0.013	10.79	0.05
Pipe Diameter (in) =		18	Area =	1.77		Wetted P =	4.71	
Channel Flow		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Roadside Ditch	H-I	216.03	293.00	279.00	0.065	0.040	9.11	0.40
			Area =	12.00		Wetted P =	12.70	
							Total Tc (Minutes) =	**12.29**

		2-Year	5-Year	10-Year	25-Year	50-Year	100-Year
Rainfall Intensity	Inches / Hour.	**3.81**	**4.46**	**5.05**	**5.73**	**6.23**	**6.69**
Aosorption Coefficient / Ground Saturation Correction Coefficient Cf		1.00	1.00	1.00	1.10	1.20	1.25
Peak Discharge	CFS.	**6.75**	**7.90**	**8.95**	**11.18**	**13.25**	**14.83**

Name of Project:	495-NEXT			Designed By:	JMON
State:	VA	**County:**	Fairfax County	Date:	11/29/21
Name of Culvert:	Post Development			Checked By:	NVD
NOAA Station:	Vienna Tysons 44-8737			Date:	11/29/21
LOCATION:	PL23-OUT 26 B-B				
				UNITS	**ENGLISH**

RATIONAL METHOD - DATA:

DRAINAGE BASIN

SUBSHED #	Land Use Description	Area Acres	C	C A
	Business: Industrial and Commercial (0.80-0.90)			
	Apartments and Townhomes (0.65-0.75)			
	Schools (0.50-0.60)		0.50	
	Residential - lots 10,000 sq. ft. (0.40-0.50)			
	- lots 12,000 sq. ft. (0.40-0.45)			
	- lots 17,000 sq. ft. (0.35-0.45)			
	- lots ½ acre or more (0.30-0.40)	0.85	0.35	0.30
	Parks, Cemeteries and Unimproved Areas (0.20-0.35)			
	Paved and Roof Areas (0.90)	1.10	0.90	0.99
	Cultivated Areas (0.50-0.70)			
	Pasture (0.35-0.45)			
	Lawns (0.25-0.35)	0.70	0.30	0.21
	Forest (0.20-0.30)	0.83	0.25	0.21
	Steep Grass (2:1) (0.40-0.70)			
	Shoulder and Ditch Areas (0.35-0.50)			
	Totals =	**3.48 Acres**	**0.49**	**1.70**

Time of Concentration (Tc)

	Reach	Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Rational C		Tc (Minutes)
Overland Flow (E.E. Seelye - VDOT Modified)								
Soil / Surface Type/Land Cover		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Rational C		
Lawn	A-B	129.16	326.44	321.00	0.042	0.30		10.55
Shallow Concentrated Flow		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Intercept Coeff.		
Grassed waterway	B-C	34.77	321.00	316.89	0.118	0.457		0.11
Channel Flow		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Roadside Ditch	C-D	211.41	316.89	312.12	0.023	0.030	7.16	0.49
			Area =	12.00		Wetted P =	12.70	
Pipe Flow		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
EX166 to EX168	D-E	238.43	306.52	297.93	0.036	0.013	9.99	0.40
Pipe Diameter (in) =		15	Area =	1.23		Wetted P =	3.93	
Pipe Flow		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
EX168 to EX169	E-F	25.73	297.93	297.57	0.014	0.013	7.03	0.06
Pipe Diameter (in) =		18	Area =	1.77		Wetted P =	4.71	
Channel Flow		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Roadside Ditch	F-G	75.53	297.57	294.00	0.047	0.030	10.37	0.12
			Area =	12.00		Wetted P =	12.70	
Pipe Flow		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Ex Culvert (Information Assumed)	G-H	30.34	294.00	293.00	0.033	0.013	10.79	0.05
Pipe Diameter (in) =		18	Area =	1.77		Wetted P =	4.71	
Channel Flow		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Roadside Ditch	H-I	216.03	293.00	279.00	0.065	0.040	9.11	0.40
			Area =	12.00		Wetted P =	12.70	
							Total Tc (Minutes) =	**12.17**

		2-Year	5-Year	10-Year	25-Year	50-Year	100-Year
Rainfall Intensity	Inches / Hour.	**3.83**	**4.47**	**5.07**	**5.76**	**6.25**	**6.72**
Aosorption Coefficient / Ground Saturation Correction Coefficient Cf		1.00	1.00	1.00	1.10	1.20	1.25
Peak Discharge	CFS.	**6.51**	**7.61**	**8.62**	**10.77**	**12.76**	**14.28**

PL23-OUT26 (B-B) Pre - 2yr

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Channel Slope	0.049 ft/ft
Discharge	6.75 cfs

Section Definitions

Station (ft)	Elevation (ft)
0+00	282.00
0+12	280.00
0+20	279.00
0+22	280.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 282.00)	(0+22, 280.00)	0.040

Options	
Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results	
Normal Depth	0.6 ft
Roughness Coefficient	0.040
Elevation	279.59 ft
Elevation Range	279.0 to 282.0 ft
Flow Area	1.9 ft²
Wetted Perimeter	6.5 ft
Hydraulic Radius	0.3 ft
Top Width	6.39 ft
Normal Depth	0.6 ft
Critical Depth	0.6 ft
Critical Slope	0.035 ft/ft
Velocity	3.58 ft/s
Velocity Head	0.20 ft
Specific Energy	0.79 ft
Froude Number	1.164
Flow Type	Supercritical

PL23-OUT26 (B-B) Pre - 2yr

GVF Input Data	
Downstream Depth	0.0 ft
Length	0.0 ft
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.0 ft
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	0.6 ft
Critical Depth	0.6 ft
Channel Slope	0.049 ft/ft
Critical Slope	0.035 ft/ft

PL23-OUT26 (B-B) Post - 2yr

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Channel Slope	0.049 ft/ft
Discharge	6.51 cfs

Section Definitions

Station (ft)	Elevation (ft)
0+00	282.00
0+12	280.00
0+20	279.00
0+22	280.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 282.00)	(0+22, 280.00)	0.040

Options	
Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results	
Normal Depth	0.6 ft
Roughness Coefficient	0.040
Elevation	279.58 ft
Elevation Range	279.0 to 282.0 ft
Flow Area	1.8 ft²
Wetted Perimeter	6.4 ft
Hydraulic Radius	0.3 ft
Top Width	6.30 ft
Normal Depth	0.6 ft
Critical Depth	0.6 ft
Critical Slope	0.036 ft/ft
Velocity	3.55 ft/s
Velocity Head	0.20 ft
Specific Energy	0.78 ft
Froude Number	1.162
Flow Type	Supercritical

PL23-OUT26 (B-B) Post - 2yr

GVF Input Data	
Downstream Depth	0.0 ft
Length	0.0 ft
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.0 ft
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	0.6 ft
Critical Depth	0.6 ft
Channel Slope	0.049 ft/ft
Critical Slope	0.036 ft/ft

PL23-OUT26 (B-B) Post - 10yr

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Channel Slope	0.049 ft/ft
Discharge	8.62 cfs

Section Definitions

Station (ft)	Elevation (ft)
0+00	282.00
0+12	280.00
0+20	279.00
0+22	280.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 282.00)	(0+22, 280.00)	0.040

Options	
Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results	
Normal Depth	0.6 ft
Roughness Coefficient	0.040
Elevation	279.65 ft
Elevation Range	279.0 to 282.0 ft
Flow Area	2.3 ft²
Wetted Perimeter	7.2 ft
Hydraulic Radius	0.3 ft
Top Width	7.00 ft
Normal Depth	0.6 ft
Critical Depth	0.7 ft
Critical Slope	0.034 ft/ft
Velocity	3.81 ft/s
Velocity Head	0.23 ft
Specific Energy	0.87 ft
Froude Number	1.184
Flow Type	Supercritical

PL23-OUT26 (B-B) Post - 10yr

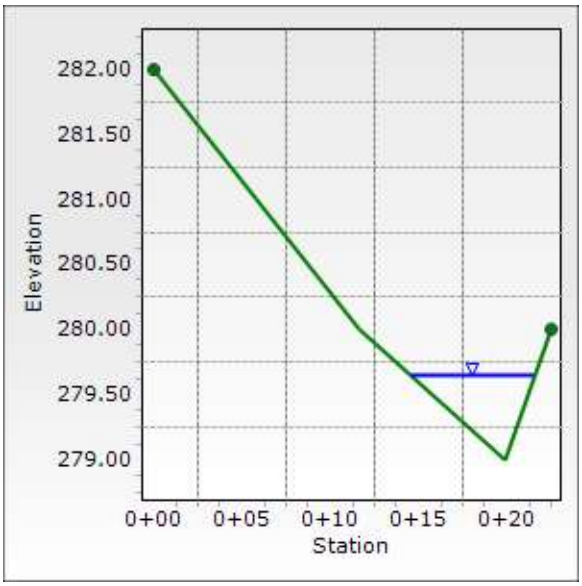
GVF Input Data	
Downstream Depth	0.0 ft
Length	0.0 ft
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.0 ft
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	0.6 ft
Critical Depth	0.7 ft
Channel Slope	0.049 ft/ft
Critical Slope	0.034 ft/ft

PL23-OUT26 (B-B) Post - 10yr

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Channel Slope	0.049 ft/ft
Normal Depth	0.6 ft
Discharge	8.62 cfs



Name of Project:	495-NEXT			Designed By:	JMON
State:	VA	**County:**	Fairfax County	Date:	11/29/21
Name of Culvert:	Pre Development			Checked By:	NVD
NOAA Station:	Vienna Tysons 44-8737			Date:	11/29/21
LOCATION:	PL23-OUT 26 C-C			UNITS	**ENGLISH**

RATIONAL METHOD - DATA:

DRAINAGE BASIN

SUBSHED #	Land Use Description	Area Acres	C	C A
	Business: Industrial and Commercial (0.80-0.90)			
	Apartments and Townhomes (0.65-0.75)			
	Schools (0.50-0.60)			
	Residential - lots 10,000 sq. ft. (0.40-0.50)			
	- lots 12,000 sq. ft. (0.40-0.45)			
	- lots 17,000 sq. ft. (0.35-0.45)			
	- lots ½ acre or more (0.30-0.40)	0.91	0.35	0.32
	Parks, Cemeteries and Unimproved Areas (0.20-0.35)			
	Paved and Roof Areas (0.90)	1.25	0.90	1.13
	Cultivated Areas (0.50-0.70)			
	Pasture (0.35-0.45)			
	Lawns (0.25-0.35)	0.46	0.30	0.14
	Forest (0.20-0.30)	1.00	0.25	0.25
	Steep Grass (2:1) (0.40-0.70)			
	Shoulder and Ditch Areas (0.35-0.50)			
	Totals =	**3.62 Acres**	**0.51**	**1.83**

Time of Concentration (Tc)

	Reach	Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Rational C		Tc (Minutes)
Overland Flow (E.E. Seelye - VDOT Modified)								
Soil / Surface Type/Land Cover		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Rational C		
Forest	A-B	97.86	326.13	320.80	0.054	0.25		10.73
Shallow Concentrated Flow		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Intercept Coeff.		
Grassed waterway	B-C	38.99	320.80	317.68	0.080	0.457		0.15
Channel Flow		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Roadside Ditch	C-D	177.71	317.68	314.07	0.020	0.025	8.16	0.36
			Area =	12.00		Wetted P =	12.70	
Channel Flow		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Roadside Ditch	D-E	57.25	314.07	312.12	0.034	0.013	20.31	0.05
			Area =	12.00		Wetted P =	12.70	
Pipe Flow		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
EX166 to EX169	E-F	262.05	306.52	297.57	0.034	0.013	10.99	0.40
Pipe Diameter (in) =		18	Area =	1.77		Wetted P =	4.71	
Channel Flow		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Roadside Ditch	F-G	75.53	297.57	294.00	0.047	0.040	7.78	0.16
			Area =	12.00		Wetted P =	12.70	
Pipe Flow		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Ex Culvert (Information Assumed)	G-H	30.34	294.00	293.00	0.033	0.013	10.79	0.05
Pipe Diameter (in) =		18	Area =	1.77		Wetted P =	4.71	
Channel Flow		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Roadside Ditch	H-I	266.06	293.00	275.35	0.066	0.040	9.21	0.48
			Area =	12.00		Wetted P =	12.70	
							Total Tc (Minutes) =	**12.38**

		2-Year	5-Year	10-Year	25-Year	50-Year	100-Year
Rainfall Intensity	Inches / Hour.	**3.80**	**4.44**	**5.04**	**5.72**	**6.21**	**6.67**
Aosorption Coefficient / Ground Saturation Correction Coefficient Cf		1.00	1.00	1.00	1.10	1.20	1.25
Peak Discharge	CFS.	**6.96**	**8.14**	**9.22**	**11.52**	**13.65**	**15.28**

Name of Project:	495-NEXT			Designed By:	JMON
State:	VA	**County:**	Fairfax County	Date:	11/29/21
Name of Culvert:	Post Development			Checked By:	NVD
NOAA Station:	Vienna Tysons 44-8737			Date:	11/29/21
LOCATION:	PL23-OUT 26 C-C				
				UNITS	**ENGLISH**

RATIONAL METHOD - DATA:

DRAINAGE BASIN

SUBSHED #	Land Use Description	Area Acres	C	C A
	Business: Industrial and Commercial (0.80-0.90)			
	Apartments and Townhomes (0.65-0.75)			
	Schools (0.50-0.60)		0.50	
	Residential - lots 10,000 sq. ft. (0.40-0.50)			
	- lots 12,000 sq. ft. (0.40-0.45)			
	- lots 17,000 sq. ft. (0.35-0.45)			
	- lots ½ acre or more (0.30-0.40)	0.91	0.35	0.32
	Parks, Cemeteries and Unimproved Areas (0.20-0.35)			
	Paved and Roof Areas (0.90)	1.14	0.90	1.02
	Cultivated Areas (0.50-0.70)			
	Pasture (0.35-0.45)			
	Lawns (0.25-0.35)	0.71	0.30	0.21
	Forest (0.20-0.30)	0.83	0.25	0.21
	Steep Grass (2:1) (0.40-0.70)			
	Shoulder and Ditch Areas (0.35-0.50)			
	Totals =	**3.58 Acres**	**0.49**	**1.76**

Time of Concentration (Tc)

	Reach	Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Rational C		Tc (Minutes)
Overland Flow (E.E. Seelye - VDOT Modified)								
Soil / Surface Type/Land Cover		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Rational C		
Lawn	A-B	129.16	326.44	321.00	0.042	0.30		10.55
Shallow Concentrated Flow		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Intercept Coeff.		
Grassed waterway	B-C	34.77	321.00	316.89	0.118	0.457		0.11
Channel Flow		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Roadside Ditch	C-D	211.41	316.89	312.12	0.023	0.030	7.16	0.49
			Area =	12.00		Wetted P =	12.70	
Pipe Flow		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
EX166 to EX168	D-E	238.43	306.52	297.93	0.036	0.013	9.99	0.40
Pipe Diameter (in) =		15	Area =	1.23		Wetted P =	3.93	
Pipe Flow		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
EX168 to EX169	E-F	25.73	297.93	297.57	0.014	0.013	7.03	0.06
Pipe Diameter (in) =		18	Area =	1.77		Wetted P =	4.71	
Channel Flow		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Roadside Ditch	F-G	75.53	297.57	294.00	0.047	0.040	7.78	0.16
			Area =	12.00		Wetted P =	12.70	
Pipe Flow		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Ex Culvert (Information Assumed)	G-H	30.34	294.00	293.00	0.033	0.013	10.79	0.05
Pipe Diameter (in) =		18	Area =	1.77		Wetted P =	4.71	
Channel Flow		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Roadside Ditch	H-I	266.06	293.00	275.35	0.066	0.040	9.21	0.48
			Area =	12.00		Wetted P =	12.70	
							Total Tc (Minutes) =	**12.30**

		2-Year	5-Year	10-Year	25-Year	50-Year	100-Year
Rainfall Intensity	Inches / Hour.	**3.81**	**4.45**	**5.05**	**5.73**	**6.23**	**6.69**
Aosorption Coefficient / Ground Saturation Correction Coefficient Cf		1.00	1.00	1.00	1.10	1.20	1.25
Peak Discharge	CFS.	**6.70**	**7.84**	**8.89**	**11.10**	**13.15**	**14.72**

PL23-OUT26 (C-C) Pre - 2yr

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Channel Slope	0.067 ft/ft
Discharge	6.96 cfs

Section Definitions

Station (ft)	Elevation (ft)
0+00	278.00
0+29	275.35
0+31	276.00
0+37	277.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 278.00)	(0+37, 277.00)	0.040

Options	
Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results	
Normal Depth	0.5 ft
Roughness Coefficient	0.040
Elevation	275.86 ft
Elevation Range	275.4 to 278.0 ft
Flow Area	1.8 ft²
Wetted Perimeter	7.3 ft
Hydraulic Radius	0.2 ft
Top Width	7.22 ft
Normal Depth	0.5 ft
Critical Depth	0.6 ft
Critical Slope	0.036 ft/ft
Velocity	3.81 ft/s
Velocity Head	0.23 ft
Specific Energy	0.73 ft
Froude Number	1.338
Flow Type	Supercritical

PL23-OUT26 (C-C) Pre - 2yr

GVF Input Data	
Downstream Depth	0.0 ft
Length	0.0 ft
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.0 ft
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	0.5 ft
Critical Depth	0.6 ft
Channel Slope	0.067 ft/ft
Critical Slope	0.036 ft/ft

PL23-OUT26 (C-C) Post - 2yr

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Channel Slope	0.067 ft/ft
Discharge	6.70 cfs

Section Definitions

Station (ft)	Elevation (ft)
0+00	278.00
0+29	275.35
0+31	276.00
0+37	277.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 278.00)	(0+37, 277.00)	0.040

Options	
Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results	
Normal Depth	0.5 ft
Roughness Coefficient	0.040
Elevation	275.85 ft
Elevation Range	275.4 to 278.0 ft
Flow Area	1.8 ft²
Wetted Perimeter	7.2 ft
Hydraulic Radius	0.2 ft
Top Width	7.12 ft
Normal Depth	0.5 ft
Critical Depth	0.6 ft
Critical Slope	0.036 ft/ft
Velocity	3.78 ft/s
Velocity Head	0.22 ft
Specific Energy	0.72 ft
Froude Number	1.333
Flow Type	Supercritical

PL23-OUT26 (C-C) Post - 2yr

GVF Input Data	
Downstream Depth	0.0 ft
Length	0.0 ft
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.0 ft
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	0.5 ft
Critical Depth	0.6 ft
Channel Slope	0.067 ft/ft
Critical Slope	0.036 ft/ft

PL23-OUT26 (C-C) Post - 10yr

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Channel Slope	0.067 ft/ft
Discharge	8.89 cfs

Section Definitions

Station (ft)	Elevation (ft)
0+00	278.00
0+29	275.35
0+31	276.00
0+37	277.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 278.00)	(0+37, 277.00)	0.040

Options	
Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results	
Normal Depth	0.6 ft
Roughness Coefficient	0.040
Elevation	275.90 ft
Elevation Range	275.4 to 278.0 ft
Flow Area	2.2 ft²
Wetted Perimeter	8.0 ft
Hydraulic Radius	0.3 ft
Top Width	7.92 ft
Normal Depth	0.6 ft
Critical Depth	0.6 ft
Critical Slope	0.035 ft/ft
Velocity	4.05 ft/s
Velocity Head	0.26 ft
Specific Energy	0.81 ft
Froude Number	1.357
Flow Type	Supercritical

PL23-OUT26 (C-C) Post - 10yr

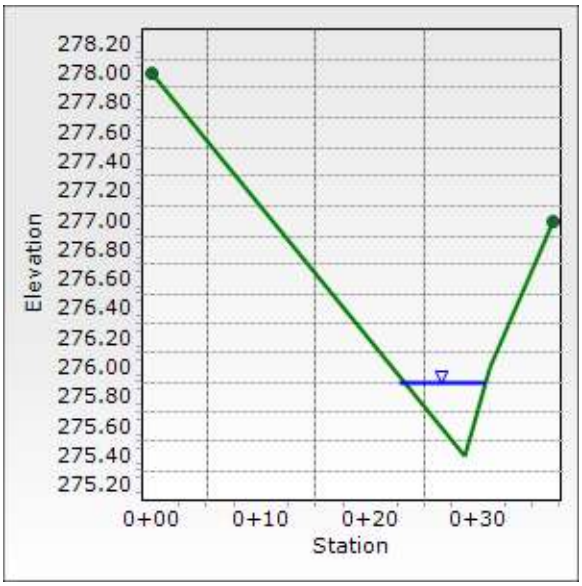
GVF Input Data	
Downstream Depth	0.0 ft
Length	0.0 ft
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.0 ft
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	0.6 ft
Critical Depth	0.6 ft
Channel Slope	0.067 ft/ft
Critical Slope	0.035 ft/ft

PL23-OUT26 (C-C) Post - 10yr

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Channel Slope	0.067 ft/ft
Normal Depth	0.6 ft
Discharge	8.89 cfs



APPENDIX C27
PL23-OUT27

Outfall PL23-OUT 27

Outfall PL23-OUT27 is an existing outfall at Georgetown Pike station 17+50 left. The outfall consists of a natural stormwater conveyance system. In existing conditions, flow is conveyed through existing channels, culverts and sheet flow to the point of analysis. The outfall prior to development is 1.34 acres.

Development of this area will result in decreased area to this outfall, due to proposed roadway grading and storm sewer design. The resulting area to the outfall will be 1.24 acres.

Drainage Area:

The drainage areas and resulting changes are summarized in the table below:

PL23-OUT 27			
Drainage Area	**Total Area**	**C (Total)**	**Tc**
Existing	1.34 ac	0.43	18.26 min
Proposed	1.24 ac	0.45	17.59 min

Limits of Study:

The location of the outfall is shown in the included outfall drainage map. The point of analysis is within the existing channel north of Georgetown Pike.

Easement Requirements:

No additional easements are required.

Outfall Discharge:

All discharges were calculated using the Rational Method and are summarized below:

PL23-OUT 27		
Drainage Area	**Peak Flow Rate (Total)**	
	2 Year	10 Year
Existing	1.82 cfs	2.44 cfs
Proposed	1.78 cfs	2.38 cfs
Net Change	**-0.04 cfs**	**-0.06 cfs**

Channel Description:

The channel at Outfall PL23-OUT 27 is a natural channel. Cross Sections were prepared utilizing topography prepared by Rinker Design Associates, P.C. and Fairfax County GIS.

Channel Protection:

Under Section 11.7.5.1 of the VDOT drainage manual, areas draining to a natural stormwater conveyance channel shall satisfy the channel protection criteria by providing

conveyance of the 2 year storm without causing erosion of the system. Calculations have been provided below supporting the 2 year velocities in the system:

Cross Section	Channel Protection - 2 Year Velocity			Outfall Adequate?
	Channel Lining	Max Permissible Velocity (ft/s)	Proposed Velocity (ft/s)	
A-A	Meadowville Complex	2.3	1.81	Yes
B-B	Meadowville Complex	2.3	1.45	Yes
C-C	Meadowville Complex	2.3	1.75	Yes

Flood Protection:

Under Section 11.7.5.2 of the VDOT drainage manual, areas draining to a natural stormwater conveyance channel shall satisfy the flood protection criteria by demonstrating that the peak flow rate from a 10 year storm will be contained within the existing channel. The post developed flows to the channel have been analyzed and yield the following results:

Cross Section	Flood Protection - 10 Year Capacity		Outfall Adequate?
	Channel Depth (ft)	Normal Depth (ft)	
A-A	1.50	0.20	Yes
B-B	4.00	0.30	Yes
C-C	5.00	0.40	Yes

Final Opinion:

This outfall is a natural stormwater conveyance system. We have shown compliance with the channel protection criteria by providing calculations demonstrating non-erosive velocities. We have shown compliance with the flood protection criteria, by demonstrating the peak discharge from a 10 year storm will be contained within the existing channel. It is therefore our opinion that this outfall is adequate.

Pre-Developed Outfall Map
PL23-27
I-495
Fairfax, VA

DRAINAGE AREA BOUNDARY

EXISTING CONTOURS

TIME OF CONCENTRATION

PL23-OUT 27
DA = 1.34 AC
C = 0.43

E

A

B

C

D

SCALE
0 75' 150'

04/2022

Post-Developed Outfall Map
PL23-27
I-495
Fairfax, VA

DRAINAGE AREA BOUNDARY

EXISTING CONTOURS

TIME OF CONCENTRATION

PL23-OUT 27
DA = 1.24 AC
C = 0.45

A

B

C

D

E

SCALE
0 75' 150'

04/2022

Name of Project:	495-NEXT			Designed By:	KRI
State:	VA	**County:**	Fairfax County	Date:	09/02/21
Name of Culvert:	Pre Development			Checked By:	NVD
NOAA Station:	Vienna Tysons 44-8737			Date:	09/02/21
LOCATION:	PL23-OUT 27				
				UNITS	**ENGLISH**

RATIONAL METHOD - DATA:

DRAINAGE BASIN

SUBSHED #	Land Use Description	Area Acres	C	C A
	Business: Industrial and Commercial (0.80-0.90)			
	Apartments and Townhomes (0.65-0.75)			
	Schools (0.50-0.60)			
	Residential - lots 10,000 sq. ft. (0.40-0.50)			
	- lots 12,000 sq. ft. (0.40-0.45)			
	- lots 17,000 sq. ft. (0.35-0.45)			
	- lots ½ acre or more (0.30-0.40)	0.57	0.35	0.20
	Parks, Cemeteries and Unimproved Areas (0.20-0.35)			
	Paved and Roof Areas (0.90)	0.28	0.90	0.25
	Cultivated Areas (0.50-0.70)			
	Pasture (0.35-0.45)			
	Lawns (0.25-0.35)	0.14	0.30	0.04
	Forest (0.20-0.30)	0.35	0.25	0.09
	Steep Grass (2:1) (0.40-0.70)			
	Shoulder and Ditch Areas (0.35-0.50)			
	Totals =	**1.34 Acres**	**0.43**	**0.58**

Time of Concentration (Tc)

			Reach	Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Rational C		Tc (Minutes)
Overland Flow (E.E. Seelye - VDOT Modified)										
	Soil / Surface Type/Land Cover			Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Rational C		
	Residential		A-B	152.14	325.3	319.0	0.041	0.35		9.73
	Forest		B-C	64.94	319.00	313.25	0.089	0.25		8.23
Channel Flow				Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Roadside Ditch			C-D	81.77	313.25	307.70	0.068	0.050	7.46	0.18
					Area =	12.00		Wetted P =	12.70	
Pipe Flow				Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
EX Culvert 165			D-E	80.39	307.70	303.95	0.047	0.013	11.37	0.12
		Pipe Diameter (in) =		15	Area =	1.23		Wetted P =	3.93	
									Total Tc (Minutes) =	**18.26**

		2-Year	**5-Year**	**10-Year**	**25-Year**	**50-Year**	**100-Year**
Rainfall Intensity	Inches / Hour.	**3.16**	**3.71**	**4.23**	**4.82**	**5.25**	**5.66**
Aosorption Coefficient / Ground Saturation Correction Coefficient Cf		1.00	1.00	1.00	1.10	1.20	1.25
Peak Discharge	CFS.	**1.82**	**2.14**	**2.44**	**3.06**	**3.64**	**4.08**

Name of Project:	495-NEXT			Designed By:	JMON
State:	VA	**County:**	Fairfax County	Date:	09/02/21
Name of Culvert:	Post Development			Checked By:	NVD
NOAA Station:	Vienna Tysons 44-8737			Date:	09/02/21
LOCATION:	PL23-OUT 27				
				UNITS	**ENGLISH**

RATIONAL METHOD - DATA:

DRAINAGE BASIN

SUBSHED #	Land Use Description	Area Acres	C	C A
	Business: Industrial and Commercial (0.80-0.90)			
	Apartments and Townhomes (0.65-0.75)			
	Schools (0.50-0.60)			
	Residential - lots 10,000 sq. ft. (0.40-0.50)			
	- lots 12,000 sq. ft. (0.40-0.45)			
	- lots 17,000 sq. ft. (0.35-0.45)			
	- lots ½ acre or more (0.30-0.40)	0.57	0.35	0.20
	Parks, Cemeteries and Unimproved Areas (0.20-0.35)			
	Paved and Roof Areas (0.90)	0.26	0.90	0.24
	Cultivated Areas (0.50-0.70)			
	Pasture (0.35-0.45)			
	Lawns (0.25-0.35)	0.30	0.30	0.09
	Forest (0.20-0.30)	0.11	0.25	0.03
	Steep Grass (2:1) (0.40-0.70)			
	Shoulder and Ditch Areas (0.35-0.50)			
	Totals =	**1.24 Acres**	**0.45**	**0.55**

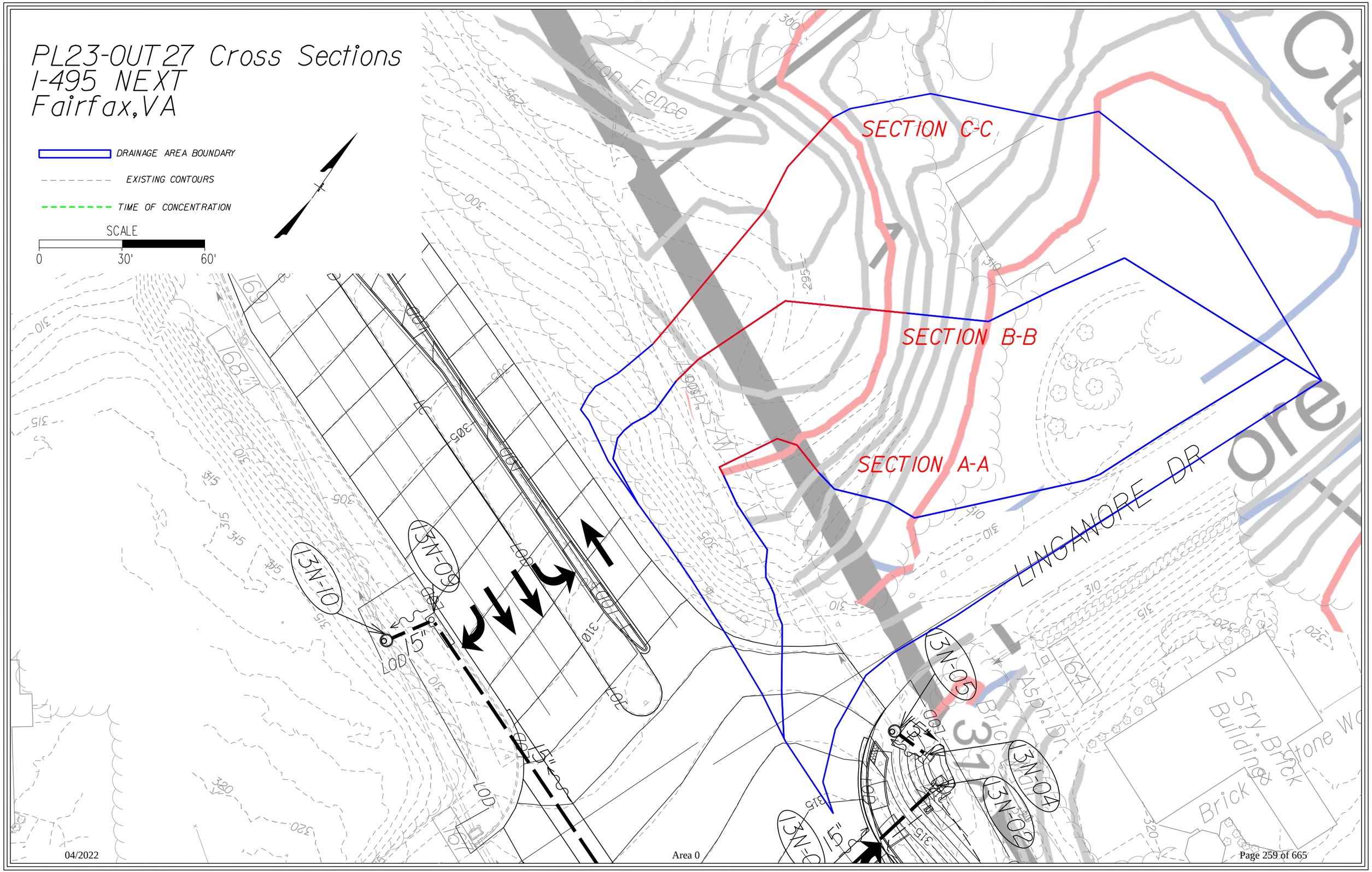
Time of Concentration (Tc)

		Reach	Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Rational C		Tc (Minutes)
Overland Flow (E.E. Seelye - VDOT Modified)									
	Soil / Surface Type/Land Cover		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Rational C		
	Residential	A-B	152.14	325.3	319.0	0.041	0.35		9.73
	Forest	B-C	56.44	319.00	313.75	0.093	0.25		7.69
Channel Flow			Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Roadside Ditch		C-D	81.48	313.75	307.70	0.074	0.050	7.80	0.17
				Area =	12.00		Wetted P =	12.70	
Pipe Flow			Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
22-04 to EX165		D-E	82.97	307.70	303.95	0.045	0.013	11.19	0.12
	Pipe Diameter (in) =		15	Area =	1.23		Wetted P =	3.93	
								Total Tc (Minutes) =	**17.59**

		2-Year	**5-Year**	**10-Year**	**25-Year**	**50-Year**	**100-Year**
Rainfall Intensity	Inches / Hour.	**3.22**	**3.78**	**4.30**	**4.91**	**5.34**	**5.75**
Aosorption Coefficient / Ground Saturation Correction Coefficient	Cf	1.00	1.00	1.00	1.10	1.20	1.25
Peak Discharge	CFS.	**1.78**	**2.09**	**2.38**	**2.99**	**3.55**	**3.98**

Outfall PL23-OUT27 Sections A-A, B-B, C-C: Looking Upstream

Outfall PL23-OUT27 Sections A-A, B-B, C-C: Looking Downstream


PL23-OUT27 Cross Sections
I-495 NEXT
Fairfax,VA
DRAINAGE AREA BOUNDARY
EXISTING CONTOURS
TIME OF CONCENTRATION
SCALE
0
30'
60'
SECTION C-C
SECTION B-B
SECTION A-A
LINGANORE DR
Iron Fence
13N-10
13N-09
13N-05
13N-04
13N-02
15"
LOD
2 Stry. Brick Building
Brick & Stone Wo

Name of Project:	495-NEXT		Designed By: JMON
State:	VA	**County:** Fairfax County	Date: 09/02/21
Name of Culvert:	Post Development		Checked By: NVD
NOAA Station:	Vienna Tysons 44-8737		Date: 09/02/21
LOCATION:	PL23-OUT 27 A-A		
			UNITS **ENGLISH**

RATIONAL METHOD - DATA:

DRAINAGE BASIN

SUBSHED #	Land Use Description	Area Acres	C	C A
	Business: Industrial and Commercial (0.80-0.90)			
	Apartments and Townhomes (0.65-0.75)			
	Schools (0.50-0.60)			
	Residential - lots 10,000 sq. ft. (0.40-0.50)			
	- lots 12,000 sq. ft. (0.40-0.45)			
	- lots 17,000 sq. ft. (0.35-0.45)			
	- lots ½ acre or more (0.30-0.40)	0.59	0.35	0.21
	Parks, Cemeteries and Unimproved Areas (0.20-0.35)			
	Paved and Roof Areas (0.90)	0.35	0.90	0.31
	Cultivated Areas (0.50-0.70)			
	Pasture (0.35-0.45)			
	Lawns (0.25-0.35)	0.33	0.30	0.10
	Forest (0.20-0.30)	0.15	0.25	0.04
	Steep Grass (2:1) (0.40-0.70)			
	Shoulder and Ditch Areas (0.35-0.50)			
	Totals =	**1.42 Acres**	**0.46**	**0.66**

Time of Concentration (Tc)

			Reach	Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Rational C		Tc (Minutes)
Overland Flow (E.E. Seelye - VDOT Modified)										
	Soil / Surface Type/Land Cover			Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Rational C		
	Residential	A-B		152.14	325.3	319.0	0.041	0.35		9.73
	Forest	B-C		56.44	319.00	313.75	0.093	0.25		7.69
Channel Flow				Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Roadside Ditch		C-D		81.48	313.75	307.70	0.074	0.050	7.80	0.17
					Area =	12.00		Wetted P =	12.70	
Pipe Flow				Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
22-04 to EX165		D-E		82.97	307.70	303.95	0.045	0.013	11.19	0.12
			Pipe Diameter (in) =	15	Area =	1.23		Wetted P =	3.93	
Channel Flow				Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Grass Channel		E-F		50.70	303.95	299.50	0.088	0.050	8.48	0.10
					Area =	12.00		Wetted P =	12.70	
									Total Tc (Minutes) =	**17.82**

		2-Year	5-Year	10-Year	25-Year	50-Year	100-Year
Rainfall Intensity	Inches / Hour.	**3.20**	**3.76**	**4.28**	**4.88**	**5.31**	**5.72**
Aosorption Coefficient / Ground Saturation Correction Coefficient Cf		1.00	1.00	1.00	1.10	1.20	1.25
Peak Discharge	CFS.	**2.10**	**2.47**	**2.81**	**3.53**	**4.19**	**4.70**

PL23-OUT27 (A-A) Post - 2yr

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Channel Slope	0.083 ft/ft
Discharge	2.10 cfs

Section Definitions

Station (ft)	Elevation (ft)
0+00	301.00
0+03	300.00
0+27	299.50
0+34	300.00
0+47	302.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 301.00)	(0+47, 302.00)	0.050

Options	
Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results	
Normal Depth	0.2 ft
Roughness Coefficient	0.050
Elevation	299.69 ft
Elevation Range	299.5 to 302.0 ft
Flow Area	1.2 ft²
Wetted Perimeter	12.0 ft
Hydraulic Radius	0.1 ft
Top Width	11.98 ft
Normal Depth	0.2 ft
Critical Depth	0.2 ft
Critical Slope	0.079 ft/ft
Velocity	1.81 ft/s
Velocity Head	0.05 ft
Specific Energy	0.24 ft
Froude Number	1.021
Flow Type	Supercritical

PL23-OUT27 (A-A) Post - 2yr

GVF Input Data	
Downstream Depth	0.0 ft
Length	0.0 ft
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.0 ft
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	0.2 ft
Critical Depth	0.2 ft
Channel Slope	0.083 ft/ft
Critical Slope	0.079 ft/ft

PL23-OUT27 (A-A) Post - 10yr

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Channel Slope	0.083 ft/ft
Discharge	2.81 cfs

Section Definitions

Station (ft)	Elevation (ft)
0+00	301.00
0+03	300.00
0+27	299.50
0+34	300.00
0+47	302.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 301.00)	(0+47, 302.00)	0.050

Options	
Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results	
Normal Depth	0.2 ft
Roughness Coefficient	0.050
Elevation	299.72 ft
Elevation Range	299.5 to 302.0 ft
Flow Area	1.4 ft²
Wetted Perimeter	13.4 ft
Hydraulic Radius	0.1 ft
Top Width	13.36 ft
Normal Depth	0.2 ft
Critical Depth	0.2 ft
Critical Slope	0.076 ft/ft
Velocity	1.94 ft/s
Velocity Head	0.06 ft
Specific Energy	0.28 ft
Froude Number	1.041
Flow Type	Supercritical

PL23-OUT27 (A-A) Post - 10yr

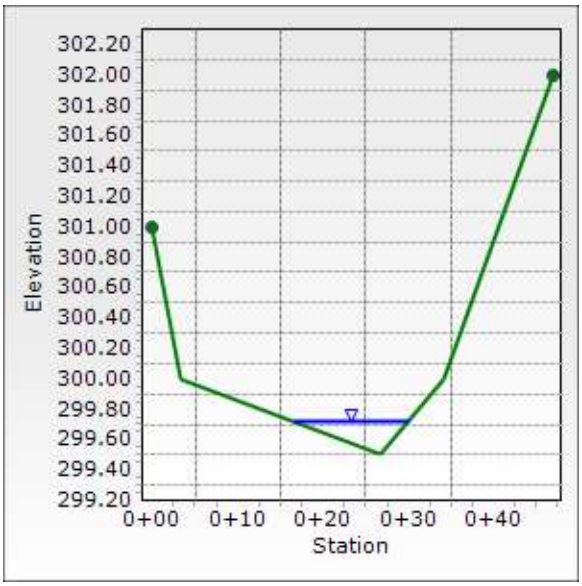
GVF Input Data	
Downstream Depth	0.0 ft
Length	0.0 ft
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.0 ft
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	0.2 ft
Critical Depth	0.2 ft
Channel Slope	0.083 ft/ft
Critical Slope	0.076 ft/ft

PL23-OUT27 (A-A) Post - 10yr

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Channel Slope	0.083 ft/ft
Normal Depth	0.2 ft
Discharge	2.81 cfs



Name of Project:	495-NEXT		Designed By: JMON
State:	VA	**County:** Fairfax County	Date: 09/02/21
Name of Culvert:	Post Development		Checked By: NVD
NOAA Station:	Vienna Tysons 44-8737		Date: 09/02/21
LOCATION:	PL23-OUT 27 B-B		
			UNITS **ENGLISH**

RATIONAL METHOD - DATA:

DRAINAGE BASIN

SUBSHED #	Land Use Description	Area Acres	C	C A
	Business: Industrial and Commercial (0.80-0.90)			
	Apartments and Townhomes (0.65-0.75)			
	Schools (0.50-0.60)			
	Residential - lots 10,000 sq. ft. (0.40-0.50)			
	- lots 12,000 sq. ft. (0.40-0.45)			
	- lots 17,000 sq. ft. (0.35-0.45)			
	- lots ½ acre or more (0.30-0.40)	0.82	0.35	0.29
	Parks, Cemeteries and Unimproved Areas (0.20-0.35)			
	Paved and Roof Areas (0.90)	0.37	0.90	0.33
	Cultivated Areas (0.50-0.70)			
	Pasture (0.35-0.45)			
	Lawns (0.25-0.35)	0.40	0.30	0.12
	Forest (0.20-0.30)	0.17	0.25	0.04
	Steep Grass (2:1) (0.40-0.70)			
	Shoulder and Ditch Areas (0.35-0.50)			
	Totals =	**1.76 Acres**	**0.44**	**0.78**

Time of Concentration (Tc)

			Reach	Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Rational C		Tc (Minutes)
Overland Flow (E.E. Seelye - VDOT Modified)										
	Soil / Surface Type/Land Cover			Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Rational C		
	Residential		A-B	152.14	325.3	319.0	0.041	0.35		9.73
	Forest		B-C	56.44	319.00	313.75	0.093	0.25		7.69
Channel Flow				Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Roadside Ditch			C-D	81.48	313.75	307.70	0.074	0.050	7.80	0.17
					Area =	12.00		Wetted P =	12.70	
Pipe Flow				Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
22-04 to EX165			D-E	82.97	307.70	303.95	0.045	0.013	11.19	0.12
		Pipe Diameter (in) =		15	Area =	1.23		Wetted P =	3.93	
Channel Flow				Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Grass Channel			E-F	100.74	303.95	297.00	0.069	0.050	7.52	0.22
					Area =	12.00		Wetted P =	12.70	
									Total Tc (Minutes) =	**17.94**

		2-Year	**5-Year**	**10-Year**	**25-Year**	**50-Year**	**100-Year**
Rainfall Intensity	Inches / Hour.	**3.19**	**3.75**	**4.26**	**4.86**	**5.29**	**5.70**
Aosorption Coefficient / Ground Saturation Correction Coefficient Cf		1.00	1.00	1.00	1.10	1.20	1.25
Peak Discharge	CFS.	**2.49**	**2.93**	**3.34**	**4.18**	**4.97**	**5.58**

PL23-OUT27 (B-B) Post - 2yr

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Channel Slope	0.044 ft/ft
Discharge	2.49 cfs

Section Definitions

Station (ft)	Elevation (ft)
0+00	301.00
0+11	298.00
0+49	297.00
0+78	298.00
0+86	300.00
0+93	302.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 301.00)	(0+93, 302.00)	0.050

Options	
Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results	
Normal Depth	0.2 ft
Roughness Coefficient	0.050
Elevation	297.23 ft
Elevation Range	297.0 to 302.0 ft
Flow Area	1.7 ft²
Wetted Perimeter	15.2 ft
Hydraulic Radius	0.1 ft
Top Width	15.15 ft
Normal Depth	0.2 ft
Critical Depth	0.2 ft
Critical Slope	0.078 ft/ft
Velocity	1.45 ft/s
Velocity Head	0.03 ft
Specific Energy	0.26 ft
Froude Number	0.763

PL23-OUT27 (B-B) Post - 2yr

Results	
Flow Type	Subcritical
GVF Input Data	
Downstream Depth	0.0 ft
Length	0.0 ft
Number Of Steps	0
GVF Output Data	
Upstream Depth	0.0 ft
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	0.00 ft/s
Upstream Velocity	0.00 ft/s
Normal Depth	0.2 ft
Critical Depth	0.2 ft
Channel Slope	0.044 ft/ft
Critical Slope	0.078 ft/ft

PL23-OUT27 (B-B) Post - 10yr

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Channel Slope	0.044 ft/ft
Discharge	3.34 cfs

Section Definitions

Station (ft)	Elevation (ft)
0+00	301.00
0+11	298.00
0+49	297.00
0+78	298.00
0+86	300.00
0+93	302.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 301.00)	(0+93, 302.00)	0.050

Options	
Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results	
Normal Depth	0.3 ft
Roughness Coefficient	0.050
Elevation	297.25 ft
Elevation Range	297.0 to 302.0 ft
Flow Area	2.1 ft²
Wetted Perimeter	16.9 ft
Hydraulic Radius	0.1 ft
Top Width	16.90 ft
Normal Depth	0.3 ft
Critical Depth	0.2 ft
Critical Slope	0.075 ft/ft
Velocity	1.57 ft/s
Velocity Head	0.04 ft
Specific Energy	0.29 ft
Froude Number	0.779

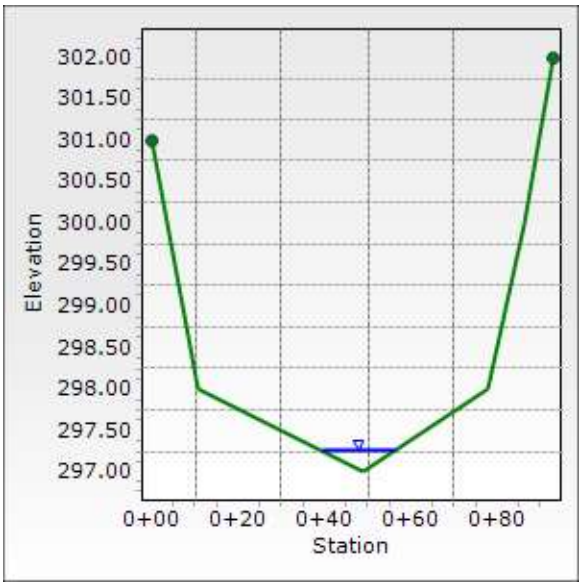
PL23-OUT27 (B-B) Post - 10yr

Results	
Flow Type	Subcritical
GVF Input Data	
Downstream Depth	0.0 ft
Length	0.0 ft
Number Of Steps	0
GVF Output Data	
Upstream Depth	0.0 ft
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	0.00 ft/s
Upstream Velocity	0.00 ft/s
Normal Depth	0.3 ft
Critical Depth	0.2 ft
Channel Slope	0.044 ft/ft
Critical Slope	0.075 ft/ft

PL23-OUT27 (B-B) Post - 10yr

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Channel Slope	0.044 ft/ft
Normal Depth	0.3 ft
Discharge	3.34 cfs



Name of Project:	495-NEXT		Designed By: JMON
State:	VA	**County:** Fairfax County	Date: 09/02/21
Name of Culvert:	Post Development		Checked By: NVD
NOAA Station:	Vienna Tysons 44-8737		Date: 09/02/21
LOCATION:	PL23-OUT 27 C-C		
			UNITS **ENGLISH**

RATIONAL METHOD - DATA:

DRAINAGE BASIN

SUBSHED #	Land Use Description	Area Acres	C	C A
	Business: Industrial and Commercial (0.80-0.90)			
	Apartments and Townhomes (0.65-0.75)			
	Schools (0.50-0.60)			
	Residential - lots 10,000 sq. ft. (0.40-0.50)			
	- lots 12,000 sq. ft. (0.40-0.45)			
	- lots 17,000 sq. ft. (0.35-0.45)			
	- lots ½ acre or more (0.30-0.40)	1.09	0.35	0.38
	Parks, Cemeteries and Unimproved Areas (0.20-0.35)			
	Paved and Roof Areas (0.90)	0.37	0.90	0.33
	Cultivated Areas (0.50-0.70)			
	Pasture (0.35-0.45)			
	Lawns (0.25-0.35)	0.42	0.30	0.13
	Forest (0.20-0.30)	0.17	0.25	0.04
	Steep Grass (2:1) (0.40-0.70)			
	Shoulder and Ditch Areas (0.35-0.50)			
	Totals =	**2.05 Acres**	**0.43**	**0.88**

Time of Concentration (Tc)

			Reach	Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Rational C		Tc (Minutes)
Overland Flow (E.E. Seelye - VDOT Modified)										
	Soil / Surface Type/Land Cover			Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Rational C		
	Residential	A-B		152.14	325.3	319.0	0.041	0.35		9.73
	Forest	B-C		56.44	319.00	313.75	0.093	0.25		7.69
Channel Flow				Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Roadside Ditch		C-D		81.48	313.75	307.70	0.074	0.050	7.80	0.17
					Area =	12.00		Wetted P =	12.70	
Pipe Flow				Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
22-04 to EX165		D-E		82.97	307.70	303.95	0.045	0.013	11.19	0.12
			Pipe Diameter (in) =	15	Area =	1.23		Wetted P =	3.93	
Channel Flow				Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Grass Channel		E-F		150.87	303.95	295.00	0.059	0.050	6.97	0.36
					Area =	12.00		Wetted P =	12.70	
									Total Tc (Minutes) =	**18.08**

		2-Year	5-Year	10-Year	25-Year	50-Year	100-Year
Rainfall Intensity	Inches / Hour.	**3.17**	**3.73**	**4.25**	**4.85**	**5.27**	**5.68**
Aosorption Coefficient / Ground Saturation Correction Coefficient Cf		1.00	1.00	1.00	1.10	1.20	1.25
Peak Discharge	CFS.	**2.81**	**3.30**	**3.76**	**4.71**	**5.60**	**6.28**

PL23-OUT27 (C-C) Post - 2yr

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Channel Slope	0.039 ft/ft
Discharge	2.81 cfs

Section Definitions

Station (ft)	Elevation (ft)
0+00	301.00
0+10	298.00
0+63	296.00
0+81	295.00
0+93	296.00
0+98	298.00
1+05	300.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 301.00)	(1+05, 300.00)	0.050

Options	
Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results	
Normal Depth	0.3 ft
Roughness Coefficient	0.050
Elevation	295.33 ft
Elevation Range	295.0 to 301.0 ft
Flow Area	1.6 ft²
Wetted Perimeter	9.8 ft
Hydraulic Radius	0.2 ft
Top Width	9.78 ft
Normal Depth	0.3 ft
Critical Depth	0.3 ft
Critical Slope	0.069 ft/ft
Velocity	1.75 ft/s
Velocity Head	0.05 ft
Specific Energy	0.38 ft

PL23-OUT27 (C-C) Post - 2yr

Results	
Froude Number	0.763
Flow Type	Subcritical

GVF Input Data	
Downstream Depth	0.0 ft
Length	0.0 ft
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.0 ft
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	0.00 ft/s
Upstream Velocity	0.00 ft/s
Normal Depth	0.3 ft
Critical Depth	0.3 ft
Channel Slope	0.039 ft/ft
Critical Slope	0.069 ft/ft

PL23-OUT27 (C-C) Post - 10yr

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Channel Slope	0.039 ft/ft
Discharge	3.76 cfs

Section Definitions

Station (ft)	Elevation (ft)
0+00	301.00
0+10	298.00
0+63	296.00
0+81	295.00
0+93	296.00
0+98	298.00
1+05	300.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 301.00)	(1+05, 300.00)	0.050

Options	
Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results	
Normal Depth	0.4 ft
Roughness Coefficient	0.050
Elevation	295.37 ft
Elevation Range	295.0 to 301.0 ft
Flow Area	2.0 ft²
Wetted Perimeter	10.9 ft
Hydraulic Radius	0.2 ft
Top Width	10.89 ft
Normal Depth	0.4 ft
Critical Depth	0.3 ft
Critical Slope	0.067 ft/ft
Velocity	1.89 ft/s
Velocity Head	0.06 ft
Specific Energy	0.42 ft

PL23-OUT27 (C-C) Post - 10yr

Results	
Froude Number	0.779
Flow Type	Subcritical

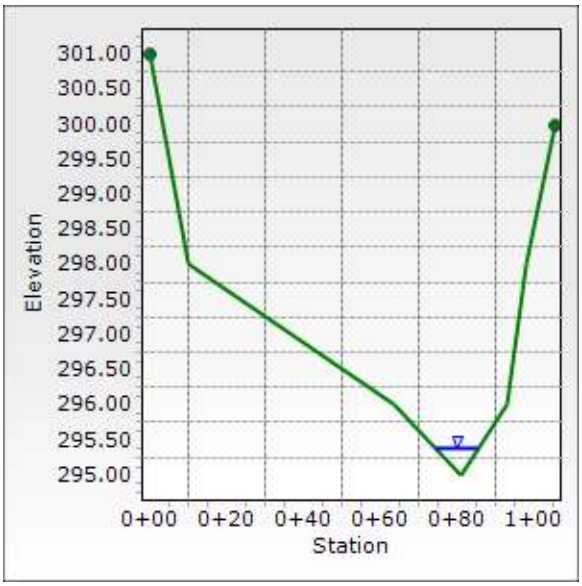
GVF Input Data	
Downstream Depth	0.0 ft
Length	0.0 ft
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.0 ft
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	0.00 ft/s
Upstream Velocity	0.00 ft/s
Normal Depth	0.4 ft
Critical Depth	0.3 ft
Channel Slope	0.039 ft/ft
Critical Slope	0.067 ft/ft

PL23-OUT27 (C-C) Post - 10yr

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Channel Slope	0.039 ft/ft
Normal Depth	0.4 ft
Discharge	3.76 cfs



APPENDIX C28
PL23-OUT28

Outfall PL23-OUT 28

Outfall PL23-OUT28 is an existing outfall at Georgetown Pike station 38+32 right. The outfall consists of a natural stormwater conveyance channel. In existing conditions, flow is conveyed through existing channels, culverts, storm sewer and sheet flow to the existing channel. The outfall prior to development is 16.58 acres.

Development of this area will result in decreased area to this outfall, due to the installation of a storm sewer system and ditches conveying drainage to adjacent outfalls. This outfall includes a proposed SWM facility (SWM-11) to further reduce flows to the outfall. The resulting area to the outfall will be 16.39 acres.

Drainage Area:

The drainage areas and resulting changes are summarized in the table below:

PL23-OUT 28			
Drainage Area	**Total Area**	**C (Total)**	**Tc**
Existing	16.58 ac	0.50	23.37 min
Prop. PL23-SWM-11	0.58 ac	0.37	5.00 min
Prop. Uncontrolled	15.81 ac	0.50	23.14 min

Limits of Study:

The location of the outfall is shown in the included outfall drainage map. The point of analysis is within the existing channel to the south of Georgetown Pike.

Easement Requirements:

No additional easements are required.

Outfall Discharge:

Discharges were calculated using the Rational Method and Pondpack and are summarized below:

PL28-OUT 28		
Drainage Area	**Peak Flow Rate (Total)**	**Peak Flow Rate (Total)**
	2 Year	10 Year
Existing	22.71 cfs	30.64 cfs
Prop. PL23-SWM-11	0.13 cfs	0.16 cfs
Prop. Unc.	21.89 cfs	29.52 cfs
Proposed Combined	22.02 cfs	29.68 cfs
Net Change	**-0.69 cfs**	**-0.96 cfs**

Channel Description:

The channel at Outfall PL23-OUT 28 is a natural channel. Cross Sections were prepared utilizing topography prepared by Rinker Design Associates, P.C.

Channel Protection:

Under Section 11.7.5.1 of the VDOT drainage manual, areas draining to a natural stormwater conveyance channel shall satisfy the channel protection criteria by providing conveyance of the 2 year storm without causing erosion of the system. Calculations have been provided below supporting the 2 year velocities in the system:

Pipe Run	Channel Protection - 2 Year Velocity				Outfall Adequate?
	Pipe Material	Max Permissible Velocity (ft/s)	Existing Velocity (ft/s)	Proposed Velocity (ft/s)	
EX145 to EX146	Concrete	No Max	14.81	14.70	Yes
Cross Section	Channel Material	Max Permissible Velocity (ft/s)	Existing Velocity (ft/s)	Proposed Velocity (ft/s)	Outfall Adequate?
A-A	Codorus Silt Loam	3.5	6.38	6.33	Yes
B-B	Codorus Silt Loam	3.5	6.80	6.75	Yes

As the velocities anticipated are not within the allowable range for this soil type, a site design has been developed to cause the pre-development rate from the 2 year storm to not increase (per Section 11.7.5.1). As there is a net 0.69 cfs reduction for the 2 year storm, requirements for channel protection have been met for this outfall.

Flood Protection:

Under Section 11.7.5.2 of the VDOT drainage manual, areas draining to a natural stormwater conveyance channel shall satisfy the flood protection criteria by demonstrating that the peak flow rate from a 10 year storm will be contained within the existing channel. The post developed flows to the channel have been analyzed and yield the following results:

Pipe Run	Flood Protection - 10 Year Capacity		Outfall Adequate?
	Max Pipe Discharge (cfs)	Pipe Discharge (cfs)	
EX145 to EX146	46.92	29.68	Yes
Cross Section	Channel Depth (ft)	Normal Depth (ft)	Outfall Adequate?
A-A	3.3	1.00	Yes
B-B	2.5	1.30	Yes

Final Opinion:

This outfall is a natural stormwater conveyance system. We have shown compliance with the channel and flood protection criteria, by providing a proposed SWM facility that will reduce proposed velocities and flows below existing. It is therefore our opinion that this outfall is adequate.

Pre-Developed Outfall Map
PL23-28
I-495
Fairfax, VA

DRAINAGE AREA BOUNDARY

EXISTING CONTOURS

TIME OF CONCENTRATION

A

B

C

D

E

F

G

PL23-OUT 28
DA = 16.58 AC
C = 0.50

SCALE

0 150' 300'

Post-Developed Outfall Map
PL23-28
I-495
Fairfax, VA

DRAINAGE AREA BOUNDARY

EXISTING CONTOURS

TIME OF CONCENTRATION

Controlled PL23-OUT 28
DA = 0.58 AC
C = 0.37

Uncontrolled PL23-OUT 28
DA = 15.81 AC
C = 0.50

SCALE
0 150' 300'

Name of Project:	495-NEXT		Designed By: KRI
State:	VA	**County:** Fairfax County	Date: 03/14/22
Name of Culvert:	Pre Development		Checked By: NVD
NOAA Station:	Vienna Tysons 44-8737		Date: 03/14/22
LOCATION:	PL23-OUT 28		UNITS **ENGLISH**

RATIONAL METHOD - DATA:

DRAINAGE BASIN

SUBSHED #	Land Use Description	Area Acres	C	C A
	Business: Industrial and Commercial (0.80-0.90)			
	Apartments and Townhomes (0.65-0.75)			
	Schools (0.50-0.60)	5.65	0.50	2.82
	Residential - lots 10,000 sq. ft. (0.40-0.50)			
	- lots 12,000 sq. ft. (0.40-0.45)			
	- lots 17,000 sq. ft. (0.35-0.45)			
	- lots ½ acre or more (0.30-0.40)	3.32	0.35	1.16
	Parks, Cemeteries and Unimproved Areas (0.20-0.35)			
	Paved and Roof Areas (0.90)	2.72	0.90	2.45
	Cultivated Areas (0.50-0.70)			
	Pasture (0.35-0.45)			
	Lawns (0.25-0.35)	2.89	0.30	0.87
	Forest (0.20-0.30)	0.96	0.25	0.24
	Steep Grass (2:1) (0.40-0.70)			
	Shoulder and Ditch Areas (0.35-0.50)			
	Gravel Lot (0.65)	1.04	0.65	0.67
	Totals =	**16.58 Acres**	**0.50**	**8.22**

Time of Concentration (Tc)

		Reach	Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Rational C		Tc (Minutes)
Overland Flow (E.E. Seelye - VDOT Modified)									
	Soil / Surface Type/Land Cover		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Rational C		
	Forest	A-B	49.48	322.09	320.55	0.031	0.25		8.96
	Grassed	B-C	150.58	320.55	313.60	0.046	0.30		11.05
Shallow Concentrated Flow			Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Intercept Coeff.		
grassed waterway		C-D	154.56	313.60	307.75	0.038	0.457		0.88
Channel Flow			Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Roadside Ditch		D-E	432.12	307.75	298.21	0.022	0.045	4.72	1.52
				Area =	12		Wetted P =	12.7	
Pipe Flow			Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
EX140 to EX139		E-F	259.22	290.76	280.78	0.039	0.013	14.13	0.31
	Pipe Diameter (in) =		24	Area =	3.14		Wetted P =	6.28	
Pipe Flow			Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
EX139 to EX145		F-G	587.44	280.78	250.02	0.052	0.013	15.07	0.65
	Pipe Diameter (in) =		21	Area =	2.41		Wetted P =	5.50	
								Total Tc (Minutes) =	**23.37**

		1-Year	2-Year	5-Year	10-Year	25-Year	50-Year	100-Year
Rainfall Intensity	Inches / Hour.	**2.21**	**2.76**	**3.26**	**3.73**	**4.27**	**4.66**	**5.03**
Aosorption Coefficient / Ground Saturation Correction Coefficient Cf		1.00	1.00	1.00	1.00	1.10	1.20	1.25
Peak Discharge	CFS.	**18.17**	**22.71**	**26.82**	**30.64**	**38.59**	**45.94**	**51.69**

Name of Project:	495-NEXT			Designed By:	JMON
State:	VA	**County:**	Fairfax County	Date:	03/14/22
Name of Culvert:	Post Development			Checked By:	NVD
NOAA Station:	Vienna Tysons 44-8737			Date:	03/14/22
LOCATION:	PL23-OUT 28 Controlled				
				UNITS	**ENGLISH**

RATIONAL METHOD - DATA:

DRAINAGE BASIN

SUBSHED #	Land Use Description	Area Acres	C	C A
	Business: Industrial and Commercial (0.80-0.90)			
	Apartments and Townhomes (0.65-0.75)			
	Schools (0.50-0.60)	0.00	0.50	
	Residential - lots 10,000 sq. ft. (0.40-0.50)			
	- lots 12,000 sq. ft. (0.40-0.45)			
	- lots 17,000 sq. ft. (0.35-0.45)			
	- lots ½ acre or more (0.30-0.40)	0.00	0.35	
	Parks, Cemeteries and Unimproved Areas (0.20-0.35)			
	Paved and Roof Areas (0.90)	0.05	0.90	0.05
	Cultivated Areas (0.50-0.70)			
	Pasture (0.35-0.45)			
	Lawns (0.25-0.35)	0.50	0.30	0.15
	Forest (0.20-0.30)	0.00	0.25	
	Steep Grass (2:1) (0.40-0.70)			
	Shoulder and Ditch Areas (0.35-0.50)			
	Gravel Lot (0.65)	0.02	0.65	0.01
	Totals =	**0.58 Acres**	**0.37**	**0.21**

Time of Concentration (Tc)

	Reach	Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Rational C		Tc (Minutes)
							Total Tc (Minutes) =	**5.00**

Name of Project:	495-NEXT		Designed By: JMON
State:	VA	**County:** Fairfax County	Date: 03/14/22
Name of Culvert:	Post Development		Checked By: NVD
NOAA Station:	Vienna Tysons 44-8737		Date: 03/14/22
LOCATION:	PL23-OUT 28 Uncontrolled		
			UNITS **ENGLISH**

RATIONAL METHOD - DATA:

DRAINAGE BASIN

SUBSHED #	Land Use Description	Area Acres	C	C A
	Business: Industrial and Commercial (0.80-0.90)			
	Apartments and Townhomes (0.65-0.75)			
	Schools (0.50-0.60)	5.65	0.50	2.82
	Residential - lots 10,000 sq. ft. (0.40-0.50)			
	- lots 12,000 sq. ft. (0.40-0.45)			
	- lots 17,000 sq. ft. (0.35-0.45)			
	- lots ½ acre or more (0.30-0.40)	3.32	0.35	1.16
	Parks, Cemeteries and Unimproved Areas (0.20-0.35)			
	Paved and Roof Areas (0.90)	2.53	0.90	2.28
	Cultivated Areas (0.50-0.70)			
	Pasture (0.35-0.45)			
	Lawns (0.25-0.35)	2.87	0.30	0.86
	Forest (0.20-0.30)	0.47	0.25	0.12
	Steep Grass (2:1) (0.40-0.70)			
	Shoulder and Ditch Areas (0.35-0.50)			
	Gravel Lot (0.65)	0.98	0.65	0.64
	Totals =	**15.81 Acres**	**0.50**	**7.88**

Time of Concentration (Tc)

		Reach	Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Rational C		Tc (Minutes)
Overland Flow (E.E. Seelye - VDOT Modified)									
	Soil / Surface Type/Land Cover		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Rational C		
	Forest	A-B	49.48	322.09	320.55	0.031	0.25		8.96
	Grassed	B-C	150.58	320.55	313.60	0.046	0.30		11.05
Shallow Concentrated Flow			Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Intercept Coeff.		
grassed waterway		C-D	154.56	313.60	307.75	0.038	0.457		0.88
Channel Flow			Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Roadside Ditch		D-E	390.76	307.75	298.00	0.025	0.045	5.02	1.30
				Area =	12		Wetted P =	12.7	
Pipe Flow			Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
13Q-11 to 13Q-12		E-F	36.06	298.00	296.90	0.031	0.013	10.38	0.06
	Pipe Diameter (in) =		18	Area =	1.77		Wetted P =	4.71	
Pipe Flow			Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
13Q-12 to EX139		F-G	259.22	296.90	280.78	0.062	0.013	17.96	0.24
	Pipe Diameter (in) =		24	Area =	3.14		Wetted P =	6.28	
Pipe Flow			Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
EX139 to EX145		G-H	587.44	280.78	250.02	0.052	0.013	15.07	0.65
	Pipe Diameter (in) =		21	Area =	2.41		Wetted P =	5.50	
								Total Tc (Minutes) =	**23.14**

		1-Year	2-Year	5-Year	10-Year	25-Year	50-Year	100-Year
Rainfall Intensity	Inches / Hour.	**2.22**	**2.78**	**3.28**	**3.75**	**4.29**	**4.68**	**5.06**
Aosorption Coefficient / Ground Saturation Correction Coefficient	Cf	1.00	1.00	1.00	1.00	1.10	1.20	1.25
Peak Discharge	CFS.	**17.52**	**21.89**	**25.85**	**29.52**	**37.18**	**44.25**	**49.78**

SWM 11 - 2 YEAR ROUTING SUMMARY

Project Summary	
Title	SWM-11
Engineer	KELSIE ISON, P.E.
Company	RINKER DESIGN ASSOCIATES
Date	3/14/2022

Notes	SWM-11

REFER TO APPENDIX C OF THE STORMWATER MANAGEMENT REPORT FOR FULL ROUTING COMPUTATIONS

SWM 11 - 2 YEAR ROUTING SUMMARY

Subsection: Master Network Summary

Catchments Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (ft³)	Time to Peak (min)	Peak Flow (ft³/s)
SWM11 - INFLOW	Base	2	415.000	5.400	0.99

Node Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (ft³)	Time to Peak (min)	Peak Flow (ft³/s)
SWM-11 OUT	Base	2	413.000	11.000	0.13

Pond Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (ft³)	Time to Peak (min)	Peak Flow (ft³/s)	Maximum Water Surface Elevation (ft)	Maximum Pond Storage (ft³)
SWM11 (IN)	Base	2	413.000	6.000	0.99	(N/A)	(N/A)
SWM11 (OUT)	Base	2	413.000	11.000	0.13	298.94	331.000

SWM 11 - 10 YEAR ROUTING SUMMARY

Project Summary	
Title	SWM-11
Engineer	KELSIE ISON, P.E.
Company	RINKER DESIGN ASSOCIATES
Date	3/14/2022

Notes	SWM-11

REFER TO APPENDIX C OF THE STORMWATER MANAGEMENT REPORT FOR FULL ROUTING COMPUTATIONS

SWM 11 - 10 YEAR ROUTING SUMMARY

Subsection: Master Network Summary

Catchments Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (ft³)	Time to Peak (min)	Peak Flow (ft³/s)
SWM11 - INFLOW	Base	10	694.000	5.600	1.29

Node Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (ft³)	Time to Peak (min)	Peak Flow (ft³/s)
SWM-11 OUT	Base	10	692.000	13.000	0.16

Pond Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (ft³)	Time to Peak (min)	Peak Flow (ft³/s)	Maximum Water Surface Elevation (ft)	Maximum Pond Storage (ft³)
SWM11 (IN)	Base	10	692.000	6.000	1.29	(N/A)	(N/A)
SWM11 (OUT)	Base	10	692.000	13.000	0.16	299.08	599.000

Outfall PL23-OUT28 Sections A-A, B-B: Looking Upstream

Outfall PL23-OUT28 Sections A-A, B-B: Looking Downstream

PL23-OUT28 Outlet Pipe/Cross Sections
I-495 NEXT
Fairfax,VA

DRAINAGE AREA BOUNDARY

EXISTING CONTOURS

TIME OF CONCENTRATION

SCALE

0 25' 50'

Ex 145
DA=16.39*
C=0.49

EX146

SECTION A-A

SECTION B-B

NOTE:
* See PL23-OUT28 for full drainage divides.

Name of Project:	495-NEXT		Designed By: JMON
State:	VA	**County:** Fairfax County	Date: 03/14/22
Name of Culvert:	Pre Development		Checked By: NVD
NOAA Station:	Vienna Tysons 44-8737		Date: 03/14/22
LOCATION:	PL23-OUT 28 Ex145-Ex146		

UNITS **ENGLISH**

RATIONAL METHOD - DATA:

DRAINAGE BASIN

SUBSHED #	Land Use Description	Area Acres	C	C A
	Business: Industrial and Commercial (0.80-0.90)			
	Apartments and Townhomes (0.65-0.75)			
	Schools (0.50-0.60)	5.65	0.50	2.82
	Residential - lots 10,000 sq. ft. (0.40-0.50)			
	- lots 12,000 sq. ft. (0.40-0.45)			
	- lots 17,000 sq. ft. (0.35-0.45)			
	- lots ½ acre or more (0.30-0.40)	3.32	0.35	1.16
	Parks, Cemeteries and Unimproved Areas (0.20-0.35)			
	Paved and Roof Areas (0.90)	2.72	0.90	2.45
	Cultivated Areas (0.50-0.70)			
	Pasture (0.35-0.45)			
	Lawns (0.25-0.35)	2.89	0.30	0.87
	Forest (0.20-0.30)	0.96	0.25	0.24
	Steep Grass (2:1) (0.40-0.70)			
	Shoulder and Ditch Areas (0.35-0.50)			
	Gravel Lot (0.65)	1.04	0.65	0.67
	Totals =	**16.58 Acres**	**0.50**	**8.22**

Time of Concentration (Tc)

	Reach	Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Rational C		Tc (Minutes)
Overland Flow (E.E. Seelye - VDOT Modified)								
Soil / Surface Type/Land Cover		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Rational C		
Forest	A-B	49.48	322.09	320.55	0.031	0.25		8.96
Grassed	B-C	150.58	320.55	313.60	0.046	0.30		11.05
Shallow Concentrated Flow		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Intercept Coeff.		
grassed waterway	C-D	154.56	313.60	307.75	0.038	0.457		0.88
Channel Flow		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Roadside Ditch	D-E	432.12	307.75	298.21	0.022	0.045	4.72	1.52
			Area =	12		Wetted P =	12.7	
Pipe Flow		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
EX140 to EX139	E-F	259.22	290.76	280.78	0.039	0.013	14.13	0.31
Pipe Diameter (in) =		24	Area =	3.14		Wetted P =	6.28	
Pipe Flow		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
EX139 to EX145	F-G	587.44	280.78	250.02	0.052	0.013	15.07	0.65
Pipe Diameter (in) =		21	Area =	2.41		Wetted P =	5.50	
							Total Tc (Minutes) =	**23.37**

	2-Year	5-Year	10-Year	25-Year	50-Year	100-Year
Rainfall Intensity Inches / Hour.	**2.76**	**3.26**	**3.73**	**4.27**	**4.66**	**5.03**
Aosorption Coefficient / Ground Saturation Correction Coefficient Cf	1.00	1.00	1.00	1.10	1.20	1.25
Peak Discharge CFS.	**22.71**	**26.82**	**30.64**	**38.59**	**45.94**	**51.69**

Name of Project:	495-NEXT			Designed By:	JMON
State:	VA	**County:**	Fairfax County	Date:	03/14/22
Name of Culvert:	Post Development			Checked By:	NVD
NOAA Station:	Vienna Tysons 44-8737			Date:	03/14/22
LOCATION:	PL23-OUT 28 Ex145-Ex146				
				UNITS	**ENGLISH**

RATIONAL METHOD - DATA:

DRAINAGE BASIN

SUBSHED #	Land Use Description	Area Acres	C	C A
	Business: Industrial and Commercial (0.80-0.90)			
	Apartments and Townhomes (0.65-0.75)			
	Schools (0.50-0.60)	5.65	0.50	2.82
	Residential - lots 10,000 sq. ft. (0.40-0.50)			
	- lots 12,000 sq. ft. (0.40-0.45)			
	- lots 17,000 sq. ft. (0.35-0.45)			
	- lots ½ acre or more (0.30-0.40)	3.32	0.35	1.16
	Parks, Cemeteries and Unimproved Areas (0.20-0.35)			
	Paved and Roof Areas (0.90)	2.53	0.90	2.28
	Cultivated Areas (0.50-0.70)			
	Pasture (0.35-0.45)			
	Lawns (0.25-0.35)	2.87	0.30	0.86
	Forest (0.20-0.30)	0.47	0.25	0.12
	Steep Grass (2:1) (0.40-0.70)			
	Shoulder and Ditch Areas (0.35-0.50)			
	Gravel Lot (0.65)	0.98	0.65	0.64
	Totals =	**15.81 Acres**	**0.50**	**7.88**

Time of Concentration (Tc)

		Reach	Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Rational C		Tc (Minutes)
Overland Flow (E.E. Seelye - VDOT Modified)									
	Soil / Surface Type/Land Cover		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Rational C		
	Forest	A-B	49.48	322.09	320.55	0.031	0.25		8.96
	Grassed	B-C	150.58	320.55	313.60	0.046	0.30		11.05
Shallow Concentrated Flow			Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Intercept Coeff.		
grassed waterway		C-D	154.56	313.60	307.75	0.038	0.457		0.88
Channel Flow			Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Roadside Ditch		D-E	390.76	307.75	298.00	0.025	0.045	5.02	1.30
				Area =	12		Wetted P =	12.7	
Pipe Flow			Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
13Q-11 to 13Q-12		E-F	36.06	298.00	296.90	0.031	0.013	9.19	0.07
	Pipe Diameter (in) =		15	Area =	1.23		Wetted P =	3.93	
Pipe Flow			Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
13Q-12 to EX139		F-G	259.22	296.90	280.78	0.062	0.013	17.96	0.24
	Pipe Diameter (in) =		24	Area =	3.14		Wetted P =	6.28	
Pipe Flow			Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
EX139 to EX145		G-H	587.44	280.78	250.02	0.052	0.013	15.07	0.65
	Pipe Diameter (in) =		21	Area =	2.41		Wetted P =	5.50	
								Total Tc (Minutes) =	**23.14**

		2-Year	5-Year	10-Year	25-Year	50-Year	100-Year
Rainfall Intensity	Inches / Hour.	**2.78**	**3.28**	**3.75**	**4.29**	**4.68**	**5.06**
Aosorption Coefficient / Ground Saturation Correction Coefficient Cf		1.00	1.00	1.00	1.10	1.20	1.25
Peak Discharge	CFS.	**21.89**	**25.85**	**29.52**	**37.18**	**44.25**	**49.78**
Pond Discharge	CFS.	**0.13**		**0.16**			
Total Discharge	CFS.	**22.02**		**29.68**			

LD-229
STORM SEWER DESIGN COMPUTATIONS

PROJECT: I-495 NEXT
LOCATION:
COUNTY: Vienna Tysons Corner

Designed by: JMON
Checked by: NVD

STORM FREQUENCY **2**

UNITS **ENGLISH**

* Pre-Developed Conditions

PIPE NO.	FROM POINT REFERENCE	FROM POINT STA.	TO POINT REFERENCE	TO POINT STA.	DRAIN. AREA "A" Acre	RUNOFF COEFF. "C"	CA INCRE-MENT	CA ACCUM-ULATED	INLET TIME Minutes	RAIN FALL In/Hr	RUNOFF Lateral CFS	RUNOFF Total Q CFS	INVERT ELEVATIONS UPPER END	INVERT ELEVATIONS LOWER END	LENGTH of Pipe Ft.	SLOPE Ft./Ft.	SIZE (Dia. Or Span/Rise) In.	SHAPE	Number of Pipes	Capacity CFS	Friction Slope Ft./Ft.	NORMAL FLOW Depth of Flow, dn Ft.	NORMAL FLOW Area of Flow, An SqFt	NORMAL FLOW Hrn Ft.	NORMAL FLOW Vn Ft/Sec	NORMAL FLOW En Ft.	FLOW TIME INCRE-MENT Minutes	FLOW TIME ACCUMU-LATED Minutes	REMARKS
	(1)		(2)		(3)	(4)	(5)	(6)	(7)	(8)		(9)	(10)	(11)	(12)	(13)	(14)			(15)							(17)	(17)	(18)
EX145EX46	EX145		EX146		-	-	-	-	-	-	-	22.71	250.02	248.32	39.52	0.04302	24	Circular	1	46.92	0.01050	0.98	1.53	0.49	14.81	4.39	0.04	5.04	

LD-229
STORM SEWER DESIGN COMPUTATIONS

STORM FREQUENCY **2**

PROJECT: I-495 NEXT
LOCATION:
COUNTY: Vienna Tysons Corner

Designed by: JMON
Checked by: NVD

UNITS **ENGLISH**

PIPE NO.	FROM POINT REFERENCE (1)	FROM POINT STA.	TO POINT REFERENCE (2)	TO POINT STA.	DRAIN. AREA "A" Acre (3)	RUNOFF COEFF. "C" (4)	CA INCRE-MENT (5)	CA ACCUM-ULATED (6)	INLET TIME Minutes (7)	RAIN FALL In/Hr (8)	RUNOFF Lateral CFS	RUNOFF Total Q CFS (9)	INVERT ELEVATIONS UPPER END (10)	INVERT ELEVATIONS LOWER END (11)	LENGTH of Pipe Ft. (12)	SLOPE Ft./Ft. (13)	SIZE (Dia. Or Span/Rise) In. (14)	SHAPE	Number of Pipes	Capacity CFS (15)	Friction Slope Ft./Ft.	NORMAL FLOW Depth of Flow, dn Ft.	NORMAL FLOW Area of Flow, An SqFt	NORMAL FLOW Hrm Ft.	NORMAL FLOW Vn Ft/Sec (16)	NORMAL FLOW En Ft.	FLOW TIME INCRE-MENT Minutes (17)	FLOW TIME ACCUMU-LATED Minutes (17)	REMARKS (18)
EX145EX146	EX145		EX146		-	-	-	-	-	-	-	22.02	250.02	248.32	39.52	0.04302	24	Circular	1	46.92	0.00990	0.96	1.50	0.49	14.70	4.32	0.05	5.05	

LD-229
STORM SEWER DESIGN COMPUTATIONS

PROJECT: I-495 NEXT
LOCATION:
COUNTY: Vienna Tysons Corner

Designed by: JMON
Checked by: NVD

STORM FREQUENCY **10**

UNITS **ENGLISH**

PIPE NO.	FROM POINT		TO POINT		DRAIN. AREA "A"	RUNOFF COEFF. "C"	CA		INLET TIME	RAIN FALL	RUNOFF		INVERT ELEVATIONS		LENGTH of Pipe	SLOPE	SIZE (Dia. Or Span/Rise)	SHAPE	Number of Pipes	Capacity	Friction Slope	NORMAL FLOW					FLOW TIME		REMARKS
	REFERENCE	STA.	REFERENCE	STA.			INCRE-MENT	ACCUM-ULATED			Lateral	Total Q	UPPER END	LOWER END								Depth of Flow, dn	Area of Flow, An	Hrn	Vn	En	INCRE-MENT	ACCUMU-LATED	
	(1)		(2)		Acre (3)	(4)	(5)	(6)	Minutes (7)	In/Hr (8)	CFS	CFS (9)	(10)	(11)	Ft. (12)	Ft./Ft. (13)	In. (14)			CFS (15)	Ft./Ft.	Ft.	SqFt	Ft.	Ft/Sec (16)	Ft.	Minutes (17)	Minutes (17)	(18)
EX145EX146	EX145		EX146		-	-	-	-	-	-	-	29.68	250.02	248.32	39.52	0.04302	24	Circular	1	46.92	0.01790	1.15	1.88	0.54	15.80	5.03	0.04	5.04	

Name of Project:	495-NEXT			Designed By:	JMON
State:	VA	**County:**	Fairfax County	Date:	03/14/22
Name of Culvert:	Pre Development			Checked By:	NVD
NOAA Station:	Vienna Tysons 44-8737			Date:	03/14/22
LOCATION:	PL23-OUT 28 A-A				
				UNITS	**ENGLISH**

RATIONAL METHOD - DATA:

DRAINAGE BASIN

SUBSHED #	Land Use Description	Area Acres	C	C A
	Business: Industrial and Commercial (0.80-0.90)			
	Apartments and Townhomes (0.65-0.75)			
	Schools (0.50-0.60)	5.65	0.50	2.82
	Residential - lots 10,000 sq. ft. (0.40-0.50)			
	- lots 12,000 sq. ft. (0.40-0.45)			
	- lots 17,000 sq. ft. (0.35-0.45)			
	- lots ½ acre or more (0.30-0.40)	3.34	0.35	1.17
	Parks, Cemeteries and Unimproved Areas (0.20-0.35)			
	Paved and Roof Areas (0.90)	2.75	0.90	2.48
	Cultivated Areas (0.50-0.70)			
	Pasture (0.35-0.45)			
	Lawns (0.25-0.35)	2.89	0.30	0.87
	Forest (0.20-0.30)	1.04	0.25	0.26
	Steep Grass (2:1) (0.40-0.70)			
	Shoulder and Ditch Areas (0.35-0.50)			
	Gravel Lot (0.65)	1.04	0.65	0.67
	Totals =	**16.71 Acres**	**0.50**	**8.27**

Time of Concentration (Tc)

		Reach	Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Rational C		Tc (Minutes)
Overland Flow (E.E. Seelye - VDOT Modified)									
	Soil / Surface Type/Land Cover		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Rational C		
	Forest	A-B	49.48	322.09	320.55	0.031	0.25		8.96
	Grassed	B-C	150.58	320.55	313.60	0.046	0.30		11.05
Shallow Concentrated Flow			Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Intercept Coeff.		
grassed waterway		C-D	154.56	313.60	307.75	0.038	0.457		0.88
Channel Flow			Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Roadside Ditch		D-E	432.12	307.75	298.21	0.022	0.045	4.72	1.52
				Area =	12		Wetted P =	12.7	
Pipe Flow			Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
EX140 to EX139		E-F	259.22	290.76	280.78	0.039	0.013	14.13	0.31
	Pipe Diameter (in) =		24	Area =	3.14		Wetted P =	6.28	
Pipe Flow			Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
EX139 to EX145		F-G	587.44	280.78	250.02	0.052	0.013	15.07	0.65
	Pipe Diameter (in) =		21	Area =	2.41		Wetted P =	5.50	
Pipe Flow			Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
EX145 to EX146		G-H	40.69	250.02	248.32	0.042	0.013	14.72	0.05
	Pipe Diameter (in) =		24	Area =	3.14		Wetted P =	6.28	
Channel Flow			Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Natural Channel		H-I	50.00	248.32	245.71	0.052	0.045	7.26	0.11
				Area =	12.00		Wetted P =	12.70	
								Total Tc (Minutes) =	**23.54**

		2-Year	**5-Year**	**10-Year**	**25-Year**	**50-Year**	**100-Year**
Rainfall Intensity	Inches / Hour.	**2.75**	**3.25**	**3.71**	**4.25**	**4.64**	**5.01**
Aosorption Coefficient / Ground Saturation Correction Coefficient Cf		1.00	1.00	1.00	1.10	1.20	1.25
Peak Discharge	CFS.	**22.76**	**26.89**	**30.72**	**38.70**	**46.07**	**51.84**

Name of Project:	495-NEXT			Designed By:	JMON
State:	VA	**County:**	Fairfax County	Date:	03/14/22
Name of Culvert:	Post Development			Checked By:	NVD
NOAA Station:	Vienna Tysons 44-8737			Date:	03/14/22
LOCATION:	PL23-OUT 28 A-A				
				UNITS	**ENGLISH**

RATIONAL METHOD - DATA:

DRAINAGE BASIN

SUBSHED #	Land Use Description	Area Acres	C	C A
	Business: Industrial and Commercial (0.80-0.90)			
	Apartments and Townhomes (0.65-0.75)			
	Schools (0.50-0.60)	5.65	0.50	2.82
	Residential - lots 10,000 sq. ft. (0.40-0.50)			
	- lots 12,000 sq. ft. (0.40-0.45)			
	- lots 17,000 sq. ft. (0.35-0.45)			
	- lots ½ acre or more (0.30-0.40)	3.34	0.35	1.17
	Parks, Cemeteries and Unimproved Areas (0.20-0.35)			
	Paved and Roof Areas (0.90)	2.56	0.90	2.30
	Cultivated Areas (0.50-0.70)			
	Pasture (0.35-0.45)			
	Lawns (0.25-0.35)	2.87	0.30	0.86
	Forest (0.20-0.30)	0.55	0.25	0.14
	Steep Grass (2:1) (0.40-0.70)			
	Shoulder and Ditch Areas (0.35-0.50)			
	Gravel Lot (0.65)	0.98	0.65	0.64
	Totals =	**15.94 Acres**	**0.50**	**7.93**

Time of Concentration (Tc)

	Reach	Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Rational C		Tc (Minutes)
Overland Flow (E.E. Seelye - VDOT Modified)								
Soil / Surface Type/Land Cover		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Rational C		
Forest	A-B	49.48	322.09	320.55	0.031	0.25		8.96
Grassed	B-C	150.58	320.55	313.60	0.046	0.30		11.05
Shallow Concentrated Flow		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Intercept Coeff.		
grassed waterway	C-D	154.56	313.60	307.75	0.038	0.457		0.88
Channel Flow		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Roadside Ditch	D-E	390.76	307.75	298.00	0.025	0.045	5.02	1.30
			Area =	12		Wetted P =	12.7	
Pipe Flow		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
13Q-11 to 13Q-12	E-F	36.06	298.00	296.90	0.031	0.013	9.19	0.07
Pipe Diameter (in) =		15	Area =	1.23		Wetted P =	3.93	
Pipe Flow		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
13Q-12 to EX139	F-G	259.22	296.90	280.78	0.062	0.013	17.96	0.24
Pipe Diameter (in) =		24	Area =	3.14		Wetted P =	6.28	
Pipe Flow		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
EX139 to EX145	G-H	587.44	280.78	250.02	0.052	0.013	15.07	0.65
Pipe Diameter (in) =		21	Area =	2.41		Wetted P =	5.50	
Pipe Flow		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
EX145 to EX146	G-H	39.52	250.02	248.32	0.043	0.013	14.93	0.04
Pipe Diameter (in) =		24	Area =	3.14		Wetted P =	6.28	
Channel Flow		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Natural Channel	H-I	50.00	248.32	245.71	0.052	0.045	7.26	0.11
			Area =	12.00		Wetted P =	12.70	
							Total Tc (Minutes) =	**23.31**

		2-Year	5-Year	10-Year	25-Year	50-Year	100-Year
Rainfall Intensity	Inches / Hour.	**2.77**	**3.27**	**3.73**	**4.27**	**4.66**	**5.04**
Aosorption Coefficient / Ground Saturation Correction Coefficient Cf		1.00	1.00	1.00	1.10	1.20	1.25
Peak Discharge	CFS.	**21.94**	**25.92**	**29.60**	**37.29**	**44.39**	**49.94**
Pond Discharge	CFS.	**0.13**		**0.16**			
Total Discharge	CFS.	**22.07**		**29.76**			

PL23-OUT28 (A-A) Pre - 2yr

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Channel Slope	0.082 ft/ft
Discharge	22.76 cfs

Section Definitions

Station (ft)	Elevation (ft)
0+00	249.00
0+03	248.00
0+04	247.00
0+06	246.00
0+08	245.71
0+09	246.00
0+12	247.00
0+13	248.00
0+20	249.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 249.00)	(0+20, 249.00)	0.045

Options	
Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results	
Normal Depth	0.9 ft
Roughness Coefficient	0.045
Elevation	246.64 ft
Elevation Range	245.7 to 249.0 ft
Flow Area	3.6 ft²
Wetted Perimeter	6.4 ft
Hydraulic Radius	0.6 ft
Top Width	6.06 ft
Normal Depth	0.9 ft
Critical Depth	1.1 ft
Critical Slope	0.036 ft/ft
Velocity	6.38 ft/s

PL23-OUT28 (A-A) Pre - 2yr

Results	
Velocity Head	0.63 ft
Specific Energy	1.56 ft
Froude Number	1.467
Flow Type	Supercritical

GVF Input Data	
Downstream Depth	0.0 ft
Length	0.0 ft
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.0 ft
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	0.9 ft
Critical Depth	1.1 ft
Channel Slope	0.082 ft/ft
Critical Slope	0.036 ft/ft

PL23-OUT28 (A-A) Post - 2yr

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Channel Slope	0.082 ft/ft
Discharge	22.08 cfs

Section Definitions

Station (ft)	Elevation (ft)
0+00	249.00
0+03	248.00
0+04	247.00
0+06	246.00
0+08	245.71
0+09	246.00
0+12	247.00
0+13	248.00
0+20	249.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 249.00)	(0+20, 249.00)	0.045

Options	
Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results	
Normal Depth	0.9 ft
Roughness Coefficient	0.045
Elevation	246.62 ft
Elevation Range	245.7 to 249.0 ft
Flow Area	3.5 ft²
Wetted Perimeter	6.4 ft
Hydraulic Radius	0.5 ft
Top Width	6.01 ft
Normal Depth	0.9 ft
Critical Depth	1.1 ft
Critical Slope	0.036 ft/ft
Velocity	6.33 ft/s

PL23-OUT28 (A-A) Post - 2yr

Results	
Velocity Head	0.62 ft
Specific Energy	1.54 ft
Froude Number	1.464
Flow Type	Supercritical

GVF Input Data	
Downstream Depth	0.0 ft
Length	0.0 ft
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.0 ft
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	0.9 ft
Critical Depth	1.1 ft
Channel Slope	0.082 ft/ft
Critical Slope	0.036 ft/ft

PL23-OUT28 (A-A) Post - 10yr

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Channel Slope	0.082 ft/ft
Discharge	29.77 cfs

Section Definitions

Station (ft)	Elevation (ft)
0+00	249.00
0+03	248.00
0+04	247.00
0+06	246.00
0+08	245.71
0+09	246.00
0+12	247.00
0+13	248.00
0+20	249.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 249.00)	(0+20, 249.00)	0.045

Options	
Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results	
Normal Depth	1.0 ft
Roughness Coefficient	0.045
Elevation	246.76 ft
Elevation Range	245.7 to 249.0 ft
Flow Area	4.3 ft²
Wetted Perimeter	7.0 ft
Hydraulic Radius	0.6 ft
Top Width	6.54 ft
Normal Depth	1.0 ft
Critical Depth	1.3 ft
Critical Slope	0.035 ft/ft
Velocity	6.88 ft/s

PL23-OUT28 (A-A) Post - 10yr

Results	
Velocity Head	0.74 ft
Specific Energy	1.78 ft
Froude Number	1.491
Flow Type	Supercritical

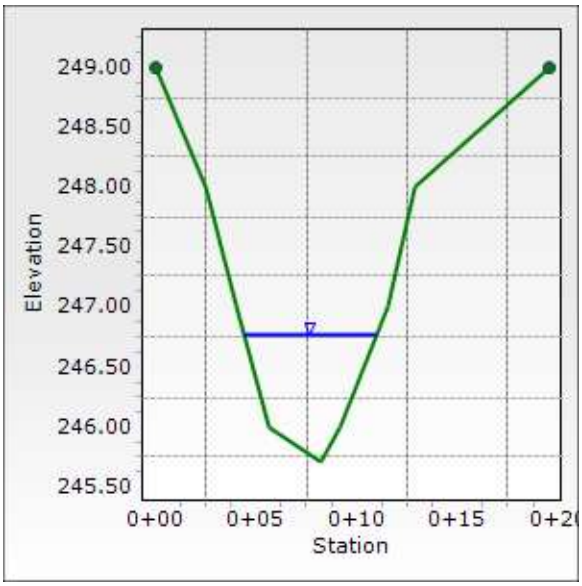
GVF Input Data	
Downstream Depth	0.0 ft
Length	0.0 ft
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.0 ft
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	1.0 ft
Critical Depth	1.3 ft
Channel Slope	0.082 ft/ft
Critical Slope	0.035 ft/ft

PL23-OUT28 (A-A) Post - 10yr

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Channel Slope	0.082 ft/ft
Normal Depth	1.0 ft
Discharge	29.77 cfs



Name of Project:	495-NEXT			Designed By:	JMON
State:	VA	**County:**	Fairfax County	Date:	03/14/22
Name of Culvert:	Pre Development			Checked By:	NVD
NOAA Station:	Vienna Tysons 44-8737			Date:	03/14/22
LOCATION:	PL23-OUT 28 B-B			UNITS	**ENGLISH**

RATIONAL METHOD - DATA:

DRAINAGE BASIN

SUBSHED #	Land Use Description	Area Acres	C	C A
	Business: Industrial and Commercial (0.80-0.90)			
	Apartments and Townhomes (0.65-0.75)			
	Schools (0.50-0.60)	5.65	0.50	2.82
	Residential - lots 10,000 sq. ft. (0.40-0.50)			
	- lots 12,000 sq. ft. (0.40-0.45)			
	- lots 17,000 sq. ft. (0.35-0.45)			
	- lots ½ acre or more (0.30-0.40)	3.35	0.35	1.17
	Parks, Cemeteries and Unimproved Areas (0.20-0.35)			
	Paved and Roof Areas (0.90)	2.75	0.90	2.48
	Cultivated Areas (0.50-0.70)			
	Pasture (0.35-0.45)			
	Lawns (0.25-0.35)	2.89	0.30	0.87
	Forest (0.20-0.30)	1.10	0.25	0.27
	Steep Grass (2:1) (0.40-0.70)			
	Shoulder and Ditch Areas (0.35-0.50)			
	Gravel Lot (0.65)	1.04	0.65	0.67
	Totals =	**16.78 Acres**	**0.49**	**8.29**

Time of Concentration (Tc)

		Reach	Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Rational C		Tc (Minutes)
Overland Flow (E.E. Seelye - VDOT Modified)									
	Soil / Surface Type/Land Cover		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Rational C		
	Forest	A-B	49.48	322.09	320.55	0.031	0.25		8.96
	Grassed	B-C	150.58	320.55	313.60	0.046	0.30		11.05
Shallow Concentrated Flow			Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Intercept Coeff.		
grassed waterway		C-D	154.56	313.60	307.75	0.038	0.457		0.88
Channel Flow			Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Roadside Ditch		D-E	432.12	307.75	298.21	0.022	0.045	4.72	1.52
				Area =	12		Wetted P =	12.7	
Pipe Flow			Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
EX140 to EX139		E-F	259.22	290.76	280.78	0.039	0.013	14.13	0.31
	Pipe Diameter (in) =		24	Area =	3.14		Wetted P =	6.28	
Pipe Flow			Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
EX139 to EX145		F-G	587.44	280.78	250.02	0.052	0.013	15.07	0.65
	Pipe Diameter (in) =		21	Area =	2.41		Wetted P =	5.50	
Pipe Flow			Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
EX145 to EX146		G-H	40.69	250.02	248.32	0.042	0.013	14.72	0.05
	Pipe Diameter (in) =		24	Area =	3.14		Wetted P =	6.28	
Channel Flow			Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Natural Channel		H-I	99.97	248.32	244.52	0.038	0.045	6.20	0.27
				Area =	12.00		Wetted P =	12.70	
								Total Tc (Minutes) =	**23.69**

		2-Year	**5-Year**	**10-Year**	**25-Year**	**50-Year**	**100-Year**
Rainfall Intensity	Inches / Hour.	**2.74**	**3.24**	**3.70**	**4.24**	**4.63**	**5.00**
Aosorption Coefficient / Ground Saturation Correction Coefficient Cf		1.00	1.00	1.00	1.10	1.20	1.25
Peak Discharge	CFS.	**22.73**	**26.86**	**30.69**	**38.66**	**46.03**	**51.79**

Name of Project:	495-NEXT			Designed By:	JMON
State:	VA	**County:**	Fairfax County	Date:	03/14/22
Name of Culvert:	Post Development			Checked By:	NVD
NOAA Station:	Vienna Tysons 44-8737			Date:	03/14/22
LOCATION:	PL23-OUT 28 B-B				
				UNITS	**ENGLISH**

RATIONAL METHOD - DATA:

DRAINAGE BASIN

SUBSHED #	Land Use Description	Area Acres	C	C A
	Business: Industrial and Commercial (0.80-0.90)			
	Apartments and Townhomes (0.65-0.75)			
	Schools (0.50-0.60)	5.65	0.50	2.82
	Residential - lots 10,000 sq. ft. (0.40-0.50)			
	- lots 12,000 sq. ft. (0.40-0.45)			
	- lots 17,000 sq. ft. (0.35-0.45)			
	- lots ½ acre or more (0.30-0.40)	3.36	0.35	1.17
	Parks, Cemeteries and Unimproved Areas (0.20-0.35)			
	Paved and Roof Areas (0.90)	2.56	0.90	2.30
	Cultivated Areas (0.50-0.70)			
	Pasture (0.35-0.45)			
	Lawns (0.25-0.35)	2.87	0.30	0.86
	Forest (0.20-0.30)	0.61	0.25	0.15
	Steep Grass (2:1) (0.40-0.70)			
	Shoulder and Ditch Areas (0.35-0.50)			
	Gravel Lot (0.65)	0.98	0.65	0.64
	Totals =	**16.02 Acres**	**0.50**	**7.95**

Time of Concentration (Tc)

	Reach	Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Rational C		Tc (Minutes)
Overland Flow (E.E. Seelye - VDOT Modified)								
Soil / Surface Type/Land Cover		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Rational C		
Forest	A-B	49.48	322.09	320.55	0.031	0.25		8.96
Grassed	B-C	150.58	320.55	313.60	0.046	0.30		11.05
Shallow Concentrated Flow		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Intercept Coeff.		
grassed waterway	C-D	154.56	313.60	307.75	0.038	0.457		0.88
Channel Flow		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Roadside Ditch	D-E	390.76	307.75	298.00	0.025	0.045	5.02	1.30
			Area =	12		Wetted P =	12.7	
Pipe Flow		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
13Q-11 to 13Q-12	E-F	36.06	298.00	296.90	0.031	0.013	9.19	0.07
Pipe Diameter (in) =		15	Area =	1.23		Wetted P =	3.93	
Pipe Flow		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
13Q-12 to EX139	F-G	259.22	296.90	280.78	0.062	0.013	17.96	0.24
Pipe Diameter (in) =		24	Area =	3.14		Wetted P =	6.28	
Pipe Flow		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
EX139 to EX145	G-H	587.44	280.78	250.02	0.052	0.013	15.07	0.65
Pipe Diameter (in) =		21	Area =	2.41		Wetted P =	5.50	
Pipe Flow		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
EX145 to EX146	G-H	39.52	250.02	248.32	0.043	0.013	14.93	0.04
Pipe Diameter (in) =		24	Area =	3.14		Wetted P =	6.28	
Channel Flow		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Natural Channel	H-I	99.97	248.32	244.52	0.038	0.045	6.20	0.27
			Area =	12.00		Wetted P =	12.70	
							Total Tc (Minutes) =	**23.46**

		2-Year	5-Year	10-Year	25-Year	50-Year	100-Year
Rainfall Intensity	Inches / Hour.	**2.76**	**3.26**	**3.72**	**4.26**	**4.65**	**5.02**
Aosorption Coefficient / Ground Saturation Correction Coefficient Cf		1.00	1.00	1.00	1.10	1.20	1.25
Peak Discharge	CFS.	**21.92**	**25.89**	**29.58**	**37.25**	**44.35**	**49.90**
Pond Discharge	CFS.	**0.13**		**0.16**			
Total Discharge	CFS.	**22.05**		**29.74**			

PL23-OUT28 (B-B) Pre - 2yr

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Channel Slope	0.081 ft/ft
Discharge	22.73 cfs

Section Definitions

Station (ft)	Elevation (ft)
0+00	247.00
0+01	246.00
0+02	245.00
0+04	244.52
0+05	245.00
0+07	246.00
0+09	247.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 247.00)	(0+09, 247.00)	0.045

Options	
Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results	
Normal Depth	1.1 ft
Roughness Coefficient	0.045
Elevation	245.66 ft
Elevation Range	244.5 to 247.0 ft
Flow Area	3.3 ft²
Wetted Perimeter	5.4 ft
Hydraulic Radius	0.6 ft
Top Width	4.81 ft
Normal Depth	1.1 ft
Critical Depth	1.4 ft
Critical Slope	0.038 ft/ft
Velocity	6.80 ft/s
Velocity Head	0.72 ft
Specific Energy	1.86 ft

PL23-OUT28 (B-B) Pre - 2yr

Results	
Froude Number	1.439
Flow Type	Supercritical

GVF Input Data	
Downstream Depth	0.0 ft
Length	0.0 ft
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.0 ft
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	1.1 ft
Critical Depth	1.4 ft
Channel Slope	0.081 ft/ft
Critical Slope	0.038 ft/ft

PL23-OUT28 (B-B) Post - 2yr

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Channel Slope	0.081 ft/ft
Discharge	22.05 cfs

Section Definitions

Station (ft)	Elevation (ft)
0+00	247.00
0+01	246.00
0+02	245.00
0+04	244.52
0+05	245.00
0+07	246.00
0+09	247.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 247.00)	(0+09, 247.00)	0.045

Options	
Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results	
Normal Depth	1.1 ft
Roughness Coefficient	0.045
Elevation	245.65 ft
Elevation Range	244.5 to 247.0 ft
Flow Area	3.3 ft²
Wetted Perimeter	5.4 ft
Hydraulic Radius	0.6 ft
Top Width	4.77 ft
Normal Depth	1.1 ft
Critical Depth	1.3 ft
Critical Slope	0.038 ft/ft
Velocity	6.75 ft/s
Velocity Head	0.71 ft
Specific Energy	1.83 ft

PL23-OUT28 (B-B) Post - 2yr

Results	
Froude Number	1.437
Flow Type	Supercritical

GVF Input Data	
Downstream Depth	0.0 ft
Length	0.0 ft
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.0 ft
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	1.1 ft
Critical Depth	1.3 ft
Channel Slope	0.081 ft/ft
Critical Slope	0.038 ft/ft

PL23-OUT28 (B-B) Post - 10yr

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Channel Slope	0.081 ft/ft
Discharge	29.74 cfs

Section Definitions

Station (ft)	Elevation (ft)
0+00	247.00
0+01	246.00
0+02	245.00
0+04	244.52
0+05	245.00
0+07	246.00
0+09	247.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 247.00)	(0+09, 247.00)	0.045

Options	
Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results	
Normal Depth	1.3 ft
Roughness Coefficient	0.045
Elevation	245.81 ft
Elevation Range	244.5 to 247.0 ft
Flow Area	4.1 ft²
Wetted Perimeter	5.9 ft
Hydraulic Radius	0.7 ft
Top Width	5.19 ft
Normal Depth	1.3 ft
Critical Depth	1.5 ft
Critical Slope	0.036 ft/ft
Velocity	7.32 ft/s
Velocity Head	0.83 ft
Specific Energy	2.12 ft

PL23-OUT28 (B-B) Post - 10yr

Results	
Froude Number	1.459
Flow Type	Supercritical

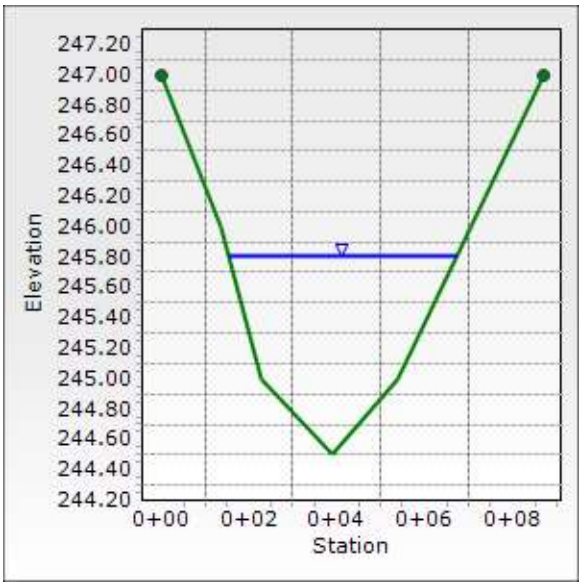
GVF Input Data	
Downstream Depth	0.0 ft
Length	0.0 ft
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.0 ft
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	1.3 ft
Critical Depth	1.5 ft
Channel Slope	0.081 ft/ft
Critical Slope	0.036 ft/ft

PL23-OUT28 (B-B) Post - 10yr

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Channel Slope	0.081 ft/ft
Normal Depth	1.3 ft
Discharge	29.74 cfs



APPENDIX C29
PL23-OUT29

Outfall PL23-OUT 29

Outfall PL23-OUT29 is an existing outfall at Georgetown Pike station 36+17 right. The outfall consists of an area of uncontrolled sheet flow. The outfall prior to development is 0.34 acres.

Development of this area will result in a reduced area to this outfall, due to the proposed roadway design and grading. The resulting area to the outfall will be 0.32 acres.

Drainage Area:

The drainage areas and resulting changes are summarized in the table below:

PL23-OUT 29			
Drainage Area	**Total Area**	**C (Total)**	**Tc**
Existing	0.34 ac	0.85	5.47 min
Proposed	0.32 ac	0.86	5.34 min

Limits of Study:

The location of the outfall is shown in the included outfall drainage map. The point of analysis is at the end of the raised median.

Easement Requirements:

No additional easements are required.

Outfall Discharge:

All discharges were calculated using the Rational Method and are summarized below:

PL23-OUT 29		
Drainage Area	**Peak Flow Rate (Total)**	
	2 Year	10 Year
Existing	1.47 cfs	1.91 cfs
Proposed	1.39 cfs	1.82 cfs
Net Change	**-0.08 cfs**	**-0.09 cfs**

Final Opinion:

Area of increased volume of sheet flow must be identified and evaluated for potential impacts. As this outfall demonstrates a decreased volume of sheet flow, no further calculations are necessary. It is therefore our opinion that this outfall is adequate.

Pre-Developed Outfall Map
PL23-29
I-495
Fairfax, VA

DRAINAGE AREA BOUNDARY

EXISTING CONTOURS

TIME OF CONCENTRATION

PL23-OUT 29
DA = 0.34 AC
C = 0.85

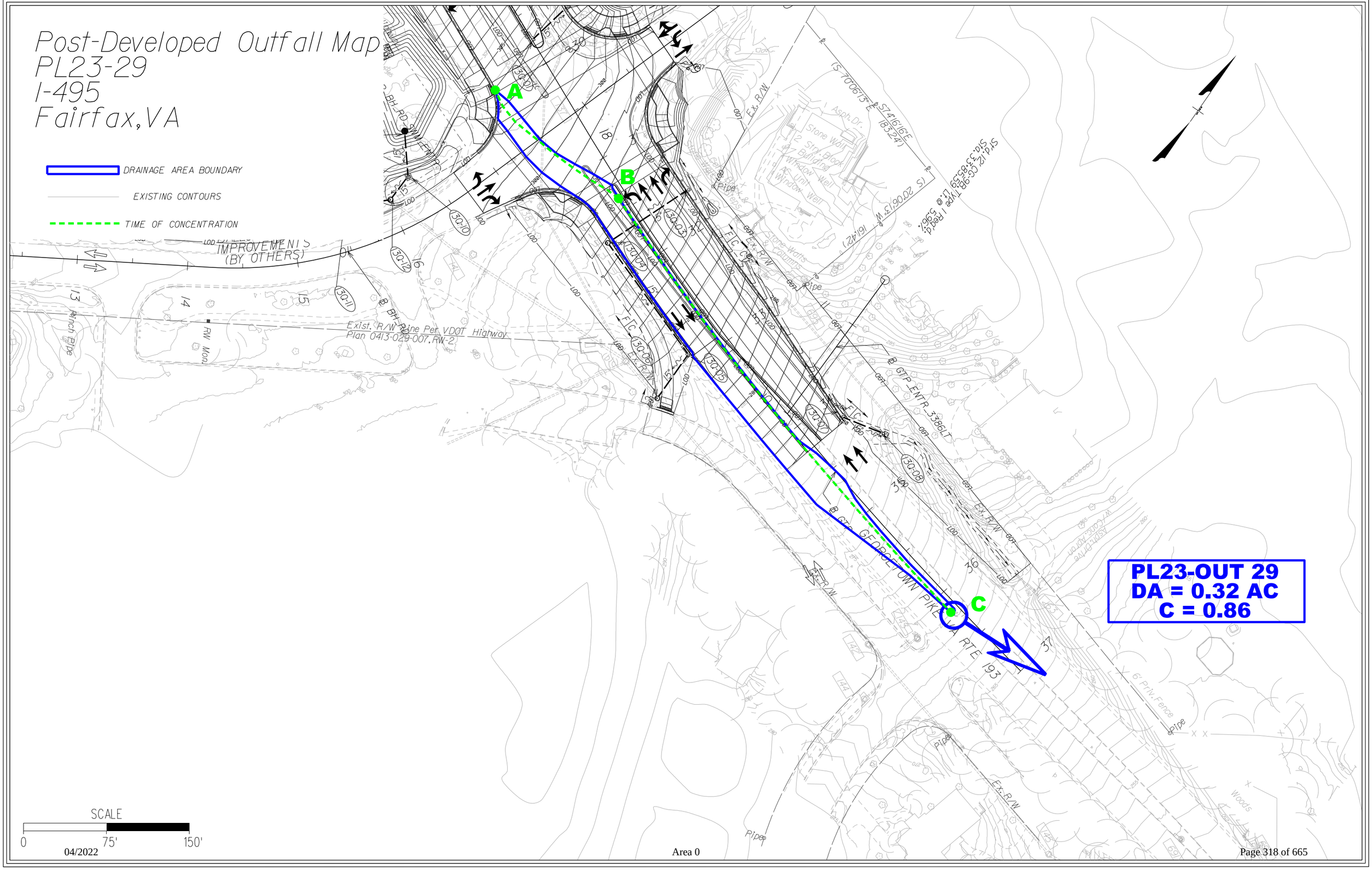
SCALE
0 75' 150'

Post-Developed Outfall Map
PL23-29
I-495
Fairfax, VA

DRAINAGE AREA BOUNDARY

EXISTING CONTOURS

TIME OF CONCENTRATION



Name of Project:	495-NEXT			Designed By:	KRI
State:	VA	**County:**	Fairfax County	Date:	03/15/22
Name of Culvert:	Pre Development			Checked By:	NVD
NOAA Station:	Vienna Tysons 44-8737			Date:	03/15/22
LOCATION:	PL23-OUT 29				
				UNITS	**ENGLISH**

RATIONAL METHOD - DATA:

DRAINAGE BASIN

SUBSHED #	Land Use Description	Area Acres	C	C A
	Business: Industrial and Commercial (0.80-0.90)			
	Apartments and Townhomes (0.65-0.75)			
	Schools (0.50-0.60)			
	Residential - lots 10,000 sq. ft. (0.40-0.50)			
	- lots 12,000 sq. ft. (0.40-0.45)			
	- lots 17,000 sq. ft. (0.35-0.45)			
	- lots ½ acre or more (0.30-0.40)		0.35	
	Parks, Cemeteries and Unimproved Areas (0.20-0.35)			
	Paved and Roof Areas (0.90)	0.31	0.90	0.28
	Cultivated Areas (0.50-0.70)			
	Pasture (0.35-0.45)			
	Lawns (0.25-0.35)	0.03	0.30	0.01
	Forest (0.20-0.30)		0.25	
	Steep Grass (2:1) (0.40-0.70)			
	Shoulder and Ditch Areas (0.35-0.50)			
	Totals =	**0.34 Acres**	**0.85**	**0.29**

Time of Concentration (Tc)

	Reach	Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Rational C		Tc (Minutes)
Overland Flow (E.E. Seelye - VDOT Modified)								
Soil / Surface Type/Land Cover		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Rational C		
Paved	A-B	165.51	303.65	296.00	0.046	0.90		3.83
Shallow Concentrated Flow		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Intercept Coeff.		
Paved	B-C	469.79	296.00	270.00	0.055	0.619		1.64
							Total Tc (Minutes) =	**5.47**

		2-Year	**5-Year**	**10-Year**	**25-Year**	**50-Year**	**100-Year**
Rainfall Intensity	Inches / Hour.	**5.06**	**5.86**	**6.61**	**7.47**	**8.10**	**8.69**
Aosorption Coefficient / Ground Saturation Correction Coefficient Cf		1.00	1.00	1.00	1.10	1.20	1.25
Peak Discharge	CFS.	**1.47**	**1.70**	**1.91**	**2.38**	**2.82**	**3.15**

Name of Project:	495-NEXT			Designed By:	JMON
State:	VA	**County:**	Fairfax County	Date:	03/15/22
Name of Culvert:	Post Development			Checked By:	NVD
NOAA Station:	Vienna Tysons 44-8737			Date:	03/15/22
LOCATION:	PL23-OUT 29				
				UNITS	**ENGLISH**

RATIONAL METHOD - DATA:

DRAINAGE BASIN

SUBSHED #	Land Use Description	Area Acres	C	C A
	Business: Industrial and Commercial (0.80-0.90)			
	Apartments and Townhomes (0.65-0.75)			
	Schools (0.50-0.60)		0.50	
	Residential - lots 10,000 sq. ft. (0.40-0.50)			
	- lots 12,000 sq. ft. (0.40-0.45)			
	- lots 17,000 sq. ft. (0.35-0.45)			
	- lots ½ acre or more (0.30-0.40)		0.35	
	Parks, Cemeteries and Unimproved Areas (0.20-0.35)			
	Paved and Roof Areas (0.90)	0.30	0.90	0.27
	Cultivated Areas (0.50-0.70)			
	Pasture (0.35-0.45)			
	Lawns (0.25-0.35)	0.02	0.30	0.01
	Forest (0.20-0.30)		0.25	
	Steep Grass (2:1) (0.40-0.70)			
	Shoulder and Ditch Areas (0.35-0.50)			
	Totals =	**0.32 Acres**	**0.86**	**0.27**

Time of Concentration (Tc)

	Reach		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Rational C		Tc (Minutes)
Overland Flow (E.E. Seelye - VDOT Modified)									
	Soil / Surface Type/Land Cover		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Rational C		
	Paved	A-B	150.87	303.93	296.41	0.050	0.90		3.63
Shallow Concentrated Flow			Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Intercept Coeff.		
Paved		B-C	484.89	296.41	270.00	0.054	0.619		1.71
								Total Tc (Minutes) =	**5.34**

		2-Year	**5-Year**	**10-Year**	**25-Year**	**50-Year**	**100-Year**
Rainfall Intensity	Inches / Hour.	**5.09**	**5.90**	**6.65**	**7.51**	**8.15**	**8.74**
Aosorption Coefficient / Ground Saturation Correction Coefficient Cf		1.00	1.00	1.00	1.10	1.20	1.25
Peak Discharge	CFS.	**1.39**	**1.61**	**1.82**	**2.26**	**2.67**	**2.99**

APPENDIX C30
PL23-OUT30

Outfall PL23-OUT 30

Outfall PL23-OUT30 is an existing outfall at Georgetown Pike station 36+50 left. The outfall consists of a natural stormwater conveyance system. In existing conditions, flow is conveyed through existing channels and sheet flow to the point of analysis. The outfall prior to development is 2.21 acres.

Development of this area will result in a decreased area to this outfall, due to the installation of storm sewer conveying drainage to adjacent outfalls. The resulting area to the outfall will be 2.03 acres.

Drainage Area:

The drainage areas and resulting changes are summarized in the table below:

PL23-OUT 30			
Drainage Area	**Total Area**	**C (Total)**	**Tc**
Existing	2.21 ac	0.52	5.22 min
Proposed	2.03 ac	0.49	5.00 min

Limits of Study:

The location of the outfall is shown in the included outfall drainage map. The point of analysis is at existing culvert 163.

Easement Requirements:

No additional easements are required.

Outfall Discharge:

All discharges were calculated using the Rational Method and are summarized below:

PL23-OUT 30		
Drainage Area	**Peak Flow Rate (Total)**	
	2 Year	10 Year
Existing	5.90 cfs	7.70 cfs
Proposed	5.20 cfs	6.78 cfs
Net Change	**-0.70 cfs**	**-0.92 cfs**

Channel Description:

Outfall PL23-OUT30 is a natural channel consisting of a metal culvert and receiving channel. Cross Sections were prepared utilizing topography prepared by Rinker Design Associates, P.C. and Fairfax County GIS.

Channel Protection:

Under Section 11.7.5.1 of the VDOT drainage manual, areas draining to a natural stormwater conveyance channel shall satisfy the channel protection criteria by providing

conveyance of the 2 year storm without causing erosion of the system. Calculations have been provided below supporting the 2 year velocities in the system:

Pipe Run	Channel Protection - 2 Year Velocity				Outfall Adequate?
	Pipe Material	Max Permissible Velocity (ft/s)	Existing Velocity (ft/s)	Proposed Velocity (ft/s)	
EX163	Metal	No Max	6.61	6.46	Yes
Cross Section	**Channel Material**	**Max Permissible**	**Existing Velocity (ft/s)**	**Proposed Velocity**	**Outfall**
A-A	Wheaton-Meadowville Complex	2.3	2.05	1.96	Yes
B-B	Wheaton-Meadowville Complex	2.3	2.95	2.87	Yes

As not all velocities are within the allowable range for this soil type, a site design has been developed to cause the pre-development rate from the 2 year storm to not increase (per Section 11.7.5.1). As there is a net 0.70 cfs reduction for the 2 year storm, requirements for channel protection have been met for this outfall.

Flood Protection:

Under Section 11.7.5.2 of the VDOT drainage manual, areas draining to a natural stormwater conveyance channel shall satisfy the flood protection criteria by demonstrating that the peak flow rate from a 10 year storm will be contained within the system. The proposed flows to the channel have been analyzed and yield the following results:

Pipe Run	Flood Protection - 10 Year Capacity						Outfall Adequate?
	Existing HW/D	Proposed HW/D	Max Allowable	Existing Freeboard	Proposed Freeboard	Minimum Freeboard	
EX163	1.86	1.58	1.50	0.47	0.81	1.50	Yes
Cross Section	**Flood Protection - 10 Year Capacity**						**Outfall Adequate?**
	Channel Depth (ft)			**Normal Depth (ft)**			
A-A	1.00			0.30			Yes
B-B	3.00			0.40			Yes

As is demonstrated by the computations above, the culvert does not meet HW/D and freeboard requirements. Per 11.7.5.2, in the case of an inadequate channel, the designer may develop a site design that does not cause the peak runoff rate to increase in the 2 or 10 year storm event. As reductions of 0.70 cfs and 0.92 cfs have been achieved, no further calculations are necessary.

Final Opinion:

This outfall is a natural stormwater conveyance system. We have shown compliance with the channel and flood protection criteria, by providing calculations demonstrating a reduction in the 2 and 10 year peak flow rates. It is therefore our opinion that this outfall is adequate.

Pre-Developed Outfall Map
PL23-30
I-495
Fairfax, VA

DRAINAGE AREA BOUNDARY

EXISTING CONTOURS

TIME OF CONCENTRATION

PL23-OUT 30
DA = 2.21 AC
C = 0.52

SCALE
0 100' 200'

Post-Developed Outfall Map
PL23-30
I-495
Fairfax, VA

DRAINAGE AREA BOUNDARY

EXISTING CONTOURS

TIME OF CONCENTRATION

PL23-OUT 30
DA = 2.03 AC
C = 0.49

SCALE
0 100' 200'

Name of Project:	495-NEXT			Designed By:	KRI
State:	VA	**County:**	Fairfax County	Date:	03/15/22
Name of Culvert:	Pre Development			Checked By:	NVD
NOAA Station:	Vienna Tysons 44-8737			Date:	03/15/22
LOCATION:	PL23-OUT 30				
				UNITS	**ENGLISH**

RATIONAL METHOD - DATA:

DRAINAGE BASIN

SUBSHED #	Land Use Description	Area Acres	C	C A
	Business: Industrial and Commercial (0.80-0.90)			
	Apartments and Townhomes (0.65-0.75)			
	Schools (0.50-0.60)			
	Residential - lots 10,000 sq. ft. (0.40-0.50)			
	- lots 12,000 sq. ft. (0.40-0.45)			
	- lots 17,000 sq. ft. (0.35-0.45)			
	- lots ½ acre or more (0.30-0.40)	1.43	0.35	0.50
	Parks, Cemeteries and Unimproved Areas (0.20-0.35)			
	Paved and Roof Areas (0.90)	0.70	0.90	0.63
	Cultivated Areas (0.50-0.70)			
	Pasture (0.35-0.45)			
	Lawns (0.25-0.35)	0.09	0.30	0.03
	Forest (0.20-0.30)		0.25	
	Steep Grass (2:1) (0.40-0.70)			
	Shoulder and Ditch Areas (0.35-0.50)			
	Totals =	**2.21 Acres**	**0.52**	**1.15**

Time of Concentration (Tc)

	Reach	Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Rational C		Tc (Minutes)
Overland Flow (E.E. Seelye - VDOT Modified)								
Soil / Surface Type/Land Cover		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Rational C		
Paved	A-B	200.00	307.37	297.63	0.049	0.90		4.11
Shallow Concentrated Flow		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Intercept Coeff.		
Paved	B-C	82.40	297.63	291.75	0.071	0.619		0.25
Channel Flow		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Roadside Channel	C-D	28.69	291.75	289.43	0.081	0.050	8.14	0.06
			Area =	12.00		Wetted P =	12.70	
Pipe Flow		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
EX Culvert 162	D-E	49.97	289.43	286.71	0.054	0.013	12.28	0.07
Pipe Diameter (in) =		15	Area =	1.23		Wetted P =	3.93	
Channel Flow		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Roadside Channel	E-F	55.96	286.71	284.40	0.041	0.050	5.81	0.16
			Area =	12.00		Wetted P =	12.70	
Pipe Flow		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Assumed Information	F-G	148.82	284.40	273.00	0.077	0.013	14.57	0.17
Pipe Diameter (in) =		15	Area =	1.23		Wetted P =	3.93	
Channel Flow		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Roadside Channel	G-H	175.59	273.00	261.58	0.065	0.050	7.30	0.40
			Area =	12.00		Wetted P =	12.70	
							Total Tc (Minutes) =	**5.22**

	2-Year	5-Year	10-Year	25-Year	50-Year	100-Year
Rainfall Intensity Inches / Hour.	**5.12**	**5.93**	**6.68**	**7.56**	**8.19**	**8.79**
Aosorption Coefficient / Ground Saturation Correction Coefficient Cf	1.00	1.00	1.00	1.10	1.20	1.25
Peak Discharge CFS.	**5.90**	**6.84**	**7.70**	**9.58**	**11.33**	**12.67**

Name of Project:	495-NEXT		Designed By: JMON
State:	VA	**County:** Fairfax County	Date: 03/15/22
Name of Culvert:	Post Development		Checked By: NVD
NOAA Station:	Vienna Tysons 44-8737		Date: 03/15/22
LOCATION:	PL23-OUT 30		
			UNITS **ENGLISH**

RATIONAL METHOD - DATA:

DRAINAGE BASIN

SUBSHED #	Land Use Description	Area Acres	C	C A
	Business: Industrial and Commercial (0.80-0.90)			
	Apartments and Townhomes (0.65-0.75)			
	Schools (0.50-0.60)		0.50	
	Residential - lots 10,000 sq. ft. (0.40-0.50)			
	- lots 12,000 sq. ft. (0.40-0.45)			
	- lots 17,000 sq. ft. (0.35-0.45)			
	- lots ½ acre or more (0.30-0.40)	1.42	0.35	0.50
	Parks, Cemeteries and Unimproved Areas (0.20-0.35)			
	Paved and Roof Areas (0.90)	0.54	0.90	0.48
	Cultivated Areas (0.50-0.70)			
	Pasture (0.35-0.45)			
	Lawns (0.25-0.35)	0.07	0.30	0.02
	Forest (0.20-0.30)		0.25	
	Steep Grass (2:1) (0.40-0.70)			
	Shoulder and Ditch Areas (0.35-0.50)			
	Totals =	**2.03 Acres**	**0.49**	**1.00**

Time of Concentration (Tc)

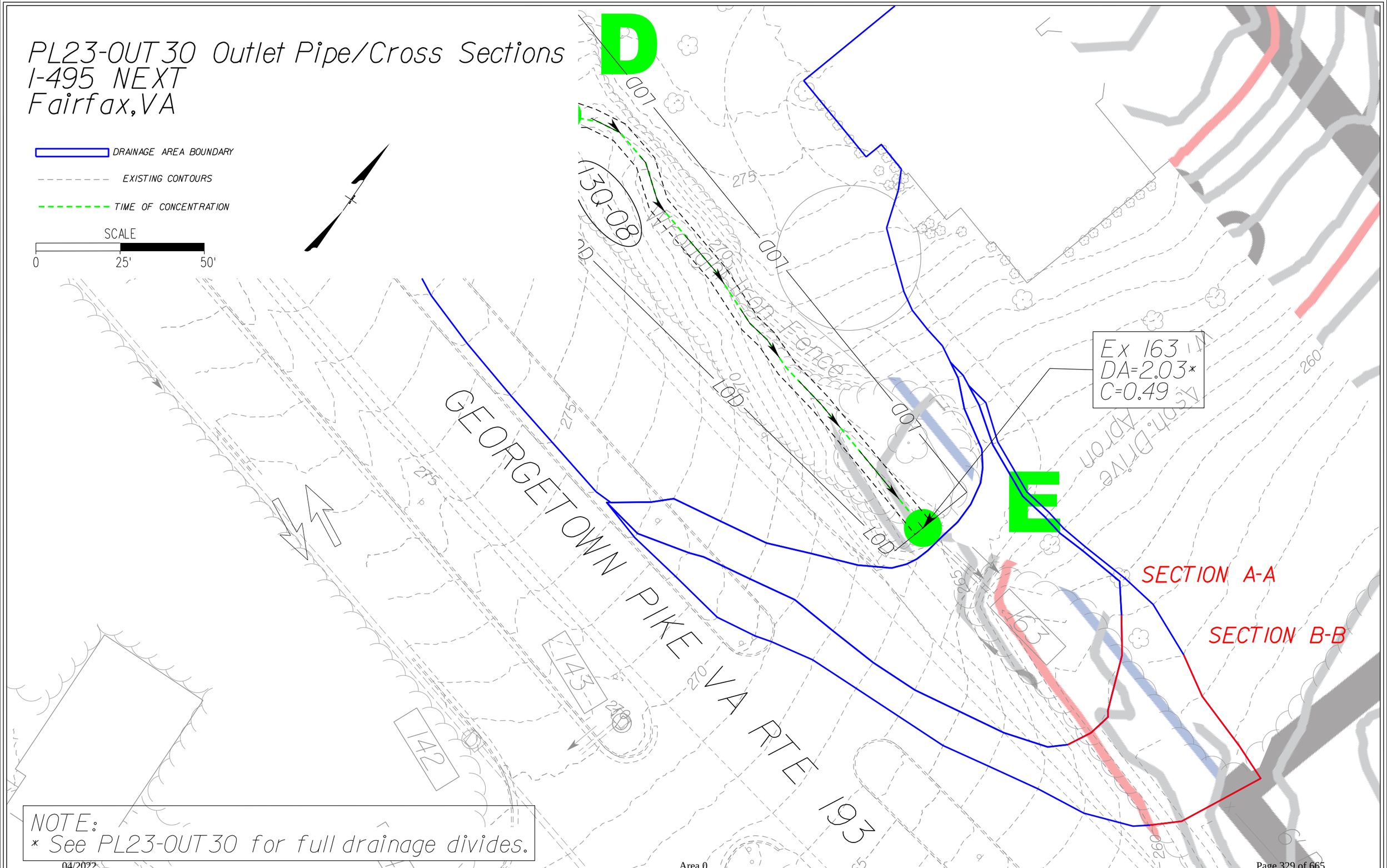
	Reach	Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Rational C		Tc (Minutes)
Overland Flow (E.E. Seelye - VDOT Modified)								
Soil / Surface Type/Land Cover		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Rational C		
Paved	A-B	163.00	302.00	293.00	0.055	0.90		3.68
Shallow Concentrated Flow		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Intercept Coeff.		
Paved	B-C	248.00	293.00	280.00	0.052	0.619		0.89
Pipe Flow		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
23-07 to 23-08	C-D	49.23	276.32	273.00	0.067	0.013	13.67	0.06
Pipe Diameter (in) =		15	Area =	1.23		Wetted P =	3.93	
Channel Flow		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Roadside ditch	D-E	167.09	273.00	261.58	0.068	0.050	7.48	0.37
			Area =	12.00		Wetted P =	12.70	
							Total Tc (Minutes) =	**5.00**

		2-Year	5-Year	10-Year	25-Year	50-Year	100-Year
Rainfall Intensity	Inches / Hour.	**5.18**	**6.00**	**6.75**	**7.63**	**8.28**	**8.89**
Aosorption Coefficient / Ground Saturation Correction Coefficient Cf		1.00	1.00	1.00	1.10	1.20	1.25
Peak Discharge	CFS.	**5.20**	**6.02**	**6.78**	**8.44**	**9.98**	**11.16**

Outfall PL23-OUT30 Sections A-A, B-B: Looking Upstream

Outfall PL23-OUT30 Sections A-A, B-B: Looking Downstream

PL23-OUT30 Outlet Pipe/Cross Sections
I-495 NEXT
Fairfax,VA



NOTE:
* See PL23-OUT30 for full drainage divides.

Name of Project:	495-NEXT			Designed By:	JMON
State:	VA	**County:**	Fairfax County	Date:	03/15/22
Name of Culvert:	Pre Development			Checked By:	NVD
NOAA Station:	Vienna Tysons 44-8737			Date:	03/15/22
LOCATION:	PL23-OUT 30 Ex Culvert 163				
				UNITS	**ENGLISH**

RATIONAL METHOD - DATA:

DRAINAGE BASIN

SUBSHED #	Land Use Description	Area Acres	C	C A
	Business: Industrial and Commercial (0.80-0.90)			
	Apartments and Townhomes (0.65-0.75)			
	Schools (0.50-0.60)			
	Residential - lots 10,000 sq. ft. (0.40-0.50)			
	- lots 12,000 sq. ft. (0.40-0.45)			
	- lots 17,000 sq. ft. (0.35-0.45)			
	- lots ½ acre or more (0.30-0.40)	1.43	0.35	0.50
	Parks, Cemeteries and Unimproved Areas (0.20-0.35)			
	Paved and Roof Areas (0.90)	0.70	0.90	0.63
	Cultivated Areas (0.50-0.70)			
	Pasture (0.35-0.45)			
	Lawns (0.25-0.35)	0.09	0.30	0.03
	Forest (0.20-0.30)		0.25	
	Steep Grass (2:1) (0.40-0.70)			
	Shoulder and Ditch Areas (0.35-0.50)			
	Totals =	**2.21 Acres**	**0.52**	**1.15**

Time of Concentration (Tc)

	Reach	Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Rational C		Tc (Minutes)
Overland Flow (E.E. Seelye - VDOT Modified)								
Soil / Surface Type/Land Cover		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Rational C		
Paved	A-B	200.00	307.37	297.63	0.049	0.90		4.11
Shallow Concentrated Flow		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Intercept Coeff.		
Paved	B-C	82.40	297.63	291.75	0.071	0.619		0.25
Channel Flow		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Roadside Channel	C-D	28.69	291.75	289.43	0.081	0.050	8.14	0.06
			Area =	12.00		Wetted P =	12.70	
Pipe Flow		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
EX Culvert 162	D-E	49.97	289.43	286.71	0.054	0.013	12.28	0.07
Pipe Diameter (in) =		15	Area =	1.23		Wetted P =	3.93	
Channel Flow		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Roadside Channel	E-F	55.96	286.71	284.40	0.041	0.050	5.81	0.16
			Area =	12.00		Wetted P =	12.70	
Pipe Flow		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Assumed Information	F-G	148.82	284.40	273.00	0.077	0.013	14.57	0.17
Pipe Diameter (in) =		15	Area =	1.23		Wetted P =	3.93	
Channel Flow		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Roadside Channel	G-H	175.59	273.00	261.58	0.065	0.050	7.30	0.40
			Area =	12.00		Wetted P =	12.70	
							Total Tc (Minutes) =	**5.22**

		2-Year	5-Year	10-Year	25-Year	50-Year	100-Year
Rainfall Intensity	Inches / Hour.	**5.12**	**5.93**	**6.68**	**7.56**	**8.19**	**8.79**
Aosorption Coefficient / Ground Saturation Correction Coefficient Cf		1.00	1.00	1.00	1.10	1.20	1.25
Peak Discharge	CFS.	**5.90**	**6.84**	**7.70**	**9.58**	**11.33**	**12.67**

Name of Project:	495-NEXT		Designed By: JMON
State:	VA	**County:** Fairfax County	Date: 03/15/22
Name of Culvert:	Post Development		Checked By: NVD
NOAA Station:	Vienna Tysons 44-8737		Date: 03/15/22
LOCATION:	PL23-OUT 30 Ex Culvert 163		
			UNITS **ENGLISH**

RATIONAL METHOD - DATA:

DRAINAGE BASIN

SUBSHED #	Land Use Description	Area Acres	C	C A
	Business: Industrial and Commercial (0.80-0.90)			
	Apartments and Townhomes (0.65-0.75)			
	Schools (0.50-0.60)		0.50	
	Residential - lots 10,000 sq. ft. (0.40-0.50)			
	- lots 12,000 sq. ft. (0.40-0.45)			
	- lots 17,000 sq. ft. (0.35-0.45)			
	- lots ½ acre or more (0.30-0.40)	1.42	0.35	0.50
	Parks, Cemeteries and Unimproved Areas (0.20-0.35)			
	Paved and Roof Areas (0.90)	0.54	0.90	0.48
	Cultivated Areas (0.50-0.70)			
	Pasture (0.35-0.45)			
	Lawns (0.25-0.35)	0.07	0.30	0.02
	Forest (0.20-0.30)		0.25	
	Steep Grass (2:1) (0.40-0.70)			
	Shoulder and Ditch Areas (0.35-0.50)			
	Totals =	**2.03 Acres**	**0.49**	**1.00**

Time of Concentration (Tc)

	Reach	Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Rational C		Tc (Minutes)
Overland Flow (E.E. Seelye - VDOT Modified)								
Soil / Surface Type/Land Cover		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Rational C		
Paved	A-B	163.00	302.00	293.00	0.055	0.90		3.68
Shallow Concentrated Flow		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Intercept Coeff.		
Paved	B-C	248.00	293.00	280.00	0.052	0.619		0.89
Pipe Flow		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
23-07 to 23-08	C-D	49.23	276.32	273.00	0.067	0.013	13.67	0.06
Pipe Diameter (in) =		15	Area =	1.23		Wetted P =	3.93	
Channel Flow		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Roadside ditch	D-E	167.09	273.00	261.58	0.068	0.050	7.48	0.37
			Area =	12.00		Wetted P =	12.70	
							Total Tc (Minutes) =	**5.00**

	2-Year	5-Year	10-Year	25-Year	50-Year	100-Year
Rainfall Intensity Inches / Hour.	**5.18**	**6.00**	**6.75**	**7.63**	**8.28**	**8.89**
Aosorption Coefficient / Ground Saturation Correction Coefficient Cf	1.00	1.00	1.00	1.10	1.20	1.25
Peak Discharge CFS.	**5.20**	**6.02**	**6.78**	**8.44**	**9.98**	**11.16**

PROJECT	**I-495 NEXT**			**CULVERT DESIGN FORM LD-269**	
ROAD	**Georgetown Pike**	**COUNTY**	Fairfax	SHEET 1 OF 1	DESIGNER: JMON DATE: 9/2/2021
CULVERT	EX163 Pre		VA	UNITS **ENGLISH**	REVIEWER: NVD DATE: 9/2/2021
NOAA Station	36+50 Vienna Tysons Corner				

HYDROLOGICAL DATA

Method: INPUT

Drainage Area: 2.21

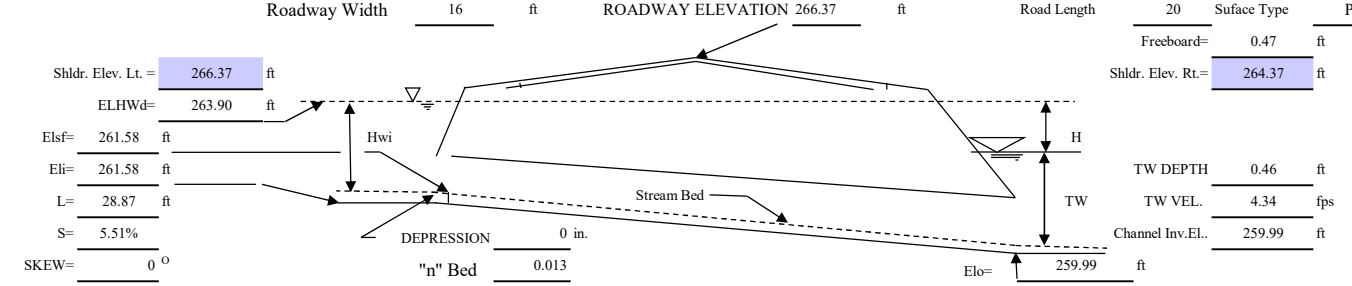
Time of Concentration 5.22

DESIGN FLOWS

R.I. (years)	FLOW (cfs)	
10	Design	7.70
2	Check	5.90
100	Max.	12.67

CULVERT DESCRIPTION:

TYPE: Single/Multiple Conforming



Inlet Edge Description:

Square edge w/headwall

Single / Multiple Conforming / Broken Back Culverts

MATERIAL	SHAPE	Size (in)	N	Mannings n	TOTAL FLOW Q cfs	FLOW PER BARREL Q/N cfs	HEADWATER CALCULATIONS: INLET CONTROL HWi/D	HWi ft	FALL ft	ELHWi ft	OUTLET CONTROL TW ft	dc ft	(dc+D)/2 ft	ho ft	ke	H ft	ELHWo ft	CONTROL HEADWATER ELEV ft	OUTLET VEL fps	MINIMUM SHOULDER ELEV. ft	COMMENTS
CMPMedCorr	Circular	15	1	0.027	7.70	7.7	1.86	2.32	0.00	263.90	0.46	1.10	1.18	1.17	0.50	2.68	263.84	263.90	6.72		
					5.90	5.9	1.36	1.70	0.00	263.28	0.40	0.98	1.12	1.12	0.50	1.57	262.68	263.28	6.61		
					12.67	12.7	3.85	4.81	0.00	266.39	0.61	1.22	1.24	1.24	0.50	4.79	266.02	266.39	10.24		

Broken Back Culvert

LENGTH	Elev.	SKEW O

TAILWATER DATA:

Channel Shape: Irregular

Bottom Width, ft: 0.00 "n" = 0.035

Side Slope Lt: (H:1V): 0.00

Side Slope Rt: (H:1V): 0.00

Channel Slope, ft/ft: 0.0850

Distance	0.00	6.00	10.00	10.40	13.00	17.00
Elevation	264.00	262.00	260.00	259.99	260.00	262.00
"n" =	0.050	0.050	0.050	0.050	0.050	

TAILWATER RESULTS:

	Discharge cfs	Elevation ft	Flow depth ft	Velocity fps	Shear force PSF
Design	7.70	260.45	0.46	4.34	2.45
Check	5.90	260.39	0.40	3.99	2.11
Max.	12.67	260.60	0.61	5.04	2.36

ROADWAY DATA:

Roadway Width, ft	16
Surface Type	PAVED
Top of Road Elevation, ft	266.37
Length of Road, ft	20

ROADWAY OVERTOPPING:

	Discharge cfs	Overtopping Discharge cfs	Overtopping Elevation ft
Design	7.70	0	0.00
Check	5.90	0	0.00
Max.	12.67	0	266.39

TECHNICAL FOOTNOTES:

(1) USE Q/NB FOR BOX CULVERTS

(2) HWi/D = HW/D OR HWi/D FROM DESIGN CHARTS

(3) FALL = HWI - (ELHWd - ELsf); FALL IS ZERO FOR CULVERTS ON GRADE

(4) ELhi = HWi + ELi (INVERT OF INLET CONTROL SECTION)

(5) TW BASED ON DOWNSTREAM CONTROL OR FLOW DEPTH IN CHANNEL

(6) ho = TW or (dc + D/2) (WHICHEVER IS GREATER)

(7) $H = [1 + ke + (29n^2L)/R^{1.33}]v^2/2g$

SUBSCRIPT DEFINITIONS:

HWd	DESIGN HEADWATER	i	INLET
HWi	HW IN INLET CONTROL	o	OUTLET
HWo	HW IN OUTLET CONTROL	sf	Streambed @ culvert face

COMMENTS / DISCUSSION:

CULVERT BARREL SELECTED

SIZE:	15"	n:	0.027
SHAPE:	Circular	MATERIAL:	CMP
ENTRANCE:	ES-1		

CULVERTSOFT by ENSOFTEC, INC.

PROJECT	**I-495 NEXT**			**CULVERT DESIGN FORM LD-269**	
ROAD	**Georgetown Pike**	**COUNTY**	Fairfax	SHEET 1 OF 1	DESIGNER: JMON DATE: 3/15/2022
CULVERT	EX163 POST		VA	UNITS **ENGLISH**	REVIEWER: NVD DATE: 3/15/2022
NOAA Station	36+50 Vienna Tysons Corner	58.00			

HYDROLOGICAL DATA

Method: INPUT

Drainage Area: 2.03

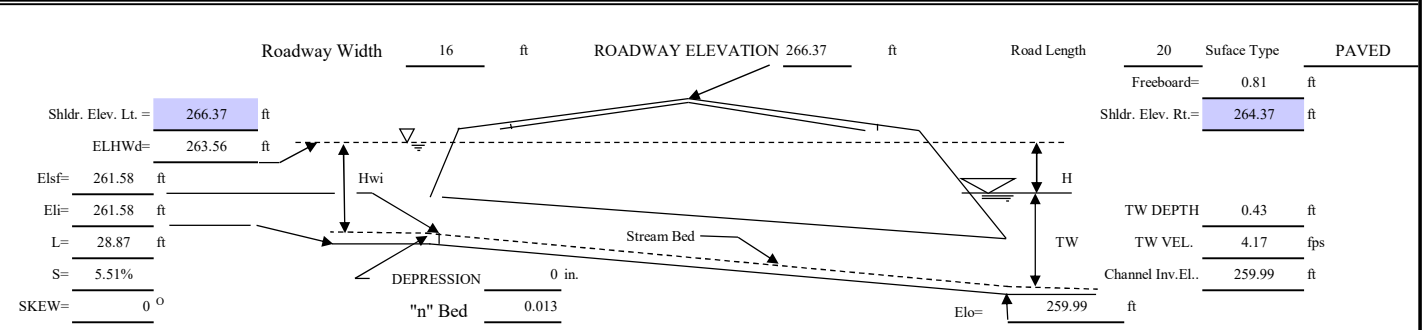
Time of Concentration 5

DESIGN FLOWS

R.I. (years)	FLOW (cfs)	
10	Design	6.78
2	Check	5.20
100	Max.	11.16

CULVERT DESCRIPTION:

TYPE: Single/Multiple Conforming



Inlet Edge Description:

Square edge w/headwall

Single / Multiple Conforming / Broken Back Culverts

HEADWATER CALCULATIONS

MATERIAL	SHAPE	Size (in)	N	Mannings n	TOTAL FLOW Q cfs	FLOW PER BARREL Q/N cfs	INLET CONTROL HWi/D	INLET CONTROL HWi ft	INLET CONTROL FALL ft	INLET CONTROL ELHWi ft	OUTLET CONTROL TW ft	OUTLET CONTROL dc ft	OUTLET CONTROL (dc+D)/2 ft	OUTLET CONTROL ho ft	OUTLET CONTROL ke	OUTLET CONTROL H ft	OUTLET CONTROL ELHWo ft	CONTROL HEADWATER ELEV ft	OUTLET VEL fps	MINIMUM SHOULDER ELEV. ft	COMMENTS
CMPMedCorr	Circular	15	1	0.027	6.78	6.8	1.58	1.98	0.00	263.56	0.43	1.05	1.15	1.15	0.50	2.08	263.21	263.56	6.75		
					5.20	5.2	1.18	1.47	0.00	263.05	0.37	0.93	1.09	1.09	0.50	1.22	262.30	263.05	6.46		
					11.16	11.2	3.54	3.96	0.00	265.54	0.57	1.21	1.23	1.23	0.50	4.79	266.01	266.01	9.09		

Broken Back Culvert

LENGTH	Elev.	SKEW O

TAILWATER DATA:

Channel Shape: Irregular

Bottom Width, ft: 0.00 "n" = 0.035

Side Slope Lt: (H:1V): 0.00

Side Slope Rt: (H:1V): 0.00

Channel Slope, ft/ft: 0.0850

Distance	0.00	6.00	10.00	10.40	13.00	17.00
Elevation	264.00	262.00	260.00	259.99	260.00	262.00
"n" =	0.050	0.050	0.050	0.050	0.050	

TAILWATER RESULTS:

	Discharge cfs	Elevation ft	Flow depth ft	Velocity fps	Shear force PSF
Design	260.42	0.43	4.17	2.28	
Check	260.36	0.37	3.83	1.97	
Max.	260.56	0.57	4.85	2.22	

ROADWAY DATA:

Roadway Width, ft	16
Surface Type	PAVED
Top of Road Elevation, ft	266.37
Length of Road, ft	20

ROADWAY OVERTOPPING:

	Discharge cfs	Overtopping Discharge cfs	Overtopping Elevation ft
Design	0		0.00
Check	0		0.00
Max.	0		0.00

TECHNICAL FOOTNOTES:

(1) USE Q/NB FOR BOX CULVERTS

(2) HWi/D = HW/D OR HWi/D FROM DESIGN CHARTS

(3) FALL = HWI - (ELHWd - ELsf); FALL IS ZERO FOR CULVERTS ON GRADE

(4) ELhi = HWi + ELi (INVERT OF INLET CONTROL SECTION)

(5) TW BASED ON DOWNSTREAM CONTROL OR FLOW DEPTH IN CHANNEL

(6) ho = TW or (dc + D/2) (WHICHEVER IS GREATER)

(7) $H = [1 + ke + (29n^2L)/R^{1.33}]v^2/2g$

SUBSCRIPT DEFINITIONS:

HWd	DESIGN HEADWATER	i	INLET
HWi	HW IN INLET CONTROL	o	OUTLET
HWo	HW IN OUTLET CONTROL	sf	Streambed @ culvert face

COMMENTS / DISCUSSION:

CULVERT BARREL SELECTED

SIZE:	15"	n:	0.027
SHAPE:	Cicular	MATERIAL:	CMP
ENTRANCE:	ES-1		

CULVERTSOFT by ENSOFTEC, INC.

Name of Project:	495-NEXT			Designed By:	JMON
State:	VA	**County:**	Fairfax County	Date:	03/15/22
Name of Culvert:	Pre Development			Checked By:	NVD
NOAA Station:	Vienna Tysons 44-8737			Date:	03/15/22
LOCATION:	PL23-OUT 30 A-A				
				UNITS	**ENGLISH**

RATIONAL METHOD - DATA:

DRAINAGE BASIN

SUBSHED #	Land Use Description	Area Acres	C	C A
	Business: Industrial and Commercial (0.80-0.90)			
	Apartments and Townhomes (0.65-0.75)			
	Schools (0.50-0.60)			
	Residential - lots 10,000 sq. ft. (0.40-0.50)			
	- lots 12,000 sq. ft. (0.40-0.45)			
	- lots 17,000 sq. ft. (0.35-0.45)			
	- lots ½ acre or more (0.30-0.40)	1.50	0.35	0.53
	Parks, Cemeteries and Unimproved Areas (0.20-0.35)			
	Paved and Roof Areas (0.90)	0.74	0.90	0.67
	Cultivated Areas (0.50-0.70)			
	Pasture (0.35-0.45)			
	Lawns (0.25-0.35)	0.09	0.30	0.03
	Forest (0.20-0.30)	0.00	0.25	
	Steep Grass (2:1) (0.40-0.70)			
	Shoulder and Ditch Areas (0.35-0.50)			
	Totals =	**2.33 Acres**	**0.52**	**1.22**

Time of Concentration (Tc)

	Reach	Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Rational C		Tc (Minutes)
Overland Flow (E.E. Seelye - VDOT Modified)								
Soil / Surface Type/Land Cover		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Rational C		
Paved	A-B	200.00	307.37	297.63	0.049	0.90		4.11
Shallow Concentrated Flow		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Intercept Coeff.		
Paved	B-C	82.40	297.63	291.75	0.071	0.619		0.25
Channel Flow		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Roadside Channel	C-D	28.69	291.75	289.43	0.081	0.050	8.14	0.06
			Area =	12.00		Wetted P =	12.70	
Pipe Flow		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
EX Culvert 162	D-E	49.97	289.43	286.71	0.054	0.013	12.28	0.07
Pipe Diameter (in) =		15	Area =	1.23		Wetted P =	3.93	
Channel Flow		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Roadside Channel	E-F	55.96	286.71	284.40	0.041	0.050	5.81	0.16
			Area =	12.00		Wetted P =	12.70	
Pipe Flow		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Assumed Information	F-G	148.82	284.40	273.00	0.077	0.013	14.57	0.17
Pipe Diameter (in) =		15	Area =	1.23		Wetted P =	3.93	
Channel Flow		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Roadside Channel	G-H	175.59	273.00	261.58	0.065	0.050	7.30	0.40
			Area =	12.00		Wetted P =	12.70	
Pipe Flow		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
EX Culvert 163	H-I	28.87	261.58	259.99	0.055	0.013	12.35	0.04
Pipe Diameter (in) =		15	Area =	1.23		Wetted P =	3.93	
Channel Flow		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Roadside Channel	I-J	49.80	259.99	258.00	0.040	0.050	5.72	0.15
			Area =	12.00		Wetted P =	12.70	
							Total Tc (Minutes) =	**5.40**

	2-Year	5-Year	10-Year	25-Year	50-Year	100-Year
Rainfall Intensity Inches / Hour.	**5.08**	**5.88**	**6.63**	**7.49**	**8.12**	**8.72**
Aosorption Coefficient / Ground Saturation Correction Coefficient Cf	1.00	1.00	1.00	1.10	1.20	1.25
Peak Discharge CFS.	**6.20**	**7.18**	**8.09**	**10.06**	**11.90**	**13.31**

Name of Project:	495-NEXT			Designed By:	JMON
State:	VA	**County:**	Fairfax County	Date:	03/15/22
Name of Culvert:	Post Development			Checked By:	NVD
NOAA Station:	Vienna Tysons 44-8737			Date:	03/15/22
LOCATION:	PL23-OUT 30 A-A			UNITS	**ENGLISH**

RATIONAL METHOD - DATA:

DRAINAGE BASIN

SUBSHED #	Land Use Description	Area Acres	C	C A
	Business: Industrial and Commercial (0.80-0.90)			
	Apartments and Townhomes (0.65-0.75)			
	Schools (0.50-0.60)		0.50	
	Residential - lots 10,000 sq. ft. (0.40-0.50)			
	- lots 12,000 sq. ft. (0.40-0.45)			
	- lots 17,000 sq. ft. (0.35-0.45)			
	- lots ½ acre or more (0.30-0.40)	1.50	0.35	0.52
	Parks, Cemeteries and Unimproved Areas (0.20-0.35)			
	Paved and Roof Areas (0.90)	0.58	0.90	0.53
	Cultivated Areas (0.50-0.70)			
	Pasture (0.35-0.45)			
	Lawns (0.25-0.35)	0.07	0.30	0.02
	Forest (0.20-0.30)	0.00	0.25	
	Steep Grass (2:1) (0.40-0.70)			
	Shoulder and Ditch Areas (0.35-0.50)			
	Totals =	**2.15 Acres**	**0.50**	**1.07**

Time of Concentration (Tc)

	Reach	Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Rational C		Tc (Minutes)
Overland Flow (E.E. Seelye - VDOT Modified)								
Soil / Surface Type/Land Cover		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Rational C		
Paved	A-B	163.00	302.00	293.00	0.055	0.90		3.68
Shallow Concentrated Flow		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Intercept Coeff.		
Paved	B-C	248.00	293.00	280.00	0.052	0.619		0.89
Pipe Flow		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
23-07 to 23-08	C-D	49.23	276.32	273.00	0.067	0.013	13.67	0.06
Pipe Diameter (in) =		15	Area =	1.23		Wetted P =	3.93	
Channel Flow		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Roadside ditch	D-E	167.09	273.00	261.58	0.068	0.050	7.48	0.37
			Area =	12.00		Wetted P =	12.70	
Pipe Flow		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Ex Culvert 163	E-F	28.87	261.58	259.99	0.055	0.013	12.35	0.04
Pipe Diameter (in) =		15	Area =	1.23		Wetted P =	3.93	
Channel Flow		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Roadside ditch	F-G	49.80	259.99	258.00	0.040	0.050	5.72	0.15
			Area =	12.00		Wetted P =	12.70	
						Total Tc (Minutes) =		**5.19**

	2-Year	**5-Year**	**10-Year**	**25-Year**	**50-Year**	**100-Year**
Rainfall Intensity Inches / Hour.	**5.13**	**5.94**	**6.69**	**7.57**	**8.21**	**8.81**
Aosorption Coefficient / Ground Saturation Correction Coefficient Cf	1.00	1.00	1.00	1.10	1.20	1.25
Peak Discharge CFS.	**5.50**	**6.37**	**7.18**	**8.93**	**10.56**	**11.81**

PL23-OUT30 (A-A) Pre - 2yr

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Channel Slope	0.050 ft/ft
Discharge	6.20 cfs

Section Definitions

Station (ft)	Elevation (ft)
0+00	262.00
0+03	261.00
0+08	260.00
0+15	258.00
0+17	258.30
0+25	258.00
0+45	259.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 262.00)	(0+45, 259.00)	0.050

Options	
Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results	
Normal Depth	0.3 ft
Roughness Coefficient	0.050
Elevation	258.33 ft
Elevation Range	258.0 to 262.0 ft
Flow Area	3.0 ft²
Wetted Perimeter	17.8 ft
Hydraulic Radius	0.2 ft
Top Width	17.69 ft
Normal Depth	0.3 ft
Critical Depth	0.3 ft
Critical Slope	0.068 ft/ft
Velocity	2.05 ft/s
Velocity Head	0.06 ft
Specific Energy	0.39 ft

PL23-OUT30 (A-A) Pre - 2yr

Results	
Froude Number	0.871
Flow Type	Subcritical

GVF Input Data	
Downstream Depth	0.0 ft
Length	0.0 ft
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.0 ft
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	0.3 ft
Critical Depth	0.3 ft
Channel Slope	0.050 ft/ft
Critical Slope	0.068 ft/ft

PL23-OUT30 (A-A) Post - 2yr

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Channel Slope	0.050 ft/ft
Discharge	5.50 cfs

Section Definitions

Station (ft)	Elevation (ft)
0+00	262.00
0+03	261.00
0+08	260.00
0+15	258.00
0+17	258.25
0+25	258.00
0+45	259.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 262.00)	(0+45, 259.00)	0.050

Options	
Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results	
Normal Depth	0.3 ft
Roughness Coefficient	0.050
Elevation	258.29 ft
Elevation Range	258.0 to 262.0 ft
Flow Area	2.8 ft²
Wetted Perimeter	17.5 ft
Hydraulic Radius	0.2 ft
Top Width	17.47 ft
Normal Depth	0.3 ft
Critical Depth	0.3 ft
Critical Slope	0.069 ft/ft
Velocity	1.96 ft/s
Velocity Head	0.06 ft
Specific Energy	0.35 ft

PL23-OUT30 (A-A) Post - 2yr

Results	
Froude Number	0.863
Flow Type	Subcritical

GVF Input Data	
Downstream Depth	0.0 ft
Length	0.0 ft
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.0 ft
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	0.3 ft
Critical Depth	0.3 ft
Channel Slope	0.050 ft/ft
Critical Slope	0.069 ft/ft

PL23-OUT30 (A-A) Post - 10yr

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Channel Slope	0.050 ft/ft
Discharge	7.18 cfs

Section Definitions

Station (ft)	Elevation (ft)
0+00	262.00
0+03	261.00
0+08	260.00
0+15	258.00
0+17	258.25
0+25	258.00
0+45	259.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 262.00)	(0+45, 259.00)	0.050

Options	
Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results	
Normal Depth	0.3 ft
Roughness Coefficient	0.050
Elevation	258.32 ft
Elevation Range	258.0 to 262.0 ft
Flow Area	3.3 ft²
Wetted Perimeter	18.3 ft
Hydraulic Radius	0.2 ft
Top Width	18.19 ft
Normal Depth	0.3 ft
Critical Depth	0.3 ft
Critical Slope	0.066 ft/ft
Velocity	2.14 ft/s
Velocity Head	0.07 ft
Specific Energy	0.40 ft

PL23-OUT30 (A-A) Post - 10yr

Results	
Froude Number	0.881
Flow Type	Subcritical

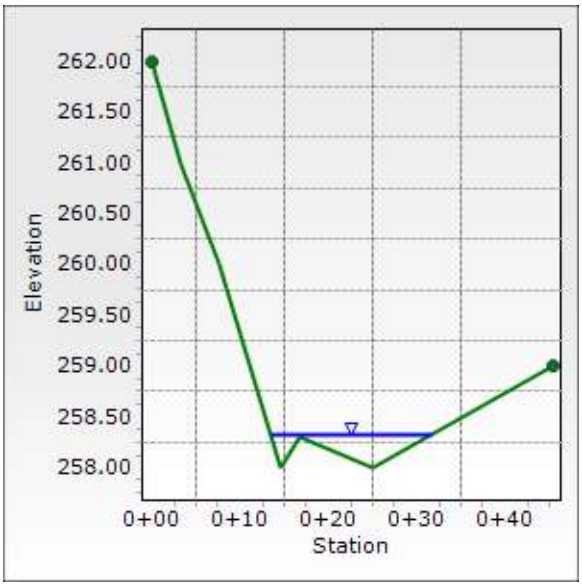
GVF Input Data	
Downstream Depth	0.0 ft
Length	0.0 ft
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.0 ft
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	0.00 ft/s
Upstream Velocity	0.00 ft/s
Normal Depth	0.3 ft
Critical Depth	0.3 ft
Channel Slope	0.050 ft/ft
Critical Slope	0.066 ft/ft

PL23-OUT30 (A-A) Post - 10yr

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Channel Slope	0.050 ft/ft
Normal Depth	0.3 ft
Discharge	7.18 cfs



Name of Project:	495-NEXT			Designed By:	JMON
State:	VA	**County:**	Fairfax County	Date:	03/15/22
Name of Culvert:	Pre Development			Checked By:	NVD
NOAA Station:	Vienna Tysons 44-8737			Date:	03/15/22
LOCATION:	PL23-OUT 30 B-B				
				UNITS	**ENGLISH**

RATIONAL METHOD - DATA:

DRAINAGE BASIN

SUBSHED #	Land Use Description	Area Acres	C	C A
	Business: Industrial and Commercial (0.80-0.90)			
	Apartments and Townhomes (0.65-0.75)			
	Schools (0.50-0.60)			
	Residential - lots 10,000 sq. ft. (0.40-0.50)			
	- lots 12,000 sq. ft. (0.40-0.45)			
	- lots 17,000 sq. ft. (0.35-0.45)			
	- lots ½ acre or more (0.30-0.40)	1.55	0.35	0.54
	Parks, Cemeteries and Unimproved Areas (0.20-0.35)			
	Paved and Roof Areas (0.90)	0.78	0.90	0.70
	Cultivated Areas (0.50-0.70)			
	Pasture (0.35-0.45)			
	Lawns (0.25-0.35)	0.09	0.30	0.03
	Forest (0.20-0.30)	0.00	0.25	
	Steep Grass (2:1) (0.40-0.70)			
	Shoulder and Ditch Areas (0.35-0.50)			
	Totals =	**2.42 Acres**	**0.53**	**1.27**

Time of Concentration (Tc)

	Reach	Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Rational C		Tc (Minutes)
Overland Flow (E.E. Seelye - VDOT Modified)								
Soil / Surface Type/Land Cover		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Rational C		
Paved	A-B	200.00	307.37	297.63	0.049	0.90		4.11
Shallow Concentrated Flow		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Intercept Coeff.		
Paved	B-C	82.40	297.63	291.75	0.071	0.619		0.25
Channel Flow		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Roadside Channel	C-D	28.69	291.75	289.43	0.081	0.050	8.14	0.06
			Area =	12.00		Wetted P =	12.70	
Pipe Flow		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
EX Culvert 162	D-E	49.97	289.43	286.71	0.054	0.013	12.28	0.07
Pipe Diameter (in) =		15	Area =	1.23		Wetted P =	3.93	
Channel Flow		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Roadside Channel	E-F	55.96	286.71	284.40	0.041	0.050	5.81	0.16
			Area =	12.00		Wetted P =	12.70	
Pipe Flow		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Assumed Information	F-G	148.82	284.40	273.00	0.077	0.013	14.57	0.17
Pipe Diameter (in) =		15	Area =	1.23		Wetted P =	3.93	
Channel Flow		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Roadside Channel	G-H	175.59	273.00	261.58	0.065	0.050	7.30	0.40
			Area =	12.00		Wetted P =	12.70	
Pipe Flow		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
EX Culvert 163	H-I	28.87	261.58	259.99	0.055	0.013	12.35	0.04
Pipe Diameter (in) =		15	Area =	1.23		Wetted P =	3.93	
Channel Flow		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Roadside Channel	I-J	100.18	259.99	255.00	0.050	0.050	6.39	0.26
			Area =	12.00		Wetted P =	12.70	
							Total Tc (Minutes) =	**5.52**

	2-Year	5-Year	10-Year	25-Year	50-Year	100-Year
Rainfall Intensity Inches / Hour.	**5.05**	**5.85**	**6.59**	**7.45**	**8.08**	**8.67**
Aosorption Coefficient / Ground Saturation Correction Coefficient Cf	1.00	1.00	1.00	1.10	1.20	1.25
Peak Discharge CFS.	**6.43**	**7.45**	**8.39**	**10.44**	**12.35**	**13.80**

Name of Project:	495-NEXT			Designed By:	JMON
State:	VA	**County:**	Fairfax County	Date:	03/15/22
Name of Culvert:	Post Development			Checked By:	NVD
NOAA Station:	Vienna Tysons 44-8737			Date:	03/15/22
LOCATION:	PL23-OUT 30 B-B			UNITS	**ENGLISH**

RATIONAL METHOD - DATA:

DRAINAGE BASIN

SUBSHED #	Land Use Description	Area Acres	C	C A
	Business: Industrial and Commercial (0.80-0.90)			
	Apartments and Townhomes (0.65-0.75)			
	Schools (0.50-0.60)		0.50	
	Residential - lots 10,000 sq. ft. (0.40-0.50)			
	- lots 12,000 sq. ft. (0.40-0.45)			
	- lots 17,000 sq. ft. (0.35-0.45)			
	- lots ½ acre or more (0.30-0.40)	1.55	0.35	0.54
	Parks, Cemeteries and Unimproved Areas (0.20-0.35)			
	Paved and Roof Areas (0.90)	0.62	0.90	0.56
	Cultivated Areas (0.50-0.70)			
	Pasture (0.35-0.45)			
	Lawns (0.25-0.35)	0.07	0.30	0.02
	Forest (0.20-0.30)	0.00	0.25	
	Steep Grass (2:1) (0.40-0.70)			
	Shoulder and Ditch Areas (0.35-0.50)			
	Totals =	**2.24 Acres**	**0.50**	**1.12**

Time of Concentration (Tc)

	Reach	Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Rational C		Tc (Minutes)
Overland Flow (E.E. Seelye - VDOT Modified)								
Soil / Surface Type/Land Cover		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Rational C		
Paved	A-B	163.00	302.00	293.00	0.055	0.90		3.68
Shallow Concentrated Flow		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Intercept Coeff.		
Paved	B-C	248.00	293.00	280.00	0.052	0.619		0.89
Pipe Flow		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
23-07 to 23-08	C-D	49.23	276.32	273.00	0.067	0.013	13.67	0.06
Pipe Diameter (in) =		15	Area =	1.23		Wetted P =	3.93	
Channel Flow		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Roadside ditch	D-E	167.09	273.00	261.58	0.068	0.050	7.48	0.37
			Area =	12.00		Wetted P =	12.70	
Pipe Flow		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Ex Culvert 163	E-F	28.87	261.58	259.99	0.055	0.013	12.35	0.04
Pipe Diameter (in) =		15	Area =	1.23		Wetted P =	3.93	
Channel Flow		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Roadside ditch	F-G	100.18	259.99	255.00	0.050	0.050	6.39	0.26
			Area =	12.00		Wetted P =	12.70	
						Total Tc (Minutes) =		**5.30**

	2-Year	5-Year	10-Year	25-Year	50-Year	100-Year
Rainfall Intensity Inches / Hour.	**5.10**	**5.91**	**6.66**	**7.53**	**8.16**	**8.76**
Aosorption Coefficient / Ground Saturation Correction Coefficient Cf	1.00	1.00	1.00	1.10	1.20	1.25
Peak Discharge CFS.	**5.74**	**6.65**	**7.49**	**9.31**	**11.02**	**12.32**

PL23-OUT30 (B-B) Pre - 2yr

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Channel Slope	0.084 ft/ft
Discharge	6.43 cfs

Section Definitions

Station (ft)	Elevation (ft)
0+00	260.00
0+09	258.00
0+20	256.00
0+36	255.00
0+48	256.00
0+66	257.00
0+80	258.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 260.00)	(0+80, 258.00)	0.050

Options	
Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results	
Normal Depth	0.4 ft
Roughness Coefficient	0.050
Elevation	255.40 ft
Elevation Range	255.0 to 260.0 ft
Flow Area	2.2 ft²
Wetted Perimeter	10.9 ft
Hydraulic Radius	0.2 ft
Top Width	10.89 ft
Normal Depth	0.4 ft
Critical Depth	0.4 ft
Critical Slope	0.061 ft/ft
Velocity	2.95 ft/s
Velocity Head	0.13 ft
Specific Energy	0.54 ft

PL23-OUT30 (B-B) Pre - 2yr

Results	
Froude Number	1.160
Flow Type	Supercritical

GVF Input Data	
Downstream Depth	0.0 ft
Length	0.0 ft
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.0 ft
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	0.4 ft
Critical Depth	0.4 ft
Channel Slope	0.084 ft/ft
Critical Slope	0.061 ft/ft

PL23-OUT30 (B-B) Post - 2yr

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Channel Slope	0.084 ft/ft
Discharge	5.74 cfs

Section Definitions

Station (ft)	Elevation (ft)
0+00	260.00
0+09	258.00
0+20	256.00
0+36	255.00
0+48	256.00
0+66	257.00
0+80	258.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 260.00)	(0+80, 258.00)	0.050

Options	
Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results	
Normal Depth	0.4 ft
Roughness Coefficient	0.050
Elevation	255.38 ft
Elevation Range	255.0 to 260.0 ft
Flow Area	2.0 ft²
Wetted Perimeter	10.5 ft
Hydraulic Radius	0.2 ft
Top Width	10.43 ft
Normal Depth	0.4 ft
Critical Depth	0.4 ft
Critical Slope	0.062 ft/ft
Velocity	2.87 ft/s
Velocity Head	0.13 ft
Specific Energy	0.51 ft

PL23-OUT30 (B-B) Post - 2yr

Results	
Froude Number	1.153
Flow Type	Supercritical

GVF Input Data	
Downstream Depth	0.0 ft
Length	0.0 ft
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.0 ft
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	0.4 ft
Critical Depth	0.4 ft
Channel Slope	0.084 ft/ft
Critical Slope	0.062 ft/ft

PL23-OUT30 (B-B) Post - 10yr

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Channel Slope	0.084 ft/ft
Discharge	7.49 cfs

Section Definitions

Station (ft)	Elevation (ft)
0+00	260.00
0+09	258.00
0+20	256.00
0+36	255.00
0+48	256.00
0+66	257.00
0+80	258.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 260.00)	(0+80, 258.00)	0.050

Options	
Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results	
Normal Depth	0.4 ft
Roughness Coefficient	0.050
Elevation	255.42 ft
Elevation Range	255.0 to 260.0 ft
Flow Area	2.4 ft²
Wetted Perimeter	11.6 ft
Hydraulic Radius	0.2 ft
Top Width	11.53 ft
Normal Depth	0.4 ft
Critical Depth	0.5 ft
Critical Slope	0.060 ft/ft
Velocity	3.06 ft/s
Velocity Head	0.15 ft
Specific Energy	0.57 ft

PL23-OUT30 (B-B) Post - 10yr

Results	
Froude Number	1.170
Flow Type	Supercritical

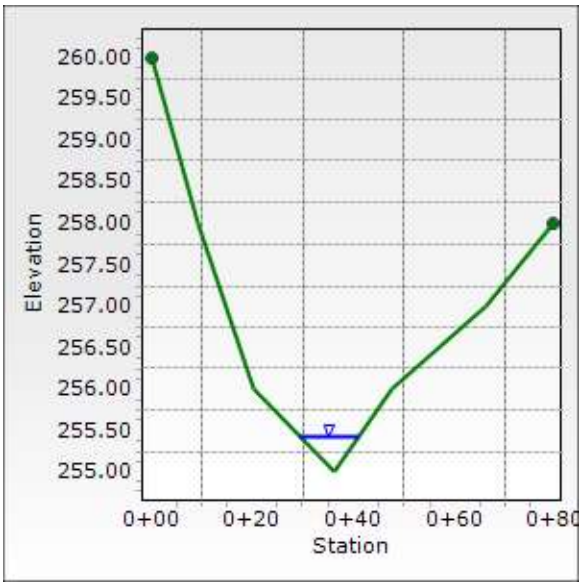
GVF Input Data	
Downstream Depth	0.0 ft
Length	0.0 ft
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.0 ft
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	0.4 ft
Critical Depth	0.5 ft
Channel Slope	0.084 ft/ft
Critical Slope	0.060 ft/ft

PL23-OUT30 (B-B) Post - 10yr

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Channel Slope	0.084 ft/ft
Normal Depth	0.4 ft
Discharge	7.49 cfs



APPENDIX C31
PL23-OUT31

Outfall PL23-OUT 31

Outfall PL23-OUT31 is an existing outfall at Balls Hill Road station 23+50 left. The outfall consists of a manmade stormwater conveyance system. In existing conditions, flow is conveyed through existing storm sewer, ditches and sheet flow to the point of analysis. The outfall prior to development is 7.10 acres.

Development of this area will result in decreased area to this outfall, due to the proposed ditches and storm sewer directing drainage to adjacent outfalls. The resulting area to the outfall will be 6.06 acres.

Drainage Area:

The drainage areas and resulting changes are summarized in the table below:

PL23-OUT 31			
Drainage Area	**Total Area**	**C (Total)**	**Tc**
Existing	7.10 ac	0.68	10.78 min
Proposed	6.06 ac	0.69	10.78 min

Limits of Study:

The location of the outfall is shown in the included outfall drainage map. The point of analysis is at existing structure 677.

Easement Requirements:

No additional easements are required.

Outfall Discharge:

All discharges were calculated using the Rational Method and are summarized below:

PL23-OUT 31		
Drainage Area	**Peak Flow Rate (Total)**	
	2 Year	10 Year
Existing	19.48 cfs	25.74 cfs
Proposed	16.83 cfs	22.24 cfs
Net Change	**-2.65 cfs**	**-3.50 cfs**

Channel Protection:

Under Section 11.7.5.1 of the VDOT drainage manual, areas draining to a manmade stormwater conveyance channel shall satisfy the channel protection criteria by providing conveyance of the 2 year storm without causing erosion of the system. As this outfall is concrete storm sewer, there is no maximum erosive velocity.

Pipe Run	Channel Protection - 2 Year Velocity			Outfall Adequate?
	Pipe Material	Max Permissible Velocity (ft/s)	Proposed Velocity (ft/s)	
EX677 to EX678	Concrete	No Max	9.74	Yes
EX678 to EX1	Concrete	No Max	11.51	Yes
EX1 to EX 2	Concrete	No Max	13.22	Yes

Flood Protection:

Under Section 11.7.5.2 of the VDOT drainage manual, areas draining to a manmade stormwater conveyance channel shall satisfy the flood protection criteria by demonstrating that the peak flow rate from a 10 year storm will be contained within the system. Computations demonstrating the adequacy of the storm sewer downstream have been provided within this section. The results have been summarized below:

Pipe Run	Flood Protection - 10 Year Capacity			Outfall Adequate?
	Max Pipe Discharge (cfs)	Existing Pipe Discharge (cfs)	Proposed Pipe Discharge (cfs)	
EX677 to EX678	29.67	25.74	22.25	Yes
EX678 to EX1	26.04	25.74	22.25	Yes
EX1 to EX 2	28.59	33.90	30.41	Yes

As demonstrated by the computations above, pipe EX1 to EX2 is in pressure flow. Per 11.7.5.2, in the case of an inadequate pipe, the designer may develop a site design that does not cause the peak runoff rate to increase in the 2 or 10 year storm event. As reductions of 2.65 cfs and 3.50 cfs have been achieved, no further calculations are necessary.

Final Opinion:

This outfall is a manmade stormwater conveyance system. We have shown compliance with the channel and flood protection criteria, by providing calculations demonstrating non-erosive velocities and demonstrating a reduction in the 2 and 10 year peak flow rates. It is therefore our opinion that this outfall is adequate.

Pre-Developed Outfall
PL23-31
I-495
Fairfax, VA

DRAINAGE AREA BOUNDARY

EXISTING CONTOURS

TIME OF CONCENTRATION

A

B

C

D

E

PL23-OUT 31
DA = 7.10 AC
C = 0.68

SCALE
0 150' 300'

Post-Developed Outfall Map
PL23-31
I-495
Fairfax, VA

DRAINAGE AREA BOUNDARY

EXISTING CONTOURS

TIME OF CONCENTRATION

A

B

C

D

E

PL23-OUT 31
DA = 6.06 AC
C = 0.69

SCALE
0 100' 200'

Name of Project:	495-NEXT			Designed By:	KRI
State:	VA	**County:**	Fairfax County	Date:	03/15/22
Name of Culvert:	Pre Development			Checked By:	NVD
NOAA Station:	Vienna Tysons 44-8737			Date:	03/15/22
LOCATION:	PL23-OUT 31				
				UNITS	**ENGLISH**

RATIONAL METHOD - DATA:

DRAINAGE BASIN

SUBSHED #	Land Use Description	Area Acres	C	C A
	Business: Industrial and Commercial (0.80-0.90)			
	Apartments and Townhomes (0.65-0.75)			
	Schools (0.50-0.60)			
	Residential - lots 10,000 sq. ft. (0.40-0.50)			
	- lots 12,000 sq. ft. (0.40-0.45)			
	- lots 17,000 sq. ft. (0.35-0.45)			
	- lots ½ acre or more (0.30-0.40)		0.35	
	Parks, Cemeteries and Unimproved Areas (0.20-0.35)			
	Paved and Roof Areas (0.90)	4.61	0.90	4.15
	Cultivated Areas (0.50-0.70)			
	Pasture (0.35-0.45)			
	Lawns (0.25-0.35)	1.32	0.30	0.40
	Forest (0.20-0.30)	1.17	0.25	0.29
	Steep Grass (2:1) (0.40-0.70)			
	Shoulder and Ditch Areas (0.35-0.50)			
	Totals =	**7.10 Acres**	**0.68**	**4.84**

Time of Concentration (Tc)

	Reach	Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Rational C		Tc (Minutes)
Overland Flow (E.E. Seelye - VDOT Modified)								
Soil / Surface Type/Land Cover		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Rational C		
Forest	A-B	90.25	298.20	293.50	0.052	0.30		8.71
Shallow Concentrated Flow		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Intercept Coeff.		
Paved	B-C	374.84	293.50	281.00	0.033	0.619		1.68
Channel Flow		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Paved Ditch	C-D	126.07	281.00	278.72	0.018	0.015	12.83	0.16
			Area =	12.00		Wetted P =	12.70	
Pipe Flow		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
EX676 to EX677	D-E	20.99	277.81	277.80	0.000	0.013	1.57	0.22
Pipe Diameter (in) =		24	Area =	3.14		Wetted P =	6.28	
							Total Tc (Minutes) =	**10.78**

		2-Year	**5-Year**	**10-Year**	**25-Year**	**50-Year**	**100-Year**
Rainfall Intensity	Inches / Hour.	**4.02**	**4.70**	**5.32**	**6.03**	**6.55**	**7.03**
Aosorption Coefficient / Ground Saturation Correction Coefficient Cf		1.00	1.00	1.00	1.10	1.20	1.25
Peak Discharge	CFS.	**19.48**	**22.74**	**25.74**	**32.12**	**38.03**	**42.55**

Name of Project:	495-NEXT			Designed By:	JMON
State:	VA	**County:**	Fairfax County	Date:	03/15/22
Name of Culvert:	Post Development			Checked By:	NVD
NOAA Station:	Vienna Tysons 44-8737			Date:	03/15/22
LOCATION:	PL23-OUT 31				
				UNITS	**ENGLISH**

RATIONAL METHOD - DATA:

DRAINAGE BASIN

SUBSHED #	Land Use Description	Area Acres	C	C A
	Business: Industrial and Commercial (0.80-0.90)			
	Apartments and Townhomes (0.65-0.75)			
	Schools (0.50-0.60)		0.50	
	Residential - lots 10,000 sq. ft. (0.40-0.50)			
	- lots 12,000 sq. ft. (0.40-0.45)			
	- lots 17,000 sq. ft. (0.35-0.45)			
	- lots ½ acre or more (0.30-0.40)		0.35	
	Parks, Cemeteries and Unimproved Areas (0.20-0.35)			
	Paved and Roof Areas (0.90)	3.942	0.90	3.55
	Cultivated Areas (0.50-0.70)			
	Pasture (0.35-0.45)			
	Lawns (0.25-0.35)	2.115	0.30	0.63
	Forest (0.20-0.30)		0.25	
	Steep Grass (2:1) (0.40-0.70)			
	Shoulder and Ditch Areas (0.35-0.50)			
	Totals =	**6.06 Acres**	**0.69**	**4.18**

Time of Concentration (Tc)

			Reach	Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Rational C		Tc (Minutes)
Overland Flow (E.E. Seelye - VDOT Modified)										
	Soil / Surface Type/Land Cover			Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Rational C		
	Lawns	A-B		90.25	298.20	293.50	0.052	0.30		8.71
Shallow Concentrated Flow				Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Intercept Coeff.		
Paved		B-C		374.84	293.50	281.00	0.033	0.619		1.68
Channel Flow				Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Paved Ditch		C-D		126.07	281.00	278.72	0.018	0.015	12.83	0.16
					Area =	12.00		Wetted P =	12.70	
Pipe Flow				Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
EX676 to EX677		D-E		20.99	277.81	277.80	0.000	0.013	1.57	0.22
			Pipe Diameter (in) =	24	Area =	3.14		Wetted P =	6.28	
									Total Tc (Minutes) =	**10.78**

		2-Year	**5-Year**	**10-Year**	**25-Year**	**50-Year**	**100-Year**
Rainfall Intensity	Inches / Hour.	**4.02**	**4.70**	**5.32**	**6.03**	**6.55**	**7.03**
Aosorption Coefficient / Ground Saturation Correction Coefficient	Cf	1.00	1.00	1.00	1.10	1.20	1.25
Peak Discharge	CFS.	**16.83**	**19.65**	**22.24**	**27.76**	**32.86**	**36.77**

Post-Developed Storm Drain Inlet Map
PL23-OUT31
I-495 NEXT
Fairfax, VA

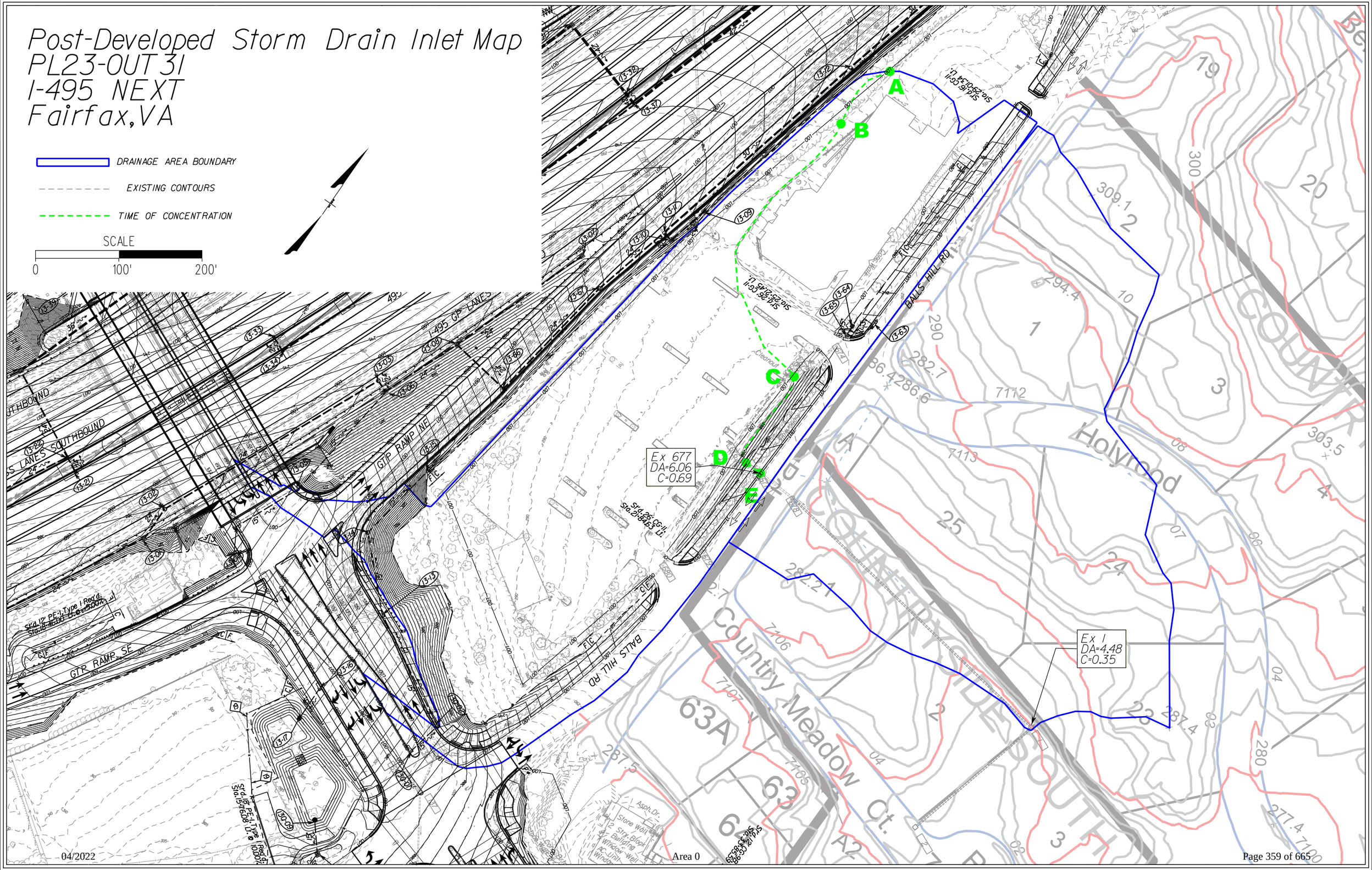
DRAINAGE AREA BOUNDARY

EXISTING CONTOURS

TIME OF CONCENTRATION

SCALE

0 100' 200'



LD-229
STORM SEWER DESIGN COMPUTATIONS

PROJECT: I-495 NEXT
LOCATION:
COUNTY: Vienna Tysons Corner

Designed by: JMON
Checked by: NVD

STORM FREQUENCY **2**

UNITS **ENGLISH**

* Post-Developed Conditions

PIPE NO.	FROM POINT		TO POINT		DRAIN. AREA	RUNOFF COEFF.	CA		INLET TIME	RAIN FALL	RUNOFF		INVERT ELEVATIONS		LENGTH of Pipe	SLOPE	SIZE (Dia. Or Span/Rise)	SHAPE	Number of Pipes	Capacity	Friction Slope	NORMAL FLOW					FLOW TIME		REMARKS
	REFERENCE	STA.	REFERENCE	STA.	"A" Acre	"C"	INCRE-MENT	ACCUM-ULATED	TIME Minutes	FALL In/Hr	Lateral CFS	Total Q CFS	UPPER END	LOWER END	of Pipe Ft.	Ft./Ft.	Span/Rise) In.			CFS	Ft./Ft.	Depth of Flow, dn Ft.	Area of Flow, An SqFt	Hrn Ft.	Vn Ft/Sec	En Ft.	INCRE-MENT Minutes	ACCUMU-LATED Minutes	
	(1)		(2)		(3)	(4)	(5)	(6)	(7)	(8)		(9)	(10)	(11)	(12)	(13)	(14)			(15)					(16)		(17)	(17)	(18)
EX1EX2	EX1		EX2		4.48	0.35	1.57	5.75	11.44	3.93	0.00	22.99	262.43	256.83	172.00	0.03256	21	Circular	1	28.59	0.02190	1.19	1.74	0.51	13.22	3.90	0.22	11.66	
EX677EX678	EX677		EX678		6.06	0.69	4.18	4.18	10.78	4.03	0.00	16.83	277.82	277.03	45.92	0.01720	24	Circular	1	29.67	0.00580	1.08	1.73	0.52	9.74	2.55	0.08	10.86	
EX678EX1	EX678		EX1		-	-	-	4.18	10.86	4.01	0.00	16.83	274.23	263.43	400.00	0.02700	21	Circular	1	26.04	0.01180	1.02	1.46	0.48	11.51	3.08	0.58	11.44	

LD-229
STORM SEWER DESIGN COMPUTATIONS

PROJECT: I-495 NEXT
LOCATION:
COUNTY: Vienna Tysons Corner

Designed by: JMON
Checked by: NVD

STORM FREQUENCY **10**

UNITS **ENGLISH**

* Pre-Developed Conditions

PIPE NO.	FROM POINT REFERENCE	FROM POINT STA.	TO POINT REFERENCE	TO POINT STA.	DRAIN. AREA "A" Acre	RUNOFF COEFF. "C"	CA INCRE-MENT	CA ACCUM-ULATED	INLET TIME Minutes	RAIN FALL In/Hr	RUNOFF Lateral CFS	RUNOFF Total Q CFS	INVERT ELEVATIONS UPPER END	INVERT ELEVATIONS LOWER END	LENGTH of Pipe Ft.	SLOPE Ft./Ft.	SIZE (Dia. Or Span/Rise) In.	SHAPE	Number of Pipes	Capacity CFS	Friction Slope Ft./Ft.	NORMAL FLOW Depth of Flow, dn Ft.	NORMAL FLOW Area of Flow, An SqFt	NORMAL FLOW Hrm Ft.	NORMAL FLOW Vn Ft/Sec	NORMAL FLOW En Ft.	FLOW TIME INCRE-MENT Minutes	FLOW TIME ACCUMU-LATED Minutes	REMARKS
	(1)		(2)		(3)	(4)	(5)	(6)	(7)	(8)		(9)	(10)	(11)	(12)	(13)	(14)			(15)					(16)		(17)	(17)	(18)
EX1EX2	EX1		EX2		4.48	0.35	1.57	6.41	11.39	5.21	0.00	33.90	262.43	256.83	172.00	0.03256	21	Circular	1	28.59	0.04770	1.75	2.41	0.44	14.09	4.84	0.20	11.60	Pressure Flow
EX677EX678	EX677		EX678		7.10	0.68	4.84	4.84	10.78	5.32	0.00	25.74	277.82	277.03	45.92	0.01720	24	Circular	1	29.67	0.01350	1.44	2.42	0.60	10.63	3.20	0.07	10.85	
EX678EX1	EX678		EX1		-	-	-	4.84	10.85	5.31	0.00	25.74	274.23	263.43	400.00	0.02700	21	Circular	1	26.04	0.02750	1.42	2.09	0.53	12.34	3.78	0.54	11.39	

LD-229
STORM SEWER DESIGN COMPUTATIONS

PROJECT: I-495 NEXT
LOCATION:
COUNTY: Vienna Tysons Corner

Designed by: JMON
Checked by: NVD

STORM FREQUENCY **10**

UNITS **ENGLISH**

* Post-Developed Conditions

PIPE NO.	FROM POINT		TO POINT		DRAIN. AREA "A" Acre	RUNOFF COEFF. "C"	CA INCRE-MENT	CA ACCUM-ULATED	INLET TIME Minutes	RAIN FALL In/Hr	RUNOFF Lateral CFS	RUNOFF Total Q CFS	INVERT ELEVATIONS UPPER END	INVERT ELEVATIONS LOWER END	LENGTH of Pipe Ft.	SLOPE Ft./Ft.	SIZE (Dia. Or Span/Rise) In.	SHAPE	Number of Pipes	Capacity CFS	Friction Slope Ft./Ft.	NORMAL FLOW Depth of Flow, dn Ft.	NORMAL FLOW Area of Flow, An SqFt	NORMAL FLOW Hrn Ft.	NORMAL FLOW Vn Ft/Sec	NORMAL FLOW En Ft.	FLOW TIME INCRE-MENT Minutes	FLOW TIME ACCUMU-LATED Minutes	REMARKS
	REFERENCE (1)	STA.	REFERENCE (2)	STA.	(3)	(4)	(5)	(6)	(7)	(8)		(9)	(10)	(11)	(12)	(13)	(14)			(15)								(17)	(17)	(18)
EX1EX2	EX1		EX2		4.48	0.35	1.57	5.75	11.40	5.21	0.00	30.41	262.43	256.83	172.00	0.03256	21	Circular	1	28.59	0.03840	1.75	2.41	0.44	12.64	4.23	0.23	11.63	Pressure Flow
EX677EX678	EX677		EX678		6.06	0.69	4.18	4.18	10.78	5.32	0.00	22.25	277.82	277.03	45.92	0.01720	24	Circular	1	29.67	0.01010	1.29	2.15	0.58	10.36	2.96	0.07	10.85	
EX678EX1	EX678		EX1		-	-	-	4.18	10.85	5.31	0.00	22.25	274.23	263.43	400.00	0.02700	21	Circular	1	26.04	0.02050	1.25	1.83	0.52	12.16	3.54	0.55	11.40	

APPENDIX C32
PL23-OUT32

Outfall PL23-OUT 32

Outfall PL23-OUT32 is an existing outfall at I-495 Southbound station 268+21 left. The outfall consists of a natural stormwater conveyance system. In existing conditions, flow is conveyed through existing channels and sheet flow to the point of analysis. The outfall prior to development is 0.95 acres.

Development of this area will result in decreased area to this outfall, due to proposed roadway widening. The resulting area to the outfall will be 0.83 acres.

Drainage Area:

The drainage areas and resulting changes are summarized in the table below:

PL23-OUT 32			
Drainage Area	**Total Area**	**C (Total)**	**Tc**
Existing	0.95 ac	0.30	13.33 min
Proposed	0.83 ac	0.30	11.94 min

Limits of Study:

The location of the outfall is shown in the included outfall drainage map. The point of analysis is within the existing channel west of I-495.

Easement Requirements:

No additional easements are required.

Outfall Discharge:

All discharges were calculated using the Rational Method and are summarized below:

PL23-OUT 32		
Drainage Area	**Peak Flow Rate (Total)**	
	2 Year	10 Year
Existing	1.03 cfs	1.37 cfs
Proposed	0.97 cfs	1.28 cfs
Net Change	**-0.06 cfs**	**-0.09 cfs**

Channel Description:

The channel at Outfall PL23-OUT32 is a natural channel. Cross Sections were prepared utilizing topography prepared by Rinker Design Associates, P.C. and Fairfax County GIS.

Channel Protection:

Under Section 11.7.5.1 of the VDOT drainage manual, areas draining to a natural stormwater conveyance channel shall satisfy the channel protection criteria by providing

conveyance of the 2 year storm without causing erosion of the system. Calculations have been provided below supporting the 2 year velocities in the system:

Cross Section	Channel Protection - 2 Year Velocity			Outfall Adequate?
	Channel Lining	Max Permissible Velocity (ft/s)	Proposed Velocity (ft/s)	
A-A	Meadowville Complex	2.3	1.30	Yes
B-B	Meadowville Complex	2.3	1.03	Yes
C-C	Meadowville Complex	2.3	1.34	Yes

Flood Protection:

Under Section 11.7.5.2 of the VDOT drainage manual, areas draining to a natural stormwater conveyance channel shall satisfy the flood protection criteria by demonstrating that the peak flow rate from a 10 year storm will be contained within the existing channel. The post developed flows to the channel have been analyzed and yield the following results:

Cross Section	Flood Protection - 10 Year Capacity		Outfall Adequate?
	Channel Depth (ft)	Normal Depth (ft)	
A-A	2.2	0.20	Yes
B-B	2.3	0.20	Yes
C-C	4.3	0.20	Yes

Final Opinion:

This outfall is a natural stormwater conveyance system. We have shown compliance with the channel protection criteria by providing calculations demonstrating non-erosive velocities. We have shown compliance with the flood protection criteria, by demonstrating the peak discharge from a 10 year storm will be contained within the existing channel. It is therefore our opinion that this outfall is adequate.

Pre-Developed Outfall Map
PL23-32
I-495
Fairfax, VA

PL23-OUT 32
DA = 0.95 AC
C = 0.30

DRAINAGE AREA BOUNDARY

EXISTING CONTOURS

TIME OF CONCENTRATION

SCALE
0 50' 100'

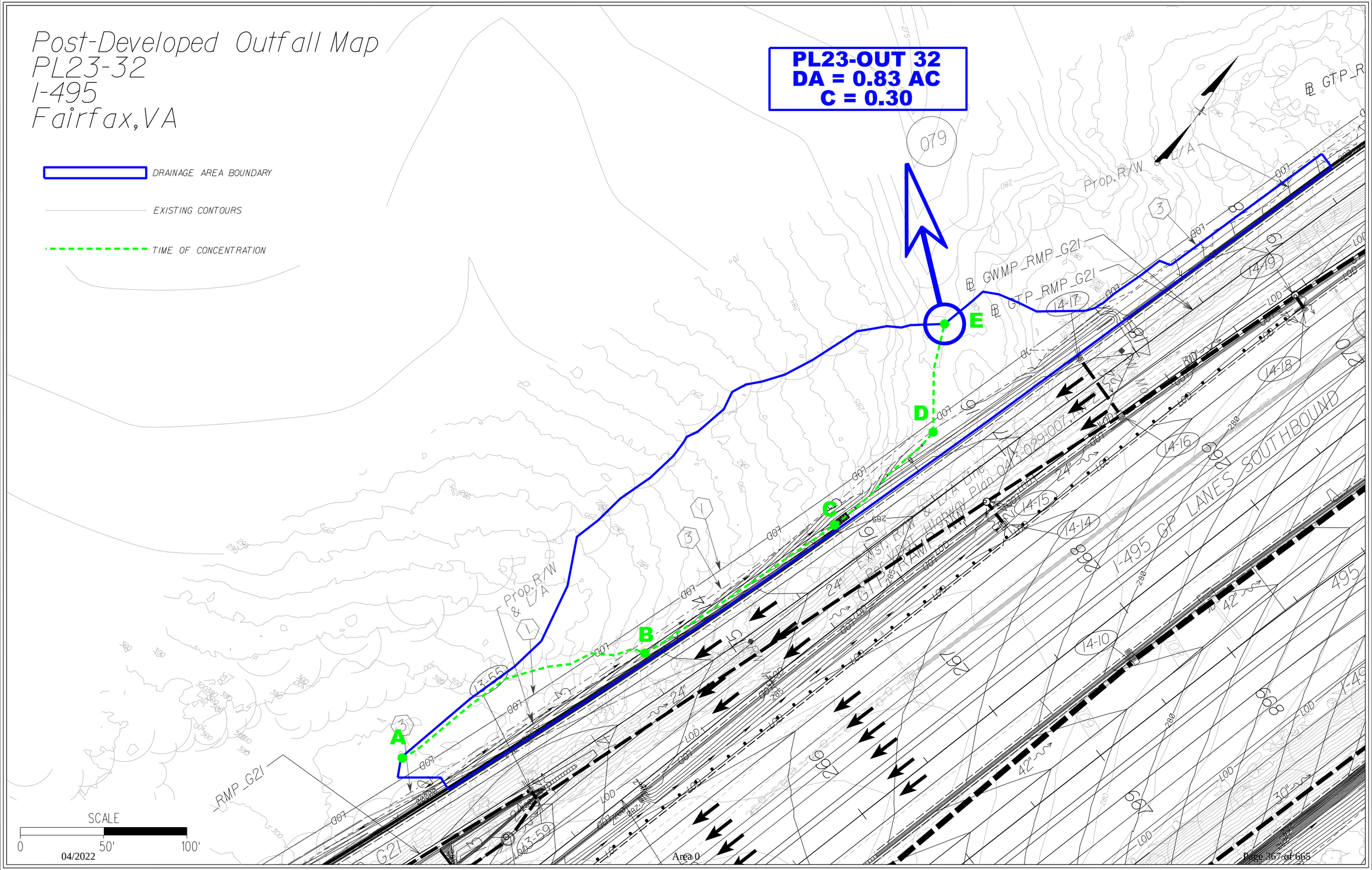
Post-Developed Outfall Map
PL23-32
I-495
Fairfax, VA

DRAINAGE AREA BOUNDARY

EXISTING CONTOURS

TIME OF CONCENTRATION

PL23-OUT 32
DA = 0.83 AC
C = 0.30



Name of Project:	495-NEXT			Designed By:	KRI
State:	VA	**County:**	Fairfax County	Date:	02/15/22
Name of Culvert:	Pre Development			Checked By:	NVD
NOAA Station:	Vienna Tysons 44-8737			Date:	02/15/22
LOCATION:	PL23-OUT 32				
				UNITS	**ENGLISH**

RATIONAL METHOD - DATA:

DRAINAGE BASIN

SUBSHED #	Land Use Description	Area Acres	C	C A
	Business: Industrial and Commercial (0.80-0.90)			
	Apartments and Townhomes (0.65-0.75)			
	Schools (0.50-0.60)			
	Residential - lots 10,000 sq. ft. (0.40-0.50)			
	- lots 12,000 sq. ft. (0.40-0.45)			
	- lots 17,000 sq. ft. (0.35-0.45)			
	- lots ½ acre or more (0.30-0.40)		0.35	
	Parks, Cemeteries and Unimproved Areas (0.20-0.35)			
	Paved and Roof Areas (0.90)		0.90	
	Cultivated Areas (0.50-0.70)			
	Pasture (0.35-0.45)			
	Lawns (0.25-0.35)	0.86	0.30	0.26
	Forest (0.20-0.30)	0.09	0.25	0.02
	Steep Grass (2:1) (0.40-0.70)			
	Shoulder and Ditch Areas (0.35-0.50)			
	Totals =	**0.95 Acres**	**0.30**	**0.28**

Time of Concentration (Tc)

	Reach	Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Rational C		Tc (Minutes)
Overland Flow (E.E. Seelye - VDOT Modified)								
Soil / Surface Type/Land Cover		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Rational C		
Lawns	A-B	195.75	301.25	292.00	0.047	0.30		12.29
Shallow Concentrated Flow		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Intercept Coeff.		
Grassed waterway	B-C	150.63	292.00	284.00	0.053	0.457		0.73
Channel Flow		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Natural Channel	C-D	131.04	284.00	279.20	0.037	0.040	6.85	0.32
			Area =	12.00		Wetted P =	12.70	
							Total Tc (Minutes) =	**13.33**

	2-Year	5-Year	10-Year	25-Year	50-Year	100-Year
Rainfall Intensity Inches / Hour.	**3.67**	**4.30**	**4.88**	**5.55**	**6.03**	**6.48**
Aosorption Coefficient / Ground Saturation Correction Coefficient Cf	1.00	1.00	1.00	1.10	1.20	1.25
Peak Discharge CFS.	**1.03**	**1.21**	**1.37**	**1.72**	**2.04**	**2.28**

Name of Project:	495-NEXT			Designed By:	JMON
State:	VA	**County:**	Fairfax County	Date:	02/15/22
Name of Culvert:	Post Development			Checked By:	NVD
NOAA Station:	Vienna Tysons 44-8737			Date:	02/15/22
LOCATION:	PL23-OUT 32				
				UNITS	**ENGLISH**

RATIONAL METHOD - DATA:

DRAINAGE BASIN

SUBSHED #	Land Use Description	Area Acres	C	C A
	Business: Industrial and Commercial (0.80-0.90)			
	Apartments and Townhomes (0.65-0.75)			
	Schools (0.50-0.60)			
	Residential - lots 10,000 sq. ft. (0.40-0.50)			
	- lots 12,000 sq. ft. (0.40-0.45)			
	- lots 17,000 sq. ft. (0.35-0.45)			
	- lots ½ acre or more (0.30-0.40)	0.00	0.35	
	Parks, Cemeteries and Unimproved Areas (0.20-0.35)			
	Paved and Roof Areas (0.90)	0.01	0.90	0.01
	Cultivated Areas (0.50-0.70)			
	Pasture (0.35-0.45)			
	Lawns (0.25-0.35)	0.81	0.30	0.24
	Forest (0.20-0.30)	0.01	0.25	0.00
	Steep Grass (2:1) (0.40-0.70)			
	Shoulder and Ditch Areas (0.35-0.50)			
	Totals =	**0.83 Acres**	**0.30**	**0.25**

Time of Concentration (Tc)

		Reach	Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Rational C		Tc (Minutes)
Overland Flow (E.E. Seelye - VDOT Modified)									
	Soil / Surface Type/Land Cover		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Rational C		
	Lawns	A-B	165.84	301.00	293.00	0.048	0.30		11.42
Channel Flow			Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Paved ditch		B-C	137.24	293.00	286.00	0.051	0.015	21.54	0.11
				Area =	12.00		Wetted P =	12.70	
Channel Flow			Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Grassed ditch		C-D	81.63	286.00	280.30	0.070	0.050	7.56	0.18
				Area =	12.00		Wetted P =	12.70	
Channel Flow			Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Natural Channel		D-E	65.69	280.30	279.20	0.017	0.040	4.63	0.24
				Area =	12.00		Wetted P =	12.70	
								Total Tc (Minutes) =	**11.94**

		2-Year	**5-Year**	**10-Year**	**25-Year**	**50-Year**	**100-Year**
Rainfall Intensity	Inches / Hour.	**3.86**	**4.51**	**5.11**	**5.80**	**6.30**	**6.77**
Aosorption Coefficient / Ground Saturation Correction Coefficient	Cf	1.00	1.00	1.00	1.10	1.20	1.25
Peak Discharge	CFS.	**0.97**	**1.13**	**1.28**	**1.60**	**1.90**	**2.12**

Outfall PL23-OUT32 Sections A-A, B-B, C-C: Looking Upstream

Outfall PL23-OUT32 Sections A-A, B-B, C-C: Looking Downstream

PL23-OUT32 Cross Sections
I-495 NEXT
Fairfax,VA

DRAINAGE AREA BOUNDARY

EXISTING CONTOURS

TIME OF CONCENTRATION

SCALE

0 40' 80'

SECTION C-C

SECTION B-B

SECTION A-A

14-19

14-17

14-18

14-16

14-15

14-14

RAMP NW

I-495 GP LANES SOUTHBOUND

30"

24"

54"

LOD

Name of Project:	495-NEXT		Designed By: JMON
State:	VA	**County:** Fairfax County	Date: 02/15/22
Name of Culvert:	Post Development		Checked By: NVD
NOAA Station:	Vienna Tysons 44-8737		Date: 02/15/22
LOCATION:	PL23-OUT 32 A-A		
			UNITS **ENGLISH**

RATIONAL METHOD - DATA:

DRAINAGE BASIN

SUBSHED #	Land Use Description	Area Acres	C	C A
	Business: Industrial and Commercial (0.80-0.90)			
	Apartments and Townhomes (0.65-0.75)			
	Schools (0.50-0.60)			
	Residential - lots 10,000 sq. ft. (0.40-0.50)			
	- lots 12,000 sq. ft. (0.40-0.45)			
	- lots 17,000 sq. ft. (0.35-0.45)			
	- lots ½ acre or more (0.30-0.40)	0.00	0.35	
	Parks, Cemeteries and Unimproved Areas (0.20-0.35)			
	Paved and Roof Areas (0.90)	0.01	0.90	0.01
	Cultivated Areas (0.50-0.70)			
	Pasture (0.35-0.45)			
	Lawns (0.25-0.35)	0.85	0.30	0.26
	Forest (0.20-0.30)	0.17	0.25	0.04
	Steep Grass (2:1) (0.40-0.70)			
	Shoulder and Ditch Areas (0.35-0.50)			
	Totals =	**1.03 Acres**	**0.29**	**0.30**

Time of Concentration (Tc)

	Reach	Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Rational C		Tc (Minutes)
Overland Flow (E.E. Seelye - VDOT Modified)								
Soil / Surface Type/Land Cover		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Rational C		
Lawns	A-B	165.84	301.00	293.00	0.048	0.30		11.42
Channel Flow		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Paved ditch	B-C	137.24	293.00	286.00	0.051	0.015	21.54	0.11
			Area =	12.00		Wetted P =	12.70	
Channel Flow		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Grassed ditch	C-D	81.63	286.00	280.30	0.070	0.050	7.56	0.18
			Area =	12.00		Wetted P =	12.70	
Channel Flow		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Natural Channel	D-E	65.69	280.30	279.20	0.017	0.040	4.63	0.24
			Area =	12.00		Wetted P =	12.70	
Channel Flow		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Natural Channel	E-F	50.17	279.20	277.84	0.027	0.040	5.89	0.14
			Area =	12.00		Wetted P =	12.70	
							Total Tc (Minutes) =	**12.08**

	2-Year	5-Year	10-Year	25-Year	50-Year	100-Year
Rainfall Intensity Inches / Hour.	**3.84**	**4.49**	**5.09**	**5.77**	**6.27**	**6.74**
Aosorption Coefficient / Ground Saturation Correction Coefficient Cf	1.00	1.00	1.00	1.10	1.20	1.25
Peak Discharge CFS.	**1.17**	**1.37**	**1.55**	**1.94**	**2.29**	**2.57**

PL23-OUT32 (A-A) Post - 2yr

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Channel Slope	0.028 ft/ft
Discharge	1.17 cfs

Section Definitions

Station (ft)	Elevation (ft)
0+00	280.00
0+07	279.00
0+17	278.00
0+23	277.84
0+26	278.00
0+35	279.00
0+47	280.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 280.00)	(0+47, 280.00)	0.040

Options	
Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results	
Normal Depth	0.2 ft
Roughness Coefficient	0.040
Elevation	278.02 ft
Elevation Range	277.8 to 280.0 ft
Flow Area	0.9 ft²
Wetted Perimeter	9.4 ft
Hydraulic Radius	0.1 ft
Top Width	9.44 ft
Normal Depth	0.2 ft
Critical Depth	0.2 ft
Critical Slope	0.054 ft/ft
Velocity	1.30 ft/s
Velocity Head	0.03 ft
Specific Energy	0.21 ft

PL23-OUT32 (A-A) Post - 2yr

Results	
Froude Number	0.741
Flow Type	Subcritical

GVF Input Data	
Downstream Depth	0.0 ft
Length	0.0 ft
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.0 ft
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	0.00 ft/s
Upstream Velocity	0.00 ft/s
Normal Depth	0.2 ft
Critical Depth	0.2 ft
Channel Slope	0.028 ft/ft
Critical Slope	0.054 ft/ft

PL23-OUT32 (A-A) Post - 10yr

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Channel Slope	0.028 ft/ft
Discharge	1.55 cfs

Section Definitions

Station (ft)	Elevation (ft)
0+00	280.00
0+07	279.00
0+17	278.00
0+23	277.84
0+26	278.00
0+35	279.00
0+47	280.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 280.00)	(0+47, 280.00)	0.040

Options	
Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results	
Normal Depth	0.2 ft
Roughness Coefficient	0.040
Elevation	278.04 ft
Elevation Range	277.8 to 280.0 ft
Flow Area	1.1 ft²
Wetted Perimeter	9.8 ft
Hydraulic Radius	0.1 ft
Top Width	9.80 ft
Normal Depth	0.2 ft
Critical Depth	0.2 ft
Critical Slope	0.051 ft/ft
Velocity	1.43 ft/s
Velocity Head	0.03 ft
Specific Energy	0.23 ft

PL23-OUT32 (A-A) Post - 10yr

Results	
Froude Number	0.760
Flow Type	Subcritical

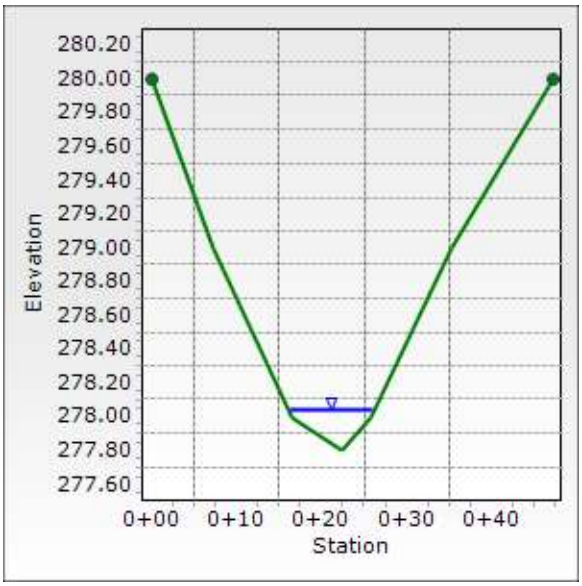
GVF Input Data	
Downstream Depth	0.0 ft
Length	0.0 ft
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.0 ft
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	0.00 ft/s
Upstream Velocity	0.00 ft/s
Normal Depth	0.2 ft
Critical Depth	0.2 ft
Channel Slope	0.028 ft/ft
Critical Slope	0.051 ft/ft

PL23-OUT32 (A-A) Post - 10yr

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Channel Slope	0.028 ft/ft
Normal Depth	0.2 ft
Discharge	1.55 cfs



Name of Project:	495-NEXT		Designed By: JMON
State:	VA	**County:** Fairfax County	Date: 02/15/22
Name of Culvert:	Post Development		Checked By: NVD
NOAA Station:	Vienna Tysons 44-8737		Date: 02/15/22
LOCATION:	PL23-OUT 32 B-B		
			UNITS **ENGLISH**

RATIONAL METHOD - DATA:

DRAINAGE BASIN

SUBSHED #	Land Use Description	Area Acres	C	C A
	Business: Industrial and Commercial (0.80-0.90)			
	Apartments and Townhomes (0.65-0.75)			
	Schools (0.50-0.60)			
	Residential - lots 10,000 sq. ft. (0.40-0.50)			
	- lots 12,000 sq. ft. (0.40-0.45)			
	- lots 17,000 sq. ft. (0.35-0.45)			
	- lots ½ acre or more (0.30-0.40)	0.00	0.35	
	Parks, Cemeteries and Unimproved Areas (0.20-0.35)			
	Paved and Roof Areas (0.90)	0.01	0.90	0.01
	Cultivated Areas (0.50-0.70)			
	Pasture (0.35-0.45)			
	Lawns (0.25-0.35)	0.92	0.30	0.27
	Forest (0.20-0.30)	0.32	0.25	0.08
	Steep Grass (2:1) (0.40-0.70)			
	Shoulder and Ditch Areas (0.35-0.50)			
	Totals =	**1.25 Acres**	**0.29**	**0.36**

Time of Concentration (Tc)

	Reach	Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Rational C		Tc (Minutes)
Overland Flow (E.E. Seelye - VDOT Modified)								
Soil / Surface Type/Land Cover		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Rational C		
Lawns	A-B	165.84	301.00	293.00	0.048	0.30		11.42
Channel Flow		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Paved ditch	B-C	137.24	293.00	286.00	0.051	0.015	21.54	0.11
			Area =	12.00		Wetted P =	12.70	
Channel Flow		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Grassed ditch	C-D	81.63	286.00	280.30	0.070	0.050	7.56	0.18
			Area =	12.00		Wetted P =	12.70	
Channel Flow		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Natural Channel	D-E	65.69	280.30	279.20	0.017	0.040	4.63	0.24
			Area =	12.00		Wetted P =	12.70	
Channel Flow		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Natural Channel	E-F	100.32	280.30	276.70	0.036	0.040	6.78	0.25
			Area =	12.00		Wetted P =	12.70	
							Total Tc (Minutes) =	**12.18**

	2-Year	5-Year	10-Year	25-Year	50-Year	100-Year
Rainfall Intensity Inches / Hour.	**3.82**	**4.47**	**5.07**	**5.75**	**6.25**	**6.72**
Aosorption Coefficient / Ground Saturation Correction Coefficient Cf	1.00	1.00	1.00	1.10	1.20	1.25
Peak Discharge CFS.	**1.38**	**1.62**	**1.83**	**2.29**	**2.71**	**3.03**

PL23-OUT32 (B-B) Post - 2yr

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Channel Slope	0.015 ft/ft
Discharge	1.38 cfs

Section Definitions

Station (ft)	Elevation (ft)
0+00	279.00
0+07	278.00
0+14	277.00
0+25	276.70
0+31	277.00
0+53	278.00
0+64	279.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 279.00)	(0+64, 279.00)	0.040

Options	
Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results	
Normal Depth	0.2 ft
Roughness Coefficient	0.040
Elevation	276.91 ft
Elevation Range	276.7 to 279.0 ft
Flow Area	1.3 ft²
Wetted Perimeter	12.5 ft
Hydraulic Radius	0.1 ft
Top Width	12.52 ft
Normal Depth	0.2 ft
Critical Depth	0.2 ft
Critical Slope	0.053 ft/ft
Velocity	1.03 ft/s
Velocity Head	0.02 ft
Specific Energy	0.23 ft

PL23-OUT32 (B-B) Post - 2yr

Results	
Froude Number	0.553
Flow Type	Subcritical

GVF Input Data	
Downstream Depth	0.0 ft
Length	0.0 ft
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.0 ft
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	0.00 ft/s
Upstream Velocity	0.00 ft/s
Normal Depth	0.2 ft
Critical Depth	0.2 ft
Channel Slope	0.015 ft/ft
Critical Slope	0.053 ft/ft

PL23-OUT32 (B-B) Post - 10yr

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Channel Slope	0.015 ft/ft
Discharge	1.83 cfs

Section Definitions

Station (ft)	Elevation (ft)
0+00	279.00
0+07	278.00
0+14	277.00
0+25	276.70
0+31	277.00
0+53	278.00
0+64	279.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 279.00)	(0+64, 279.00)	0.040

Options	
Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results	
Normal Depth	0.2 ft
Roughness Coefficient	0.040
Elevation	276.94 ft
Elevation Range	276.7 to 279.0 ft
Flow Area	1.7 ft²
Wetted Perimeter	13.9 ft
Hydraulic Radius	0.1 ft
Top Width	13.91 ft
Normal Depth	0.2 ft
Critical Depth	0.2 ft
Critical Slope	0.051 ft/ft
Velocity	1.10 ft/s
Velocity Head	0.02 ft
Specific Energy	0.26 ft

PL23-OUT32 (B-B) Post - 10yr

Results	
Froude Number	0.563
Flow Type	Subcritical

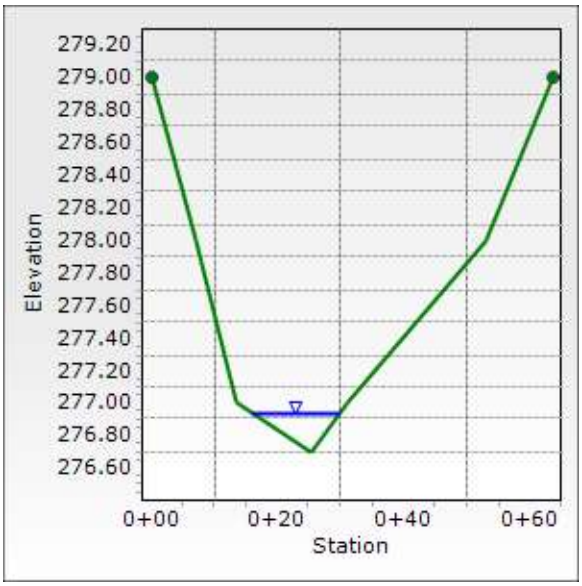
GVF Input Data	
Downstream Depth	0.0 ft
Length	0.0 ft
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.0 ft
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	0.00 ft/s
Upstream Velocity	0.00 ft/s
Normal Depth	0.2 ft
Critical Depth	0.2 ft
Channel Slope	0.015 ft/ft
Critical Slope	0.051 ft/ft

PL23-OUT32 (B-B) Post - 10yr

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Channel Slope	0.015 ft/ft
Normal Depth	0.2 ft
Discharge	1.83 cfs



Name of Project:	495-NEXT		Designed By: JMON
State:	VA	**County:** Fairfax County	Date: 02/15/22
Name of Culvert:	Post Development		Checked By: NVD
NOAA Station:	Vienna Tysons 44-8737		Date: 02/15/22
LOCATION:	PL23-OUT 32 C-C		
			UNITS **ENGLISH**

RATIONAL METHOD - DATA:

DRAINAGE BASIN

SUBSHED #	Land Use Description	Area Acres	C	C A
	Business: Industrial and Commercial (0.80-0.90)			
	Apartments and Townhomes (0.65-0.75)			
	Schools (0.50-0.60)			
	Residential - lots 10,000 sq. ft. (0.40-0.50)			
	- lots 12,000 sq. ft. (0.40-0.45)			
	- lots 17,000 sq. ft. (0.35-0.45)			
	- lots ½ acre or more (0.30-0.40)	0.00	0.35	
	Parks, Cemeteries and Unimproved Areas (0.20-0.35)			
	Paved and Roof Areas (0.90)	0.01	0.90	0.01
	Cultivated Areas (0.50-0.70)			
	Pasture (0.35-0.45)			
	Lawns (0.25-0.35)	1.12	0.30	0.33
	Forest (0.20-0.30)	0.69	0.25	0.17
	Steep Grass (2:1) (0.40-0.70)			
	Shoulder and Ditch Areas (0.35-0.50)			
	Totals =	**1.81 Acres**	**0.28**	**0.51**

Time of Concentration (Tc)

	Reach	Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Rational C		Tc (Minutes)
Overland Flow (E.E. Seelye - VDOT Modified)								
Soil / Surface Type/Land Cover		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Rational C		
Lawns	A-B	165.84	301.00	293.00	0.048	0.30		11.42
Channel Flow		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Paved ditch	B-C	137.24	293.00	286.00	0.051	0.015	21.54	0.11
			Area =	12.00		Wetted P =	12.70	
Channel Flow		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Grassed ditch	C-D	81.63	286.00	280.30	0.070	0.050	7.56	0.18
			Area =	12.00		Wetted P =	12.70	
Channel Flow		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Natural Channel	D-E	65.69	280.30	279.20	0.017	0.040	4.63	0.24
			Area =	12.00		Wetted P =	12.70	
Channel Flow		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Natural Channel	E-F	152.05	280.30	275.70	0.030	0.040	6.22	0.41
			Area =	12.00		Wetted P =	12.70	
							Total Tc (Minutes) =	**12.35**

	2-Year	5-Year	10-Year	25-Year	50-Year	100-Year
Rainfall Intensity Inches / Hour.	**3.80**	**4.45**	**5.04**	**5.72**	**6.22**	**6.68**
Aosorption Coefficient / Ground Saturation Correction Coefficient Cf	1.00	1.00	1.00	1.10	1.20	1.25
Peak Discharge CFS.	**1.95**	**2.28**	**2.58**	**3.22**	**3.82**	**4.27**

PL23-OUT32 (C-C) Post - 2yr

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Channel Slope	0.025 ft/ft
Discharge	1.95 cfs

Section Definitions

Station (ft)	Elevation (ft)
0+00	280.00
0+25	278.00
0+62	276.00
0+70	275.70
0+81	276.00
1+10	278.00
1+33	280.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 280.00)	(1+33, 280.00)	0.040

Options	
Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results	
Normal Depth	0.2 ft
Roughness Coefficient	0.040
Elevation	275.92 ft
Elevation Range	275.7 to 280.0 ft
Flow Area	1.5 ft²
Wetted Perimeter	13.5 ft
Hydraulic Radius	0.1 ft
Top Width	13.46 ft
Normal Depth	0.2 ft
Critical Depth	0.2 ft
Critical Slope	0.051 ft/ft
Velocity	1.34 ft/s
Velocity Head	0.03 ft
Specific Energy	0.24 ft

PL23-OUT32 (C-C) Post - 2yr

Results	
Froude Number	0.716
Flow Type	Subcritical

GVF Input Data	
Downstream Depth	0.0 ft
Length	0.0 ft
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.0 ft
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	0.00 ft/s
Upstream Velocity	0.00 ft/s
Normal Depth	0.2 ft
Critical Depth	0.2 ft
Channel Slope	0.025 ft/ft
Critical Slope	0.051 ft/ft

PL23-OUT32 (C-C) Post - 10yr

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Channel Slope	0.025 ft/ft
Discharge	2.58 cfs

Section Definitions

Station (ft)	Elevation (ft)
0+00	280.00
0+25	278.00
0+62	276.00
0+70	275.70
0+81	276.00
1+10	278.00
1+33	280.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 280.00)	(1+33, 280.00)	0.040

Options	
Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results	
Normal Depth	0.2 ft
Roughness Coefficient	0.040
Elevation	275.94 ft
Elevation Range	275.7 to 280.0 ft
Flow Area	1.8 ft²
Wetted Perimeter	15.0 ft
Hydraulic Radius	0.1 ft
Top Width	14.96 ft
Normal Depth	0.2 ft
Critical Depth	0.2 ft
Critical Slope	0.049 ft/ft
Velocity	1.43 ft/s
Velocity Head	0.03 ft
Specific Energy	0.27 ft

PL23-OUT32 (C-C) Post - 10yr

Results	
Froude Number	0.728
Flow Type	Subcritical

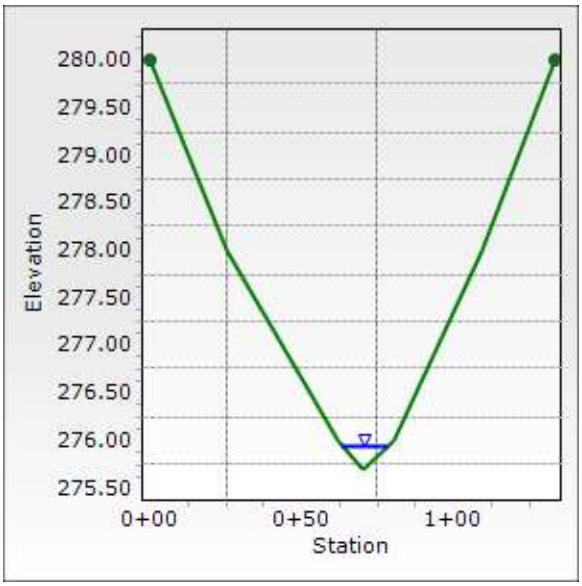
GVF Input Data	
Downstream Depth	0.0 ft
Length	0.0 ft
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.0 ft
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	0.00 ft/s
Upstream Velocity	0.00 ft/s
Normal Depth	0.2 ft
Critical Depth	0.2 ft
Channel Slope	0.025 ft/ft
Critical Slope	0.049 ft/ft

PL23-OUT32 (C-C) Post - 10yr

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Channel Slope	0.025 ft/ft
Normal Depth	0.2 ft
Discharge	2.58 cfs



APPENDIX C33
PL23-OUT33

Outfall PL23-OUT 33

Outfall PL23-OUT33 is an existing outfall at I-495 Southbound station 269+75 left. The outfall consists of an area of uncontrolled sheet flow. The outfall prior to development is 0.15 acres.

Development of this area will result in a reduced area to this outfall, due to the proposed roadway and drainage design. The resulting area to the outfall will be 0.05 acres.

Drainage Area:

The drainage areas and resulting changes are summarized in the table below:

PL23-OUT 33			
Drainage Area	**Total Area**	**C (Total)**	**Tc**
Existing	0.15 ac	0.30	5.00 min
Proposed	0.05 ac	0.30	5.00 min

Limits of Study:

The location of the outfall is shown in the included outfall drainage map. The point of analysis is at the site limits.

Easement Requirements:

No additional easements are required.

Outfall Discharge:

All discharges were calculated using the Rational Method and are summarized below:

PL23-OUT 33		
Drainage Area	**Peak Flow Rate (Total)**	
	2 Year	10 Year
Existing	0.23 cfs	0.30 cfs
Proposed	0.08 cfs	0.11 cfs
Net Change	**-0.15 cfs**	**-0.19 cfs**

Final Opinion:

Area of increased volume of sheet flow must be identified and evaluated for potential impacts. As this outfall demonstrates a decreased volume of sheet flow, no further calculations are necessary. It is therefore our opinion that this outfall is adequate.

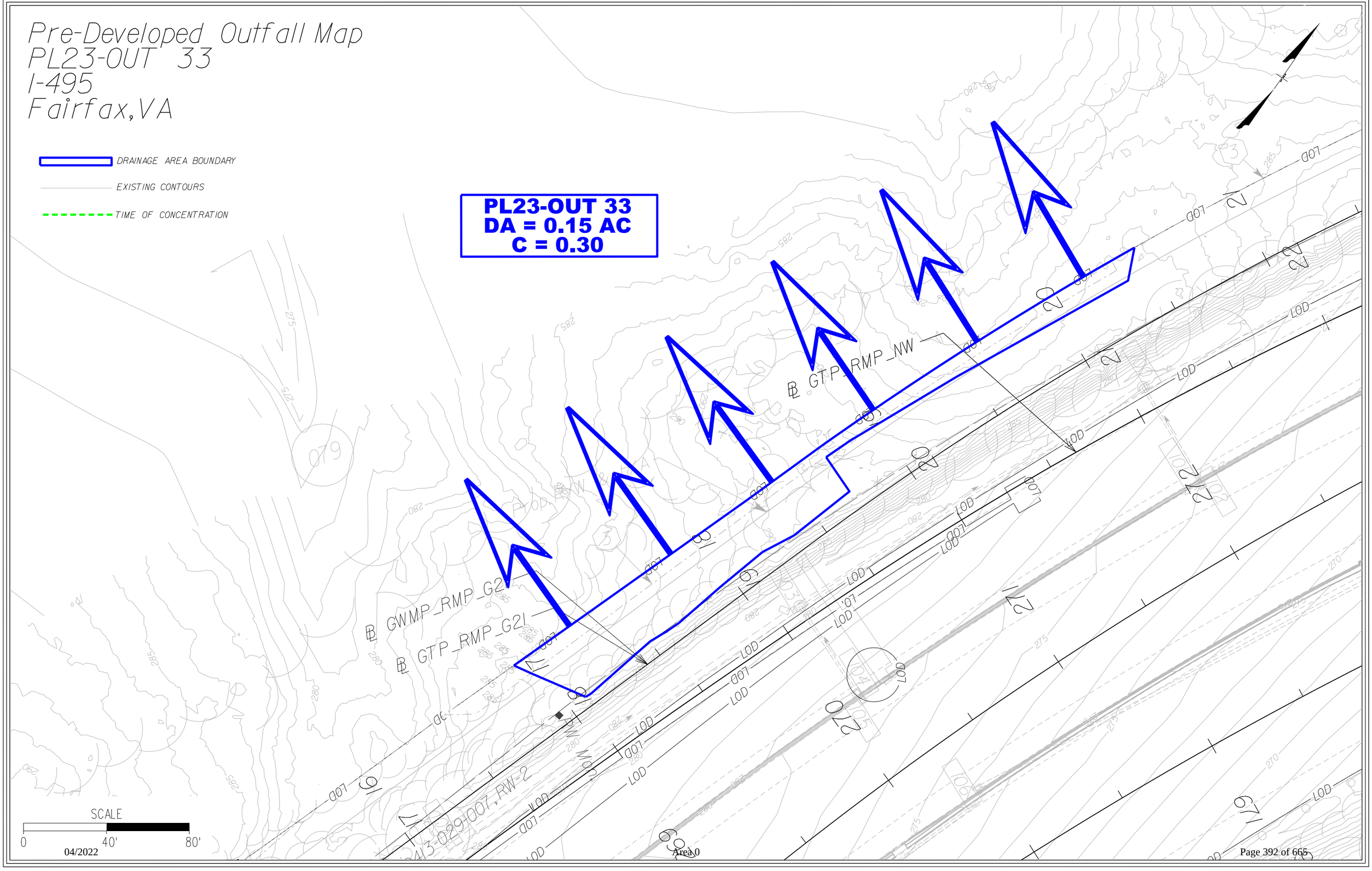
Pre-Developed Outfall Map
PL23-OUT 33
I-495
Fairfax, VA

DRAINAGE AREA BOUNDARY

EXISTING CONTOURS

TIME OF CONCENTRATION

PL23-OUT 33
DA = 0.15 AC
C = 0.30



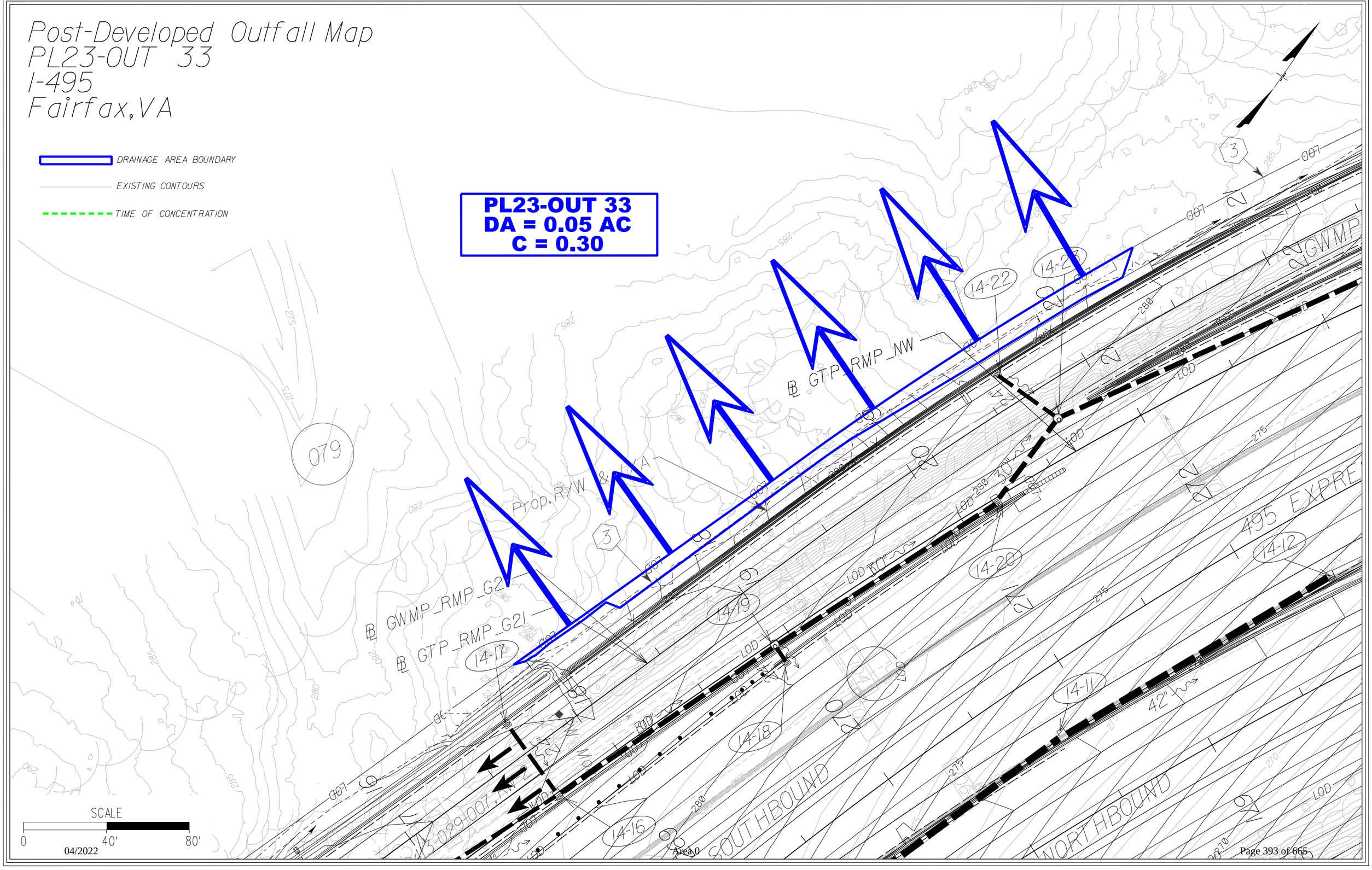
Post-Developed Outfall Map
PL23-OUT 33
I-495
Fairfax, VA

DRAINAGE AREA BOUNDARY

EXISTING CONTOURS

TIME OF CONCENTRATION

PL23-OUT 33
DA = 0.05 AC
C = 0.30



Name of Project:	495-NEXT			Designed By:	KRI
State:	VA	**County:**	Fairfax County	Date:	09/24/21
Name of Culvert:	Pre Development			Checked By:	NVD
NOAA Station:	Vienna Tysons 44-8737			Date:	09/24/21
LOCATION:	PL23-OUT 33				
				UNITS	**ENGLISH**

RATIONAL METHOD - DATA:

DRAINAGE BASIN

SUBSHED #	Land Use Description	Area Acres	C	C A
	Business: Industrial and Commercial (0.80-0.90)			
	Apartments and Townhomes (0.65-0.75)			
	Schools (0.50-0.60)			
	Residential - lots 10,000 sq. ft. (0.40-0.50)			
	- lots 12,000 sq. ft. (0.40-0.45)			
	- lots 17,000 sq. ft. (0.35-0.45)			
	- lots ½ acre or more (0.30-0.40)		0.35	
	Parks, Cemeteries and Unimproved Areas (0.20-0.35)			
	Paved and Roof Areas (0.90)		0.90	
	Cultivated Areas (0.50-0.70)			
	Pasture (0.35-0.45)			
	Lawns (0.25-0.35)	0.15	0.30	0.04
	Forest (0.20-0.30)		0.25	
	Steep Grass (2:1) (0.40-0.70)			
	Shoulder and Ditch Areas (0.35-0.50)			
	Totals =	**0.15 Acres**	**0.30**	**0.04**

Time of Concentration (Tc)

	Reach	Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Rational C		Tc (Minutes)
							Total Tc (Minutes) =	**5.00**

		2-Year	**5-Year**	**10-Year**	**25-Year**	**50-Year**	**100-Year**
Rainfall Intensity	Inches / Hour.	**5.18**	**6.00**	**6.76**	**7.64**	**8.28**	**8.89**
Aosorption Coefficient / Ground Saturation Correction Coefficient Cf		1.00	1.00	1.00	1.10	1.20	1.25
Peak Discharge	CFS.	**0.23**	**0.27**	**0.30**	**0.38**	**0.44**	**0.50**

Name of Project:	495-NEXT			Designed By:	JMON
State:	VA	**County:**	Fairfax County	Date:	09/24/21
Name of Culvert:	Post Development			Checked By:	NVD
NOAA Station:	Vienna Tysons 44-8737			Date:	09/24/21
LOCATION:	PL23-OUT 33				
				UNITS	**ENGLISH**

RATIONAL METHOD - DATA:

DRAINAGE BASIN

SUBSHED #	Land Use Description	Area Acres	C	C A
	Business: Industrial and Commercial (0.80-0.90)			
	Apartments and Townhomes (0.65-0.75)			
	Schools (0.50-0.60)			
	Residential - lots 10,000 sq. ft. (0.40-0.50)			
	- lots 12,000 sq. ft. (0.40-0.45)			
	- lots 17,000 sq. ft. (0.35-0.45)			
	- lots ½ acre or more (0.30-0.40)		0.35	
	Parks, Cemeteries and Unimproved Areas (0.20-0.35)			
	Paved and Roof Areas (0.90)		0.90	
	Cultivated Areas (0.50-0.70)			
	Pasture (0.35-0.45)			
	Lawns (0.25-0.35)	0.05	0.30	0.02
	Forest (0.20-0.30)		0.25	
	Steep Grass (2:1) (0.40-0.70)			
	Shoulder and Ditch Areas (0.35-0.50)			
	Totals =	**0.05 Acres**	**0.30**	**0.02**

Time of Concentration (Tc)

	Reach	Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Rational C		Tc (Minutes)
							Total Tc (Minutes) =	**5.00**

		2-Year	**5-Year**	**10-Year**	**25-Year**	**50-Year**	**100-Year**
Rainfall Intensity	Inches / Hour.	**5.18**	**6.00**	**6.76**	**7.64**	**8.28**	**8.89**
Aosorption Coefficient / Ground Saturation Correction Coefficient Cf		1.00	1.00	1.00	1.10	1.20	1.25
Peak Discharge	CFS.	**0.08**	**0.10**	**0.11**	**0.14**	**0.16**	**0.18**

APPENDIX C34
PL23-OUT34

Outfall PL23-OUT 34

Outfall PL23-OUT34 is an existing outfall at Live Oak Drive station 18+14 left. The outfall consists of a natural stormwater conveyance system. In existing conditions, flow is conveyed through existing channels and sheet flow to the point of analysis. The outfall prior to development is 1.14 acres.

Development of this area will result in decreased area to this outfall, due to proposed storm sewer and ditches conveying drainage to an adjacent outfall. The resulting area to the outfall will be 0.09 acres.

Drainage Area:

The drainage areas and resulting changes are summarized in the table below:

PL23-OUT 34			
Drainage Area	**Total Area**	**C (Total)**	**Tc**
Existing	1.14 ac	0.52	5.00 min
Proposed	0.09 ac	0.35	5.00 min

Limits of Study:

The location of the outfall is shown in the included outfall drainage map. The point of analysis is within the existing channel west of Live Oak Drive.

Easement Requirements:

No additional easements are required.

Outfall Discharge:

All discharges were calculated using the Rational Method and are summarized below:

PL23-OUT 34		
Drainage Area	**Peak Flow Rate (Total)**	
	2 Year	10 Year
Existing	3.07 cfs	4.00 cfs
Proposed	0.16 cfs	0.20 cfs
Net Change	**-2.91 cfs**	**-3.80 cfs**

Channel Description:

The channel at Outfall PL23-OUT34 is a natural channel. Cross Sections were prepared utilizing topography prepared by Rinker Design Associates, P.C.

Channel Protection:

Under Section 11.7.5.1 of the VDOT drainage manual, areas draining to a natural stormwater conveyance channel shall satisfy the channel protection criteria by providing

conveyance of the 2 year storm without causing erosion of the system. Calculations have been provided below supporting the 2 year velocities in the system:

Cross Section	Channel Protection - 2 Year Velocity			Outfall Adequate?
	Channel Lining	Max Permissible Velocity (ft/s)	Proposed Velocity (ft/s)	
A-A	Meadowville Complex	2.3	0.66	Yes
B-B	Meadowville Complex	2.3	1.27	Yes
C-C	Meadowville Complex	2.3	1.34	Yes

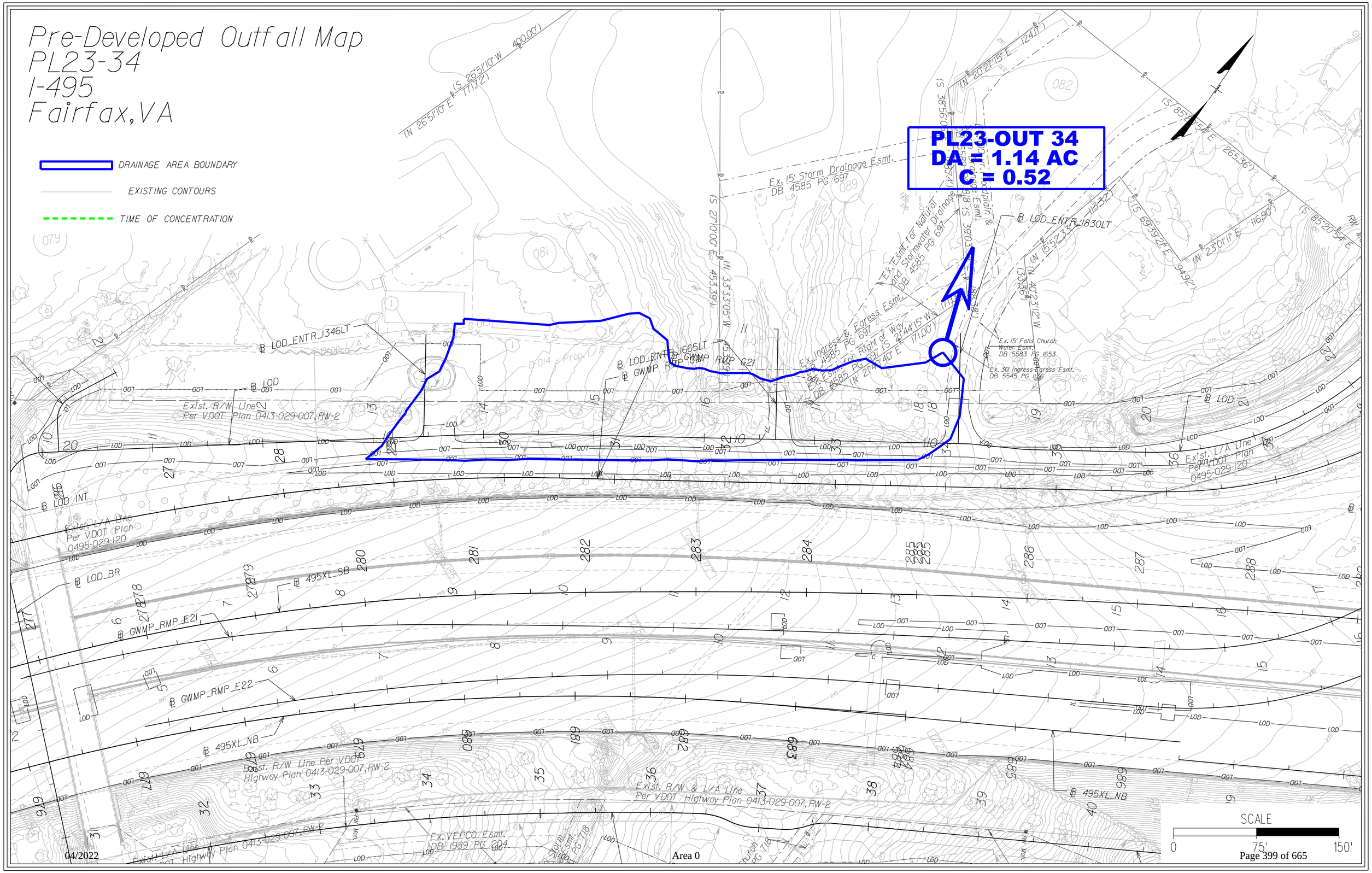
Flood Protection:

Under Section 11.7.5.2 of the VDOT drainage manual, areas draining to a natural stormwater conveyance channel shall satisfy the flood protection criteria by demonstrating that the peak flow rate from a 10 year storm will be contained within the existing channel. The post developed flows to the channel have been analyzed and yield the following results:

Cross Section	Flood Protection - 10 Year Capacity		Outfall Adequate?
	Channel Depth (ft)	Normal Depth (ft)	
A-A	0.6	0.10	Yes
B-B	2.0	0.20	Yes
C-C	2.0	0.30	Yes

Final Opinion:

This outfall is a natural stormwater conveyance system. We have shown compliance with the channel protection criteria by providing calculations demonstrating non-erosive velocities. We have shown compliance with the flood protection criteria, by demonstrating the peak discharge from a 10 year storm will be contained within the existing channel. It is therefore our opinion that this outfall is adequate.


Pre-Developed Outfall Map
PL23-34
I-495
Fairfax, VA
DRAINAGE AREA BOUNDARY
EXISTING CONTOURS
TIME OF CONCENTRATION
PL23-OUT 34
DA = 1.14 AC
C = 0.52
SCALE
0
75'
150'

Post-Developed Outfall Map
PL23-34
I-495
Fairfax, VA

DRAINAGE AREA BOUNDARY

EXISTING CONTOURS

TIME OF CONCENTRATION

PL23-OUT 34
DA = 0.09 AC
C = 0.35

SCALE
0 75' 150'

Name of Project:	495-NEXT			Designed By:	KRI
State:	VA	**County:**	Fairfax County	Date:	09/03/21
Name of Culvert:	Pre Development			Checked By:	NVD
NOAA Station:	Vienna Tysons 44-8737			Date:	09/03/21
LOCATION:	PL23-OUT 34				
				UNITS	**ENGLISH**

RATIONAL METHOD - DATA:

DRAINAGE BASIN

SUBSHED #	Land Use Description	Area Acres	C	C A
	Business: Industrial and Commercial (0.80-0.90)			
	Apartments and Townhomes (0.65-0.75)			
	Schools (0.50-0.60)			
	Residential - lots 10,000 sq. ft. (0.40-0.50)			
	- lots 12,000 sq. ft. (0.40-0.45)			
	- lots 17,000 sq. ft. (0.35-0.45)			
	- lots ½ acre or more (0.30-0.40)		0.35	
	Parks, Cemeteries and Unimproved Areas (0.20-0.35)			
	Paved and Roof Areas (0.90)	0.44	0.90	0.40
	Cultivated Areas (0.50-0.70)			
	Pasture (0.35-0.45)			
	Lawns (0.25-0.35)	0.38	0.30	0.11
	Forest (0.20-0.30)	0.32	0.25	0.08
	Steep Grass (2:1) (0.40-0.70)			
	Shoulder and Ditch Areas (0.35-0.50)			
	Totals =	**1.14 Acres**	**0.52**	**0.59**

Time of Concentration (Tc)

	Reach	Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Rational C		Tc (Minutes)
							Total Tc (Minutes) =	**5.00**

		2-Year	**5-Year**	**10-Year**	**25-Year**	**50-Year**	**100-Year**
Rainfall Intensity	Inches / Hour.	**5.18**	**6.00**	**6.76**	**7.64**	**8.28**	**8.89**
Aosorption Coefficient / Ground Saturation Correction Coefficient Cf		1.00	1.00	1.00	1.10	1.20	1.25
Peak Discharge	CFS.	**3.07**	**3.55**	**4.00**	**4.97**	**5.88**	**6.58**

Name of Project:	495-NEXT			Designed By:	JMON
State:	VA	**County:**	Fairfax County	Date:	11/19/21
Name of Culvert:	Post Development			Checked By:	NVD
NOAA Station:	Vienna Tysons 44-8737			Date:	11/19/21
LOCATION:	PL23-OUT 34				
				UNITS	**ENGLISH**

RATIONAL METHOD - DATA:

DRAINAGE BASIN

SUBSHED #	Land Use Description	Area Acres	C	C A
	Business: Industrial and Commercial (0.80-0.90)			
	Apartments and Townhomes (0.65-0.75)			
	Schools (0.50-0.60)		0.50	
	Residential - lots 10,000 sq. ft. (0.40-0.50)			
	- lots 12,000 sq. ft. (0.40-0.45)			
	- lots 17,000 sq. ft. (0.35-0.45)			
	- lots ½ acre or more (0.30-0.40)		0.35	
	Parks, Cemeteries and Unimproved Areas (0.20-0.35)			
	Paved and Roof Areas (0.90)	0.01	0.90	0.01
	Cultivated Areas (0.50-0.70)			
	Pasture (0.35-0.45)			
	Lawns (0.25-0.35)	0.02	0.30	0.01
	Forest (0.20-0.30)	0.06	0.25	0.01
	Steep Grass (2:1) (0.40-0.70)			
	Shoulder and Ditch Areas (0.35-0.50)			
	Totals =	**0.09 Acres**	**0.35**	**0.03**

Time of Concentration (Tc)

	Reach	Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Rational C		Tc (Minutes)
							Total Tc (Minutes) =	**5.00**

	2-Year	**5-Year**	**10-Year**	**25-Year**	**50-Year**	**100-Year**
Rainfall Intensity Inches / Hour.	**5.18**	**6.00**	**6.76**	**7.64**	**8.28**	**8.89**
Aosorption Coefficient / Ground Saturation Correction Coefficient Cf	1.00	1.00	1.00	1.10	1.20	1.25
Peak Discharge CFS.	**0.16**	**0.18**	**0.20**	**0.25**	**0.30**	**0.33**

Outfall PL23-OUT34 Sections A-A, B-B, C-C: Looking Upstream

Outfall PL23-OUT34 Sections A-A, B-B, C-C: Looking Downstream

PL23-OUT34 Cross Sections
I-495 NEXT
Fairfax,VA

DRAINAGE AREA BOUNDARY

EXISTING CONTOURS

TIME OF CONCENTRATION

SCALE

0 25' 50'

SECTION C-C

SECTION B-B

SECTION A-A

15-43

15-42

15-44

15-46

15-45

16-20

LOD

15"

Name of Project:	495-NEXT			Designed By:	JMON
State:	VA	**County:**	Fairfax County	Date:	11/19/21
Name of Culvert:	Post Development			Checked By:	NVD
NOAA Station:	Vienna Tysons 44-8737			Date:	11/19/21
LOCATION:	PL23-OUT 34 A-A				
				UNITS	**ENGLISH**

RATIONAL METHOD - DATA:

DRAINAGE BASIN

SUBSHED #	Land Use Description	Area Acres	C	C A
	Business: Industrial and Commercial (0.80-0.90)			
	Apartments and Townhomes (0.65-0.75)			
	Schools (0.50-0.60)		0.50	
	Residential - lots 10,000 sq. ft. (0.40-0.50)			
	- lots 12,000 sq. ft. (0.40-0.45)			
	- lots 17,000 sq. ft. (0.35-0.45)			
	- lots ½ acre or more (0.30-0.40)		0.35	
	Parks, Cemeteries and Unimproved Areas (0.20-0.35)			
	Paved and Roof Areas (0.90)	0.02	0.90	0.02
	Cultivated Areas (0.50-0.70)			
	Pasture (0.35-0.45)			
	Lawns (0.25-0.35)	0.05	0.30	0.02
	Forest (0.20-0.30)	0.10	0.25	0.03
	Steep Grass (2:1) (0.40-0.70)			
	Shoulder and Ditch Areas (0.35-0.50)			
	Totals =	**0.18 Acres**	**0.35**	**0.06**

Time of Concentration (Tc)

	Reach	Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Rational C		Tc (Minutes)
							Total Tc (Minutes) =	**5.00**

	2-Year	**5-Year**	**10-Year**	**25-Year**	**50-Year**	**100-Year**
Rainfall Intensity Inches / Hour.	**5.18**	**6.00**	**6.76**	**7.64**	**8.28**	**8.89**
Aosorption Coefficient / Ground Saturation Correction Coefficient Cf	1.00	1.00	1.00	1.10	1.20	1.25
Peak Discharge CFS.	**0.32**	**0.37**	**0.42**	**0.52**	**0.61**	**0.69**

PL23-OUT34 (A-A) Post - 2yr

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Channel Slope	0.020 ft/ft
Discharge	0.32 cfs

Section Definitions

Station (ft)	Elevation (ft)
0+00	238.00
0+31	237.00
0+58	236.00
0+72	235.43
0+94	236.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 238.00)	(0+94, 236.00)	0.050

Options	
Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results	
Normal Depth	0.1 ft
Roughness Coefficient	0.050
Elevation	235.55 ft
Elevation Range	235.4 to 238.0 ft
Flow Area	0.5 ft²
Wetted Perimeter	7.9 ft
Hydraulic Radius	0.1 ft
Top Width	7.87 ft
Normal Depth	0.1 ft
Critical Depth	0.1 ft
Critical Slope	0.102 ft/ft
Velocity	0.66 ft/s
Velocity Head	0.01 ft
Specific Energy	0.13 ft
Froude Number	0.467
Flow Type	Subcritical

PL23-OUT34 (A-A) Post - 2yr

GVF Input Data	
Downstream Depth	0.0 ft
Length	0.0 ft
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.0 ft
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	0.00 ft/s
Upstream Velocity	0.00 ft/s
Normal Depth	0.1 ft
Critical Depth	0.1 ft
Channel Slope	0.020 ft/ft
Critical Slope	0.102 ft/ft

PL23-OUT34 (A-A) Post - 10yr

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Channel Slope	0.020 ft/ft
Discharge	0.42 cfs

Section Definitions

Station (ft)	Elevation (ft)
0+00	238.00
0+31	237.00
0+58	236.00
0+72	235.43
0+94	236.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 238.00)	(0+94, 236.00)	0.050

Options	
Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results	
Normal Depth	0.1 ft
Roughness Coefficient	0.050
Elevation	235.57 ft
Elevation Range	235.4 to 238.0 ft
Flow Area	0.6 ft²
Wetted Perimeter	8.7 ft
Hydraulic Radius	0.1 ft
Top Width	8.72 ft
Normal Depth	0.1 ft
Critical Depth	0.1 ft
Critical Slope	0.099 ft/ft
Velocity	0.70 ft/s
Velocity Head	0.01 ft
Specific Energy	0.14 ft
Froude Number	0.474
Flow Type	Subcritical

PL23-OUT34 (A-A) Post - 10yr

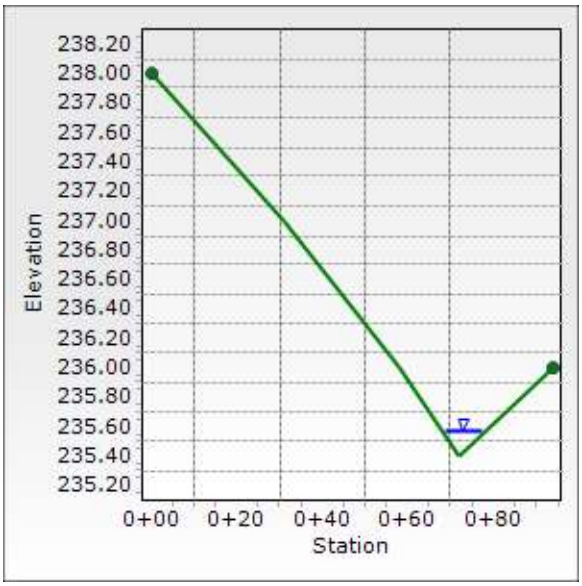
GVF Input Data	
Downstream Depth	0.0 ft
Length	0.0 ft
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.0 ft
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	0.00 ft/s
Upstream Velocity	0.00 ft/s
Normal Depth	0.1 ft
Critical Depth	0.1 ft
Channel Slope	0.020 ft/ft
Critical Slope	0.099 ft/ft

PL23-OUT34 (A-A) Post - 10yr

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Channel Slope	0.020 ft/ft
Normal Depth	0.1 ft
Discharge	0.42 cfs



Name of Project:	495-NEXT			Designed By:	JMON
State:	VA	**County:**	Fairfax County	Date:	11/19/21
Name of Culvert:	Post Development			Checked By:	NVD
NOAA Station:	Vienna Tysons 44-8737			Date:	11/19/21
LOCATION:	PL23-OUT 34 B-B				
				UNITS	**ENGLISH**

RATIONAL METHOD - DATA:

DRAINAGE BASIN

SUBSHED #	Land Use Description	Area Acres	C	C A
	Business: Industrial and Commercial (0.80-0.90)			
	Apartments and Townhomes (0.65-0.75)			
	Schools (0.50-0.60)		0.50	
	Residential - lots 10,000 sq. ft. (0.40-0.50)			
	- lots 12,000 sq. ft. (0.40-0.45)			
	- lots 17,000 sq. ft. (0.35-0.45)			
	- lots ½ acre or more (0.30-0.40)		0.35	
	Parks, Cemeteries and Unimproved Areas (0.20-0.35)			
	Paved and Roof Areas (0.90)	0.04	0.90	0.03
	Cultivated Areas (0.50-0.70)			
	Pasture (0.35-0.45)			
	Lawns (0.25-0.35)	0.07	0.30	0.02
	Forest (0.20-0.30)	0.17	0.25	0.04
	Steep Grass (2:1) (0.40-0.70)			
	Shoulder and Ditch Areas (0.35-0.50)			
	Totals =	**0.27 Acres**	**0.35**	**0.10**

Time of Concentration (Tc)

	Reach	Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Rational C		Tc (Minutes)
							Total Tc (Minutes) =	**5.00**

	2-Year	**5-Year**	**10-Year**	**25-Year**	**50-Year**	**100-Year**
Rainfall Intensity Inches / Hour.	**5.18**	**6.00**	**6.76**	**7.64**	**8.28**	**8.89**
Aosorption Coefficient / Ground Saturation Correction Coefficient Cf	1.00	1.00	1.00	1.10	1.20	1.25
Peak Discharge CFS.	**0.49**	**0.57**	**0.64**	**0.80**	**0.95**	**1.06**

PL23-OUT34 (B-B) Post - 2yr

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Channel Slope	0.048 ft/ft
Discharge	0.49 cfs

Section Definitions

Station (ft)	Elevation (ft)
0+00	235.00
0+12	234.00
0+31	233.00
0+38	234.00
0+59	235.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 235.00)	(0+59, 235.00)	0.050

Options	
Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results	
Normal Depth	0.2 ft
Roughness Coefficient	0.050
Elevation	233.17 ft
Elevation Range	233.0 to 235.0 ft
Flow Area	0.4 ft²
Wetted Perimeter	4.5 ft
Hydraulic Radius	0.1 ft
Top Width	4.45 ft
Normal Depth	0.2 ft
Critical Depth	0.2 ft
Critical Slope	0.086 ft/ft
Velocity	1.27 ft/s
Velocity Head	0.03 ft
Specific Energy	0.20 ft
Froude Number	0.763
Flow Type	Subcritical

PL23-OUT34 (B-B) Post - 2yr

GVF Input Data	
Downstream Depth	0.0 ft
Length	0.0 ft
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.0 ft
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	0.00 ft/s
Upstream Velocity	0.00 ft/s
Normal Depth	0.2 ft
Critical Depth	0.2 ft
Channel Slope	0.048 ft/ft
Critical Slope	0.086 ft/ft

PL23-OUT34 (B-B) Post - 10yr

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Channel Slope	0.048 ft/ft
Discharge	0.64 cfs

Section Definitions

Station (ft)	Elevation (ft)
0+00	235.00
0+12	234.00
0+31	233.00
0+38	234.00
0+59	235.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 235.00)	(0+59, 235.00)	0.050

Options	
Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results	
Normal Depth	0.2 ft
Roughness Coefficient	0.050
Elevation	233.19 ft
Elevation Range	233.0 to 235.0 ft
Flow Area	0.5 ft²
Wetted Perimeter	4.9 ft
Hydraulic Radius	0.1 ft
Top Width	4.93 ft
Normal Depth	0.2 ft
Critical Depth	0.2 ft
Critical Slope	0.083 ft/ft
Velocity	1.36 ft/s
Velocity Head	0.03 ft
Specific Energy	0.22 ft
Froude Number	0.775
Flow Type	Subcritical

PL23-OUT34 (B-B) Post - 10yr

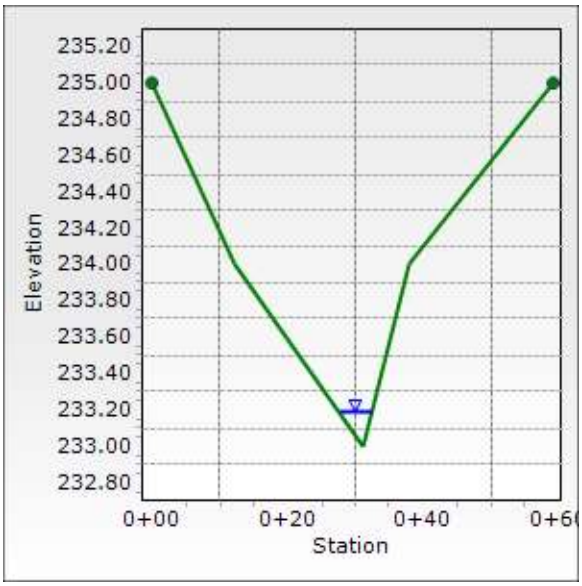
GVF Input Data	
Downstream Depth	0.0 ft
Length	0.0 ft
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.0 ft
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	0.00 ft/s
Upstream Velocity	0.00 ft/s
Normal Depth	0.2 ft
Critical Depth	0.2 ft
Channel Slope	0.048 ft/ft
Critical Slope	0.083 ft/ft

PL23-OUT34 (B-B) Post - 10yr

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Channel Slope	0.048 ft/ft
Normal Depth	0.2 ft
Discharge	0.64 cfs



Name of Project:	495-NEXT			Designed By:	JMON
State:	VA	**County:**	Fairfax County	Date:	11/19/21
Name of Culvert:	Post Development			Checked By:	NVD
NOAA Station:	Vienna Tysons 44-8737			Date:	11/19/21
LOCATION:	PL23-OUT 34 C-C				
				UNITS	**ENGLISH**

RATIONAL METHOD - DATA:

DRAINAGE BASIN

SUBSHED #	Land Use Description	Area Acres	C	C A
	Business: Industrial and Commercial (0.80-0.90)			
	Apartments and Townhomes (0.65-0.75)			
	Schools (0.50-0.60)		0.50	
	Residential - lots 10,000 sq. ft. (0.40-0.50)			
	- lots 12,000 sq. ft. (0.40-0.45)			
	- lots 17,000 sq. ft. (0.35-0.45)			
	- lots ½ acre or more (0.30-0.40)		0.35	
	Parks, Cemeteries and Unimproved Areas (0.20-0.35)			
	Paved and Roof Areas (0.90)	0.09	0.90	0.08
	Cultivated Areas (0.50-0.70)			
	Pasture (0.35-0.45)			
	Lawns (0.25-0.35)	0.14	0.30	0.04
	Forest (0.20-0.30)	0.48	0.25	0.12
	Steep Grass (2:1) (0.40-0.70)			
	Shoulder and Ditch Areas (0.35-0.50)			
	Totals =	**0.70 Acres**	**0.34**	**0.24**

Time of Concentration (Tc)

	Reach	Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Rational C		Tc (Minutes)
							Total Tc (Minutes) =	**5.00**

	2-Year	**5-Year**	**10-Year**	**25-Year**	**50-Year**	**100-Year**
Rainfall Intensity Inches / Hour.	**5.18**	**6.00**	**6.76**	**7.64**	**8.28**	**8.89**
Aosorption Coefficient / Ground Saturation Correction Coefficient Cf	1.00	1.00	1.00	1.10	1.20	1.25
Peak Discharge CFS.	**1.24**	**1.43**	**1.62**	**2.01**	**2.38**	**2.66**

PL23-OUT34 (C-C) Post - 2yr

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Channel Slope	0.026 ft/ft
Discharge	1.24 cfs

Section Definitions

Station (ft)	Elevation (ft)
0+00	234.00
0+11	233.00
0+21	232.00
0+32	233.00
0+61	234.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 234.00)	(0+61, 234.00)	0.050

Options	
Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results	
Normal Depth	0.3 ft
Roughness Coefficient	0.050
Elevation	232.30 ft
Elevation Range	232.0 to 234.0 ft
Flow Area	0.9 ft²
Wetted Perimeter	6.2 ft
Hydraulic Radius	0.1 ft
Top Width	6.20 ft
Normal Depth	0.3 ft
Critical Depth	0.2 ft
Critical Slope	0.074 ft/ft
Velocity	1.34 ft/s
Velocity Head	0.03 ft
Specific Energy	0.33 ft
Froude Number	0.614
Flow Type	Subcritical

PL23-OUT34 (C-C) Post - 2yr

GVF Input Data	
Downstream Depth	0.0 ft
Length	0.0 ft
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.0 ft
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	0.00 ft/s
Upstream Velocity	0.00 ft/s
Normal Depth	0.3 ft
Critical Depth	0.2 ft
Channel Slope	0.026 ft/ft
Critical Slope	0.074 ft/ft

PL23-OUT34 (C-C) Post - 10yr

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Channel Slope	0.026 ft/ft
Discharge	1.62 cfs

Section Definitions

Station (ft)	Elevation (ft)
0+00	234.00
0+11	233.00
0+21	232.00
0+32	233.00
0+61	234.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 234.00)	(0+61, 234.00)	0.050

Options	
Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results	
Normal Depth	0.3 ft
Roughness Coefficient	0.050
Elevation	232.33 ft
Elevation Range	232.0 to 234.0 ft
Flow Area	1.1 ft²
Wetted Perimeter	6.9 ft
Hydraulic Radius	0.2 ft
Top Width	6.85 ft
Normal Depth	0.3 ft
Critical Depth	0.3 ft
Critical Slope	0.071 ft/ft
Velocity	1.44 ft/s
Velocity Head	0.03 ft
Specific Energy	0.36 ft
Froude Number	0.624
Flow Type	Subcritical

PL23-OUT34 (C-C) Post - 10yr

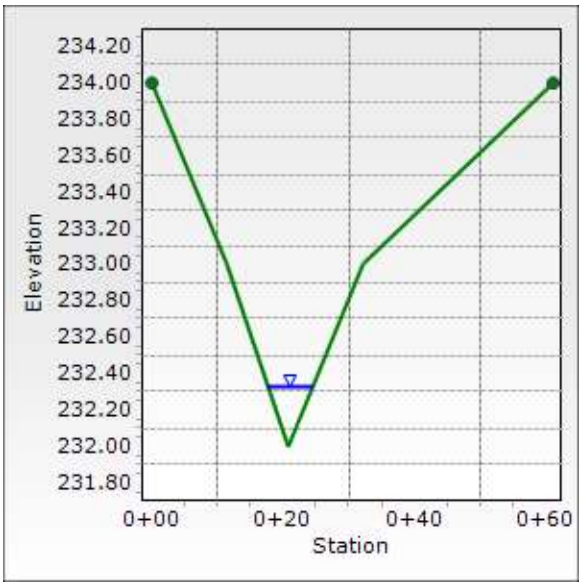
GVF Input Data	
Downstream Depth	0.0 ft
Length	0.0 ft
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.0 ft
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	0.00 ft/s
Upstream Velocity	0.00 ft/s
Normal Depth	0.3 ft
Critical Depth	0.3 ft
Channel Slope	0.026 ft/ft
Critical Slope	0.071 ft/ft

PL23-OUT34 (C-C) Post - 10yr

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Channel Slope	0.026 ft/ft
Normal Depth	0.3 ft
Discharge	1.62 cfs



APPENDIX C35
PL23-OUT35

Outfall PL23-OUT 35

Outfall PL23-OUT35 is an existing outfall at Live Oak Drive station 28+92 left. The outfall consists of a natural stormwater conveyance channel. In existing conditions, flow is conveyed through existing channels, culverts, storm sewer and sheet flow to the existing channel. The outfall prior to development is 169.00 acres.

Development of this area will result in an increased area to this outfall, due to the proposed grading and installation of a storm sewer system conveying drainage from adjacent outfalls to a proposed BMP (BMP-14). The resulting area to the outfall will be 179.49 acres.

Drainage Area:

The drainage areas and resulting changes are summarized in the table below:

PL23-OUT 35			
Drainage Area	**Total Area**	**RCN**	**Tc**
Existing 35A	59.90 ac	72.6	20.53 min
Existing 35B	65.17 ac	75.0	22.95 min
Existing 35C	36.87 ac	73.5	15.06 min
Existing 35D	7.06 ac	75.2	17.09 min
Prop. 35A	17.48 ac	69.9	21.04 min
Prop. 35B	92.63 ac	75.0	22.94 min
Prop. 35C - BMP-14	36.31 ac	91.3	14.67 min
Prop. 35C - Bypass	30.40 ac	72.3	14.29 min
Prop. 35D	2.67 ac	71.4	5.69 min

Limits of Study:

The location of the outfall is shown in the included outfall drainage map. The point of analysis is within the existing channel to the west of Live Oak Drive.

Easement Requirements:

No additional easements are required.

Outfall Discharge:

Discharges were calculated using Pondpack and are summarized below:

PL23-OUT 35		
Drainage Area	**Peak Flow Rate (Total)**	**Peak Flow Rate (Total)**
	2 Year	10 Year
Existing 35A	39.99 cfs	96.86 cfs
Existing 35B	48.77 cfs	111.05 cfs
Existing 35C	29.18 cfs	69.04 cfs
Existing 35D	5.97 cfs	13.49 cfs
Existing Combined	121.50 cfs	285.26 cfs
Prop. 35A	9.52 cfs	25.00 cfs
Prop. 35B	69.29 cfs	158.14 cfs
Prop. 35C - BMP-14	69.09 cfs	116.12 cfs
Prop. 35C - Bypass	22.64 cfs	55.15 cfs
Prop. 35C Combined	24.35 cfs	69.97 cfs
Prop. 35D	2.32 cfs	5.65 cfs
Proposed Combined	102.50 cfs	255.69 cfs
Net Change	**-19.00 cfs**	**-29.57 cfs**

Channel Description:

The channel at Outfall PL23-OUT 35 is a natural channel. Cross Sections were prepared utilizing topography prepared by Rinker Design Associates, P.C. and Fairfax County GIS.

Channel Protection:

Under Section 11.7.5.1 of the VDOT drainage manual, areas draining to a natural stormwater conveyance channel shall satisfy the channel protection criteria by providing conveyance of the 2 year storm without causing erosion of the system. Calculations have been provided below supporting the 2 year velocities in the system:

Cross Section	Channel Protection - 2 Year Velocity				Outfall Adequate?
	Channel Lining	Max Permissible Velocity (ft/s)	Existing Velocity (ft/s)	Proposed Velocity (ft/s)	
A-A	Glenelg Silt Loam	3.5	7.36	6.99	Yes
B-B	Glenelg Silt Loam	3.5	2.46	2.36	Yes
C-C	Glenelg Silt Loam	3.5	7.43	7.11	Yes

As the velocities anticipated are not within the allowable range for this soil type, a site design has been developed to cause the pre-development rate from the 2 year storm to not increase (per Section 11.7.5.1). As there is a net 19.00 cfs reduction for the 2 year storm, requirements for channel protection have been met for this outfall.

Flood Protection:

Under Section 11.7.5.2 of the VDOT drainage manual, areas draining to a natural stormwater conveyance channel shall satisfy the flood protection criteria by demonstrating

that the peak flow rate from a 10 year storm will be contained within the existing channel. The post developed flows to the channel have been analyzed and yield the following results:

Cross Section	Flood Protection - 10 Year Capacity		Outfall Adequate?
	Channel Depth (ft)	Normal Depth (ft)	
A-A	5.5	3.00	Yes
B-B	8.8	4.90	Yes
C-C	4.3	2.10	Yes

Internal Analysis

Drainage is conveyed to the outfall at PL23-OUT35 through a combination of storm sewer, culverts and ditches. As flow has been re-routed within the outfall through different conveyance channels, the main flow paths have been analyzed within this section.

The overall flows to the outfall have decreased, however, increased flow is anticipated through one of the main conveyance channels. The flow rates to the internal points of analysis are summarized below:

PL23-OUT35, Internal Analysis Points						
Analysis Point	Peak Flow Rate					
	2 Year			10 Year		
	Existing	Proposed	Net Change	Existing	Proposed	Net Change
PL23-OUT35A	39.99 cfs	9.52 cfs	-30.47	96.86 cfs	25.00 cfs	-71.86
PL23-OUT35B	48.77 cfs	69.29	20.52	111.05 cfs	158.14 cfs	47.09
PL23-OUT35C	29.18 cfs	24.35	-4.83	69.04 cfs	69.97 cfs	0.93
PL23-OUT35D	5.97 cfs	2.32	-3.65	13.49 cfs	5.65 cfs	-7.84

As shown above, PL23-OUT35A and D experience significant decreases in flow and are adequate as a site design has been developed to cause the pre-development rate from the 2-year and 10-year storm to not increase (per section 11.7.5.1 and 11.7.5.2 of the VDOT Drainage Manual). PL23-OUT35B and C have experienced significant increases in flow due to the proposed design. As the existing pipe is steel plate pipe, erosion concerns are not anticipated. Downstream outlet protection has been provided to combat the increased flow to this location. Pipe capacity has been assessed for the increased flow to the storm sewer system.

Pipe Run	50 Year Capacity		Outfall Adequate ?
	Max Pipe Discharge (cfs)	Pipe Discharge (cfs)	
PL23-OUT35B			
16-10 to 043	329.87	291.39	Yes
043 to 042	329.49	291.39	Yes
PL23-OUT35C			
17-22 to 041	218.96	201.93	Yes

As shown in the above table, the increased flow is completely contained within the existing pipes. As such, this internal analysis point is adequate.

Final Opinion:

This outfall is a natural stormwater conveyance system. We have shown compliance with the channel and flood protection criteria, by providing a proposed BMP facility that will reduce proposed velocities and flows below existing. It is therefore our opinion that this outfall is adequate.

Pre-Developed Outfall Map
PL23-35
I-495
Fairfax, VA

DRAINAGE AREA BOUNDARY

EXISTING CONTOURS

TIME OF CONCENTRATION

PL23-OUT 35
DA = 169.00 AC
RCN = 73.8

PL23-OUT 35A
DA = 59.90 AC
RCN = 72.6

PL23-OUT 35D
DA = 7.06 AC
RCN = 75.2

PL23-OUT 35B
DA = 65.17 AC
RCN = 75.0

PL23-OUT 35C
DA = 36.87 AC
RCN = 73.5

SCALE
0 375' 750'

Post-Developed Outfall Map
PL23-35
I-495
Fairfax, VA

DRAINAGE AREA BOUNDARY

EXISTING CONTOURS

TIME OF CONCENTRATION

PL23-OUT 35D
DA = 2.67 AC
RCN = 71.4

PL23-OUT 35
DA = 179.49 AC
RCN = 77.3

PL23-OUT 35A
DA = 17.48 AC
RCN = 69.9

PL23-OUT 35C Bypass
DA = 30.40 AC
RCN = 72.3

PL23-OUT 35B
DA = 92.63 AC
RCN = 75.0

PL23-OUT 35C - BMP-14
DA = 36.31 AC
RCN = 91.3

SCALE
0 375' 750'

Runoff Volume, Curve Number, and Time of Concentration Calculations
EXISTING OUTFALL PL23-OUT35A

Enter design storm rainfall depths (in):

1-year storm	2-year storm	10-year storm	25-year storm	100-year storm
2.62	3.17	4.87	6.09	8.41

Drainage Area Curve Numbers and Runoff Depths

Drainage Area		A Soils	B Soils	C Soils	D Soils
Forest/Open Space	Area (acres)	1.04	8.54	2.26	0.47
	CN	30	55	70	77
Managed Turf -- disturbed, graded for yards or other turf to be mowed/managed	Area (acres)	1.50	2.39	2.01	2.68
	CN	39	61	74	80
Impervious Cover	Area (acres)	0.00	0.00	0.00	17.91
	CN	98.00	98.00	98.00	98.00
Residential	Area (acres)	9.83	10.09	1.18	0.00
	CN	54	70	80	85
					$CN_{(D.A. A)}$
					72.6

Total Area (acres):	59.90

Time of Concentration (Tc)

Reach	Soil / Surface Type/Land Cover		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Rational C		Tc (Minutes)
Overland Flow (E.E. Seelye - VDOT Modified)									
	Soil / Surface Type/Land Cover		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Rational C		
	Residential	A-B	92.24	309.10	306.00	0.034	0.35		8.19
	Residential	B-C	103.83	306.00	290.00	0.154	0.35		6.45
Shallow Concentrated Flow			Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Intercept Coeff.		
Grassed Waterway		C-D	246.06	290.00	275.50	0.059	0.457		1.13
Pipe Flow			Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Existing Culvert (Assumed Information)		D-E	57.33	275.50	274.00	0.026	0.013	8.51	0.11
	Pipe Diameter (in) =		15	Area =	1.23		Wetted P =	3.93	
Channel Flow			Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Natural Channel		E-F	763.04	274.00	254.60	0.025	0.040	5.70	2.23
				Area =	12.00		Wetted P =	12.70	
Pipe Flow			Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Existing Culvert (Assumed Information)		F-G	73.80	254.60	250.00	0.062	0.013	9.61	0.13
	Pipe Diameter (in) =		15	Area =	1.23		Wetted P =	6.28	
Channel Flow			Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Natural Channel		G-H	226.67	250.00	243.00	0.031	0.040	6.29	0.60
				Area =	12.00		Wetted P =	12.70	
Pipe Flow			Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Ex 082 to 081		H-I	24.53	243.00	241.00	0.082	0.013	32.64	0.01
	Pipe Diameter (in) =		48	Area =	12.57		Wetted P =	12.57	
Channel Flow			Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Natural Channel		I-J	49.26	241.00	239.24	0.036	0.040	6.76	0.12
				Area =	12.00		Wetted P =	12.70	
Pipe Flow			Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Ex 074 to 066		J-K	581.63	239.24	220.12	0.033	0.013	24.05	0.40
	Pipe Diameter (in) =		60	Area =	19.63		Wetted P =	15.71	
Channel Flow			Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Natural Channel		K-L	33.72	220.12	218.00	0.063	0.040	8.97	0.06
				Area =	12.00		Wetted P =	12.70	
Channel Flow			Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Ditch		L-M	859.52	218.00	153.00	0.076	0.030	13.12	1.09
				Area =	12.00		Wetted P =	12.70	
								Total Tc (Minutes) =	**20.53**

Runoff Volume, Curve Number, and Time of Concentration Calculations
EXISTING OUTFALL PL23-OUT35B

Enter design storm rainfall depths (in):

1-year storm	2-year storm	10-year storm	25-year storm	100-year storm
2.62	3.17	4.87	6.09	8.41

Drainage Area Curve Numbers and Runoff Depths

Drainage Area		A Soils	B Soils	C Soils	D Soils
Forest/Open Space	Area (acres)	0.02	1.27	0.90	0.26
	CN	30	55	70	77
Managed Turf -- disturbed, graded for yards or other turf to be mowed/managed	Area (acres)	0.12	0.74	0.76	0.57
	CN	39	61	74	80
Impervious Cover	Area (acres)	0.00	0.00	0.00	3.91
	CN	98	98	98	98
Residential	Area (acres)	6.91	15.31	34.40	0.00
	CN	54	70	80	85
					$CN_{(D.A. A)}$
					75.0

Total Area (acres):	65.17

Time of Concentration (Tc)

Reach	Soil / Surface Type/Land Cover		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Rational C		Tc (Minutes)
Overland Flow (E.E. Seelye - VDOT Modified)									
	Soil / Surface Type/Land Cover		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Rational C		
	Residential	A-B	80.20	279.50	266.00	0.168	0.35		5.69
	Residential	B-C	67.30	266.00	264.00	0.030	0.35		7.35
	Residential	C-D	52.50	264.00	257.00	0.133	0.35		4.98
Shallow Concentrated Flow			Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Intercept Coeff.		
Short grass pasture		D-E	117.90	257.00	249.00	0.068	0.213		1.08
Pipe Flow			Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Existing Culvert (Assumed Information)		E-F	94.50	245.00	244.00	0.011	0.013	6.11	0.26
		Pipe Diameter (in) =	18	Area =	1.77		Wetted P =	4.71	
Channel Flow			Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Paved Channel		F-G	316.20	244.00	233.30	0.034	0.013	20.25	0.26
				Area =	12.00		Wetted P =	12.70	
Pipe Flow			Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Existing Storm Sewer (Assumed Information)		G-H	180.70	228.30	223.75	0.025	0.013	11.43	0.26
		Pipe Diameter (in) =	24	Area =	3.14		Wetted P =	6.28	
Channel Flow			Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Natural Channel		H-I	1177.10	223.75	178.32	0.039	0.040	7.03	2.79
				Area =	12.00		Wetted P =	12.70	
Pipe Flow			Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Ex 063 to 043		I-J	426.00	178.32	167.16	0.026	0.013	24.24	0.29
		Pipe Diameter (in) =	72	Area =	28.27		Wetted P =	18.85	
								Total Tc (Minutes) =	**22.95**

Runoff Volume, Curve Number, and Time of Concentration Calculations
EXISTING OUTFALL PL23-OUT35C

Enter design storm rainfall depths (in):

1-year storm	2-year storm	10-year storm	25-year storm	100-year storm
2.62	3.17	4.87	6.09	8.41

Drainage Area Curve Numbers and Runoff Depths

Drainage Area		A Soils	B Soils	C Soils	D Soils
Forest/Open Space	Area (acres)	0.00	4.56	5.03	0.10
	CN	30	55	70	77
Managed Turf -- disturbed, graded for yards or other turf to be mowed/managed	Area (acres)	0.00	0.48	1.13	0.70
	CN	39	61	74	80
Impervious Cover	Area (acres)	0.00	0.00	0.00	5.41
	CN	98	98	98	98
Residential	Area (acres)	0.00	15.69	3.77	0.00
	CN	54	70	80	85
					$CN_{(D.A. A)}$
					73.5

Total Area (acres):	36.87

Time of Concentration (Tc)								
Reach	Soil / Surface Type/Land Cover		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Rational C	Tc (Minutes)
Overland Flow (E.E. Seelye - VDOT Modified)								
	Soil / Surface Type/Land Cover		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Rational C	
	Residential	A-B	200.00	255.20	238.00	0.086	0.35	9.48
Shallow Concentrated Flow			Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Intercept Coeff.	
Short grass pasture		B-C	292.73	238.00	224.00	0.048	0.213	3.19
Channel Flow			Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS
Natural Channel		C-D	199.37	224.00	220.00	0.020	0.040	5.07
				Area =	12.00		Wetted P =	12.70
Pipe Flow			Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS
Existing Culvert (Assumed Information)		D-E	29.83	220.00	218.50	0.050	0.013	16.15
	Pipe Diameter (in) =		24	Area =	3.14		Wetted P =	6.28
Channel Flow			Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS
Natural Channel		E-F	309.17	218.50	186.18	0.105	0.040	11.57
				Area =	12.00		Wetted P =	12.70
Pipe Flow			Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS
Ex 036 to 039		F-G	436.25	186.18	172.79	0.031	0.013	23.24
	Pipe Diameter (in) =		60	Area =	19.63		Wetted P =	15.71
Channel Flow			Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS
Natural Channel		G-H	333.82	172.79	163.52	0.028	0.040	5.96
				Area =	12.00		Wetted P =	12.70
							Total Tc (Minutes) =	**15.06**

Runoff Volume, Curve Number, and Time of Concentration Calculations
EXISTING OUTFALL PL23-OUT35D

Enter design storm rainfall depths (in):

1-year storm	2-year storm	10-year storm	25-year storm	100-year storm
2.62	3.17	4.87	6.09	8.41

Drainage Area Curve Numbers and Runoff Depths

Drainage Area		A Soils	B Soils	C Soils	D Soils
Forest/Open Space	Area (acres)	0.00	3.10	0.28	0.53
	CN	30	55	70	77
Managed Turf -- disturbed, graded for yards or other turf to be mowed/managed	Area (acres)	0.00	0.04	0.00	0.39
	CN	39	61	74	80
Impervious Cover	Area (acres)	0.00	0.00	0.00	2.72
	CN	98	98	98	98
Residential	Area (acres)	0.00	0.00	0.00	0.00
	CN	54	70	80	85
					$CN_{(D.A. A)}$
					75.2

Total Area (acres): 7.06

Time of Concentration (Tc)								
Reach	Soil / Surface Type/Land Cover		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Rational C	Tc (Minutes)
Overland Flow (E.E. Seelye - VDOT Modified)								
	Soil / Surface Type/Land Cover		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Rational C	
	Forest	A-B	67.00	244.50	241.00	0.052	0.25	9.22
	Forest	B-C	52.92	241.00	222.00	0.359	0.25	5.79
Channel Flow			Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n' / Velocity FPS	
Roadside Ditch		C-D	555.72	222.00	210.30	0.021	0.030 / 6.92	1.34
				Area =	12.00		Wetted P = / 12.70	
Channel Flow			Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n' / Velocity FPS	
Paved Ditch		D-E	442.07	210.30	198.23	0.027	0.013 / 18.19	0.41
				Area =	12.00		Wetted P = / 12.70	
Pipe Flow			Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n' / Velocity FPS	
Ex 134 to 135		E-F	61.65	195.18	189.92	0.085	0.013 / 15.38	0.07
	Pipe Diameter (in) =		15	Area =	1.23		Wetted P = / 3.93	
Channel Flow			Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n' / Velocity FPS	
Riprap Channel		F-G	86.94	189.92	152.00	0.436	0.070 / 13.50	0.11
				Area =	12.00		Wetted P = / 12.70	
Channel Flow			Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n' / Velocity FPS	
Natural Channel		G-H	54.14	152.00	150.75	0.023	0.040 / 5.44	0.17
				Area =	12.00		Wetted P = / 12.70	
							Total Tc (Minutes) =	**17.09**

Runoff Volume, Curve Number, and Time of Concentration Calculations
Post Development, Controlled to PL23-OUT35C - BMP-14

Enter design storm rainfall depths (in):

1-year storm	2-year storm	10-year storm	25-year storm	100-year storm
2.62	3.17	4.87	6.09	8.41

Drainage Area Curve Numbers and Runoff Depths

Drainage Area		A Soils	B Soils	C Soils	D Soils
Forest/Open Space	Area (acres)	0.00	0.00	0.00	0.00
	CN	30	55	70	77
Managed Turf -- disturbed, graded for yards or other turf to be mowed/managed	Area (acres)	0.06	0.69	6.84	2.79
	CN	39	61	74	80
Impervious Cover	Area (acres)	0.00	0.00	0.00	25.93
	CN	98	98	98	98
Residential	Area (acres)	0.00	0.00	0.00	0.00
	CN	54	70	80	85
					$CN_{(D.A. A)}$
					91.3

Total Area (acres): 36.31

Time of Concentration (Tc)

Reach	Soil / Surface Type/Land Cover		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Rational C		Tc (Minutes)
Overland Flow (E.E. Seelye - VDOT Modified)									
	Soil / Surface Type/Land Cover		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Rational C		
	Lawns	A-B	106.68	326.44	317.00	0.088	0.30		8.45
Channel Flow			Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Natural Channel		B-C	73.18	317.00	308.00	0.123	0.050	10.04	0.12
				Area =	12.00		Wetted P =	12.70	
Channel Flow			Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Roadside Ditch		C-D	60.33	308.00	306.47	0.025	0.030	7.60	0.13
				Area =	12.00		Wetted P =	12.70	
Pipe Flow			Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
13-18 to 13-24		D-E	430.61	301.50	288.10	0.031	0.013	12.70	0.56
	Pipe Diameter (in) =		24	Area =	3.14		Wetted P =	6.28	
Pipe Flow			Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
13-24 to 13-27		E-F	290.00	288.10	282.90	0.018	0.013	12.64	0.38
	Pipe Diameter (in) =		36	Area =	7.07		Wetted P =	9.42	
Pipe Flow			Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
13-27 to 14-12		F-G	1664.28	282.90	262.40	0.012	0.013	11.61	2.39
	Pipe Diameter (in) =		42	Area =	9.62		Wetted P =	11.00	
Pipe Flow			Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
14-12 to 15-25		G-H	1136.68	262.40	241.07	0.019	0.013	15.66	1.20
	Pipe Diameter (in) =		48	Area =	12.57		Wetted P =	12.57	
Pipe Flow			Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
15-25 to SWM-14		H-I	1770.72	241.07	183.50	0.033	0.013	20.61	1.43
	Pipe Diameter (in) =		48	Area =	12.57		Wetted P =	12.57	
							Total Tc (Minutes) =		**14.67**

Runoff Volume, Curve Number, and Time of Concentration Calculations
Post Development, Uncontrolled to PL23-OUT35A

Enter design storm rainfall depths (in):

1-year storm	2-year storm	10-year storm	25-year storm	100-year storm
2.62	3.17	4.87	6.09	8.41

Drainage Area Curve Numbers and Runoff Depths

Drainage Area		A Soils	B Soils	C Soils	D Soils
Forest/Open Space	Area (acres)	0.50	5.39	0.11	0.00
	CN	30	55	70	77
Managed Turf -- disturbed, graded for yards or other turf to be mowed/managed	Area (acres)	1.61	1.64	0.00	0.48
	CN	39	61	74	80
Impervious Cover	Area (acres)	0.00	0.00	0.00	5.74
	CN	98	98	98	98
Residential	Area (acres)	0.10	1.91	0.00	0.00
	CN	54	70	80	85
					$CN_{(D.A. A)}$
					69.9

Total Area (acres): 17.48

Time of Concentration (Tc)

Reach	Soil / Surface Type/Land Cover		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Rational C		Tc (Minutes)
Overland Flow (E.E. Seelye - VDOT Modified)									
	Soil / Surface Type/Land Cover		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Rational C		
	Forest	A-B	200.00	325.00	307.50	0.088	0.25		13.23
Shallow Concentrated Flow			Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Intercept Coeff.		
Grassed waterway		B-C	228.17	307.50	295.00	0.055	0.457		1.08
Channel Flow			Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Paved Ditch		C-D	59.74	295.00	291.00	0.067	0.013	28.48	0.03
				Area =	12.00		Wetted P =	12.70	
Pipe Flow			Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
13-47 to 14-16		D-E	872.46	280.70	274.10	0.008	0.013	6.26	2.32
	Pipe Diameter (in) =		24	Area =	3.14		Wetted P =	6.28	
Pipe Flow			Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
14-16 to 15-32		E-F	837.39	274.10	263.50	0.013	0.013	8.10	1.72
	Pipe Diameter (in) =		30	Area =	3.14		Wetted P =	6.28	
Pipe Flow			Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
15-32 to 16-24		F-G	1116.86	263.50	220.75	0.038	0.013	14.09	1.32
	Pipe Diameter (in) =		36	Area =	3.14		Wetted P =	6.28	
Channel Flow			Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Paved Ditch		G-H	86.10	220.75	218.75	0.023	0.013	16.78	0.09
				Area =	12.00		Wetted P =	12.70	
Channel Flow			Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Ditch		H-I	774.43	218.75	153.00	0.085	0.040	10.42	1.24
				Area =	12.00		Wetted P =	12.70	
							Total Tc (Minutes) =		**21.04**

Runoff Volume, Curve Number, and Time of Concentration Calculations
Post Development, Uncontrolled to PL23-OUT35B

Enter design storm rainfall depths (in):

1-year storm	2-year storm	10-year storm	25-year storm	100-year storm
2.62	3.17	4.87	6.09	8.41

Drainage Area Curve Numbers and Runoff Depths

Drainage Area		A Soils	B Soils	C Soils	D Soils
Forest/Open Space	Area (acres)	0.00	0.00	0.00	0.00
	CN	30	55	70	77
Managed Turf -- disturbed, graded for yards or other turf to be mowed/managed	Area (acres)	0.58	1.75	2.97	2.29
	CN	39	61	74	80
Impervious Cover	Area (acres)	0.00	0.00	0.00	13.06
	CN	98	98	98	98
Residential	Area (acres)	15.75	21.71	34.53	0.00
	CN	54	70	80	85
					$CN_{(D.A. A)}$
					75.0

Total Area (acres): 92.63

Time of Concentration (Tc)

Reach	Soil / Surface Type/Land Cover		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Rational C		Tc (Minutes)
Overland Flow (E.E. Seelye - VDOT Modified)									
	Soil / Surface Type/Land Cover		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Rational C		
	Residential	A-B	80.20	279.50	266.00	0.168	0.35		5.69
	Residential	B-C	67.30	266.00	264.00	0.030	0.35		7.35
	Residential	C-D	52.50	264.00	257.00	0.133	0.35		4.98
Shallow Concentrated Flow			Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Intercept Coeff.		
Short grass pasture		D-E	117.90	257.00	249.00	0.068	0.213		1.08
Pipe Flow			Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Existing Culvert (Assumed Information)		E-F	94.50	245.00	244.00	0.011	0.013	6.11	0.26
		Pipe Diameter (in) =	18	Area =	1.77		Wetted P =	4.71	
Channel Flow			Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Paved Channel		F-G	316.20	244.00	233.30	0.034	0.013	20.25	0.26
				Area =	12.00		Wetted P =	12.70	
Pipe Flow			Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Existing Storm Sewer (Assumed Information)		G-H	180.70	228.30	223.75	0.025	0.013	11.43	0.26
		Pipe Diameter (in) =	24	Area =	3.14		Wetted P =	6.28	
Channel Flow			Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Natural channel		H-I	1167.24	223.75	178.52	0.039	0.040	7.04	2.76
				Area =	12.00		Wetted P =	12.70	
Pipe Flow			Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
16-10 to EX042		I-J	440.43	178.52	167.16	0.026	0.013	24.06	0.31
		Pipe Diameter (in) =	72	Area =	28.27		Wetted P =	18.85	
								Total Tc (Minutes) =	**22.94**

Runoff Volume, Curve Number, and Time of Concentration Calculations
Post Development, Controlled to PL23-OUT35C - Bypass

Enter design storm rainfall depths (in):

1-year storm	2-year storm	10-year storm	25-year storm	100-year storm
2.62	3.17	4.87	6.09	8.41

Drainage Area Curve Numbers and Runoff Depths

Drainage Area		A Soils	B Soils	C Soils	D Soils
Forest/Open Space	Area (acres)	0.00	0.60	0.00	0.00
	CN	30	55	70	77
Managed Turf -- disturbed, graded for yards or other turf to be mowed/managed	Area (acres)	0.11	4.62	0.36	0.23
	CN	39	61	74	80
Impervious Cover	Area (acres)	0.00	0.00	0.00	2.87
	CN	98	98	98	98
Residential	Area (acres)	0.34	16.72	4.55	0.00
	CN	54	70	80	85
					$CN_{(D.A. A)}$
					72.3

Total Area (acres): 30.40

Time of Concentration (Tc)								
Reach	Soil / Surface Type/Land Cover		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Rational C	Tc (Minutes)
Overland Flow (E.E. Seelye - VDOT Modified)								
	Soil / Surface Type/Land Cover		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Rational C	
	Residential	A-B	200.00	255.20	238.00	0.086	0.35	9.48
Shallow Concentrated Flow			Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Intercept Coeff.	
Short grass pasture		B-C	292.73	238.00	224.00	0.048	0.213	3.19
Channel Flow			Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS
Natural Channel		C-D	199.37	224.00	220.00	0.020	0.040	5.07	0.66
				Area =	12.00		Wetted P =	12.70	
Pipe Flow			Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS
Existing Culvert (Assumed Information)		D-E	29.83	220.00	218.50	0.050	0.013	16.15	0.03
	Pipe Diameter (in) =		24	Area =	3.14		Wetted P =	6.28	
Channel Flow			Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS
Natural Channel		E-F	183.67	218.50	194.00	0.133	0.040	13.06	0.23
				Area =	12.00		Wetted P =	12.70	
Pipe Flow			Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS
17L-03 to 17-22		F-G	971.49	194.00	163.77	0.031	0.013	23.40	0.69
	Pipe Diameter (in) =		60	Area =	19.63		Wetted P =	15.71	
							Total Tc (Minutes) =	**14.29**

Runoff Volume, Curve Number, and Time of Concentration Calculations
Post Development, Uncontrolled to PL23-OUT35D

Enter design storm rainfall depths (in):

1-year storm	2-year storm	10-year storm	25-year storm	100-year storm
2.62	3.17	4.87	6.09	8.41

Drainage Area Curve Numbers and Runoff Depths

Drainage Area		A Soils	B Soils	C Soils	D Soils
Forest/Open Space	Area (acres)	0.00	0.94	0.00	0.00
	CN	30	55	70	77
Managed Turf -- disturbed, graded for yards or other turf to be mowed/managed	Area (acres)	0.00	0.76	0.02	0.11
	CN	39	61	74	80
Impervious Cover	Area (acres)	0.00	0.00	0.00	0.84
	CN	98	98	98	98
Residential	Area (acres)	0.00	0.00	0.00	0.00
	CN	54	70	80	85
					$CN_{(D.A. A)}$
					71.4

Total Area (acres): 2.67

Time of Concentration (Tc)								
Reach	Soil / Surface Type/Land Cover		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Rational C	Tc (Minutes)
Overland Flow (E.E. Seelye - VDOT Modified)								
	Soil / Surface Type/Land Cover		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Rational C	
	Paved	A-B	154.83	242.70	232.75	0.064	0.90	3.50
Shallow Concentrated Flow			Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Intercept Coeff.	
Paved		B-C	536.38	232.75	200.65	0.060	0.619	1.80
Channel Flow			Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS
Riprap		C-D	10.35	200.65	199.00	0.159	0.070	8.16	0.02
				Area =	12.00		Wetted P =	12.70	
Channel Flow			Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS
Paved Ditch		D-E	10.55	199.00	198.23	0.073	0.070	5.52	0.03
				Area =	12.00		Wetted P =	12.70	
Pipe Flow			Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS
Ex 134 to 135		E-F	61.65	195.18	189.92	0.085	0.013	15.38	0.07
	Pipe Diameter (in) =		15	Area =	1.23		Wetted P =	3.93	
Channel Flow			Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS
Riprap Channel		F-G	86.94	189.92	152.00	0.436	0.070	13.50	0.11
				Area =	12.00		Wetted P =	12.70	
Channel Flow			Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS
Natural Channel		G-H	54.14	152.00	150.75	0.023	0.040	5.44	0.17
				Area =	12.00		Wetted P =	12.70	
							Total Tc (Minutes) =	**5.69**

BMP-14 - 2 YEAR ROUTING SUMMARY

Project Summary	
Title	BMP-14
Engineer	KELSIE ISON, P.E.
Company	RINKER DESIGN ASSOCIATES
Date	3/9/2022

Notes	BMP-14

REFER TO APPENDIX C OF THE STORMWATER MANAGEMENT REPORT FOR FULL ROUTING COMPUTATIONS

BMP-14 - 2 YEAR ROUTING SUMMARY

Subsection: Master Network Summary

Catchments Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (ft³)	Time to Peak (min)	Peak Flow (ft³/s)
BMP14 - INFLOW	2 Year	2	296,862.000	730.000	69.09
PL23-OUT35A Existing	2 Year	2	203,900.000	736.000	39.99
PL23-OUT35A UNC	2 Year	2	50,851.000	738.000	9.52
PL23-OUT35B Existing	2 Year	2	252,643.000	738.000	48.77
PL23-OUT35B UNC	2 Year	2	359,130.000	737.000	69.29
PL23-OUT35C Existing	2 Year	2	132,104.000	733.000	29.18
PL23-OUT35C UNC	2 Year	2	101,907.000	732.000	22.64
PL23-OUT35D Existing	2 Year	2	27,699.000	734.000	5.97
PL23-OUT35D UNC	2 Year	2	8,520.000	727.000	2.32

Node Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (ft³)	Time to Peak (min)	Peak Flow (ft³/s)
PL23-OUT35 Existing	2 Year	2	616,347.000	736.000	121.50
PL23-OUT35 Proposed	2 Year	2	657,429.000	737.000	102.50
PL23-OUT35C Combined	2 Year	2	239,090.000	732.000	24.35

Pond Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (ft³)	Time to Peak (min)	Peak Flow (ft³/s)	Maximum Water Surface Elevation (ft)	Maximum Pond Storage (ft³)
BMP14 (IN)	2 Year	2	296,862.000	730.000	69.09	(N/A)	(N/A)
BMP14 (OUT)	2 Year	2	137,183.000	835.000	5.93	181.73	182,587.000

BMP-14 - 10 YEAR ROUTING SUMMARY

Project Summary	
Title	BMP-14
Engineer	KELSIE ISON, P.E.
Company	RINKER DESIGN ASSOCIATES
Date	3/9/2022

Notes	BMP-14

REFER TO APPENDIX C OF THE STORMWATER MANAGEMENT REPORT FOR FULL ROUTING COMPUTATIONS

BMP-14 - 10 YEAR ROUTING SUMMARY

Subsection: Master Network Summary

Catchments Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (ft³)	Time to Peak (min)	Peak Flow (ft³/s)
BMP14 - INFLOW	10 Year	10	511,346.000	730.000	116.12
PL23-OUT35A Existing	10 Year	10	464,807.000	736.000	96.86
PL23-OUT35A UNC	10 Year	10	122,087.000	735.000	25.00
PL23-OUT35B Existing	10 Year	10	552,092.000	737.000	111.05
PL23-OUT35B UNC	10 Year	10	784,799.000	737.000	158.14
PL23-OUT35C Existing	10 Year	10	296,223.000	731.000	69.04
PL23-OUT35C UNC	10 Year	10	233,530.000	731.000	55.15
PL23-OUT35D Existing	10 Year	10	60,312.000	733.000	13.49
PL23-OUT35D UNC	10 Year	10	19,850.000	727.000	5.65

Node Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (ft³)	Time to Peak (min)	Peak Flow (ft³/s)
PL23-OUT35 Existing	10 Year	10	1,373,433.000	734.000	285.26
PL23-OUT35 Proposed	10 Year	10	1,499,164.000	737.000	255.69
PL23-OUT35C Combined	10 Year	10	572,616.000	738.000	69.97

Pond Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (ft³)	Time to Peak (min)	Peak Flow (ft³/s)	Maximum Water Surface Elevation (ft)	Maximum Pond Storage (ft³)
BMP14 (IN)	10 Year	10	511,346.000	730.000	116.12	(N/A)	(N/A)
BMP14 (OUT)	10 Year	10	339,085.000	756.000	36.33	183.66	250,060.000

Outfall PL23-OUT35 Section A-A, B-B, C- C: Looking Upstream

Outfall PL23-OUT35 Section A-A, B-B, C- C: Looking Downstream

Outfall PL23-OUT35A (Ex Concrete Channel): Looking Upstream

Outfall PL23-OUT35B (Ex Str 042): Looking Upstream

Outfall PL23-OUT35A/B: Looking Downstream

Outfall PL23-OUT35C (Ex Str 041): Looking Upstream

Outfall PL23-OUT35C: Looking Downstream

PL23-OUT35 Cross Sections
I-495 NEXT
Fairfax,VA

DRAINAGE AREA BOUNDARY

EXISTING CONTOURS

TIME OF CONCENTRATION

SCALE

0 40' 80'

SECTION C-C

SECTION B-B

SECTION A-A

NOTE:
* See PL23-OUT35 for full drainage divides.

Name of Project:	495-NEXT			Designed By:	JMON
State:	VA	**County:**	Fairfax County	Date:	03/09/22
Name of Culvert:	Pre Development			Checked By:	NVD
NOAA Station:	Vienna Tysons 44-8737			Date:	03/09/22
LOCATION:	PL23-OUT 35 A-A				
				UNITS	**ENGLISH**

RATIONAL METHOD - DATA:

DRAINAGE BASIN

SUBSHED #	Land Use Description	Area Acres	C	C A
	Business: Industrial and Commercial (0.80-0.90)			
	Apartments and Townhomes (0.65-0.75)			
	Schools (0.50-0.60)			
	Residential - lots 10,000 sq. ft. (0.40-0.50)			
	- lots 12,000 sq. ft. (0.40-0.45)			
	- lots 17,000 sq. ft. (0.35-0.45)			
	- lots ½ acre or more (0.30-0.40)	0.00	0.35	
	Parks, Cemeteries and Unimproved Areas (0.20-0.35)			
	Paved and Roof Areas (0.90)	0.00	0.90	
	Cultivated Areas (0.50-0.70)			
	Pasture (0.35-0.45)			
	Lawns (0.25-0.35)	0.00	0.30	
	Forest (0.20-0.30)	0.44	0.25	0.11
	Steep Grass (2:1) (0.40-0.70)			
	Shoulder and Ditch Areas (0.35-0.50)			
	Totals =	**0.44 Acres**	**0.25**	**0.11**

Time of Concentration (Tc)

Total Tc (Minutes) = 5.00

		2-Year	5-Year	10-Year	25-Year	50-Year	100-Year
Rainfall Intensity	Inches / Hour.	**5.18**	**6.00**	**6.76**	**7.64**	**8.28**	**8.89**
Aosorption Coefficient / Ground Saturation Correction Coefficient Cf		1.00	1.00	1.00	1.10	1.20	1.25
Peak Discharge	CFS.	**0.58**	**0.67**	**0.75**	**0.93**	**1.10**	**1.23**
Total Outfall Discharge	CFS.	**121.50**		**185.26**			
Total Discharge	CFS.	**122.08**		**186.01**			

Name of Project:	495-NEXT			Designed By:	JMON
State:	VA	**County:**	Fairfax County	Date:	03/09/22
Name of Culvert:	Post Development			Checked By:	NVD
NOAA Station:	Vienna Tysons 44-8737			Date:	03/09/22
LOCATION:	PL23-OUT 35 A-A				
				UNITS	**ENGLISH**

RATIONAL METHOD - DATA:

DRAINAGE BASIN

SUBSHED #	Land Use Description	Area Acres	C	C A
	Business: Industrial and Commercial (0.80-0.90)			
	Apartments and Townhomes (0.65-0.75)			
	Schools (0.50-0.60)			
	Residential - lots 10,000 sq. ft. (0.40-0.50)			
	- lots 12,000 sq. ft. (0.40-0.45)			
	- lots 17,000 sq. ft. (0.35-0.45)			
	- lots ½ acre or more (0.30-0.40)	0.00	0.35	
	Parks, Cemeteries and Unimproved Areas (0.20-0.35)			
	Paved and Roof Areas (0.90)	0.00	0.90	
	Cultivated Areas (0.50-0.70)			
	Pasture (0.35-0.45)			
	Lawns (0.25-0.35)	0.00	0.30	
	Forest (0.20-0.30)	0.44	0.25	0.11
	Steep Grass (2:1) (0.40-0.70)			
	Shoulder and Ditch Areas (0.35-0.50)			
	Totals =	**0.44 Acres**	**0.25**	**0.11**

Time of Concentration (Tc)

	Reach	Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Rational C		Tc (Minutes)
							Total Tc (Minutes) =	**5.00**

		2-Year	**5-Year**	**10-Year**	**25-Year**	**50-Year**	**100-Year**
Rainfall Intensity	Inches / Hour.	**5.18**	**6.00**	**6.76**	**7.64**	**8.28**	**8.89**
Aosorption Coefficient / Ground Saturation Correction Coefficient Cf		1.00	1.00	1.00	1.10	1.20	1.25
Peak Discharge	CFS.	**0.58**	**0.67**	**0.75**	**0.93**	**1.10**	**1.23**
Total Outfall Discharge	CFS.	**102.50**		**255.69**			
Total Discharge	CFS.	**103.08**		**256.44**			

PL23-OUT35 (A-A) Pre - 2yr

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Channel Slope	0.027 ft/ft
Discharge	122.08 cfs

Section Definitions

Station (ft)	Elevation (ft)
0+00	155.00
0+02	154.00
0+03	153.00
0+04	152.00
0+05	151.00
0+06	150.00
0+09	149.50
0+13	150.00
0+15	151.00
0+16	152.00
0+17	153.00
0+19	154.00
0+25	155.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 155.00)	(0+25, 155.00)	0.040

Options	
Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results	
Normal Depth	2.1 ft
Roughness Coefficient	0.040
Elevation	151.56 ft
Elevation Range	149.5 to 155.0 ft
Flow Area	16.6 ft²
Wetted Perimeter	12.5 ft
Hydraulic Radius	1.3 ft
Top Width	11.34 ft

PL23-OUT35 (A-A) Pre - 2yr

Results	
Normal Depth	2.1 ft
Critical Depth	2.1 ft
Critical Slope	0.023 ft/ft
Velocity	7.36 ft/s
Velocity Head	0.84 ft
Specific Energy	2.90 ft
Froude Number	1.073
Flow Type	Supercritical

GVF Input Data	
Downstream Depth	0.0 ft
Length	0.0 ft
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.0 ft
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	2.1 ft
Critical Depth	2.1 ft
Channel Slope	0.027 ft/ft
Critical Slope	0.023 ft/ft

PL23-OUT35 (A-A) Post - 2yr

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Channel Slope	0.027 ft/ft
Discharge	103.08 cfs

Section Definitions

Station (ft)	Elevation (ft)
0+00	155.00
0+02	154.00
0+03	153.00
0+04	152.00
0+05	151.00
0+06	150.00
0+09	149.50
0+13	150.00
0+15	151.00
0+16	152.00
0+17	153.00
0+19	154.00
0+25	155.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 155.00)	(0+25, 155.00)	0.040

Options	
Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results	
Normal Depth	1.9 ft
Roughness Coefficient	0.040
Elevation	151.40 ft
Elevation Range	149.5 to 155.0 ft
Flow Area	14.8 ft²
Wetted Perimeter	12.0 ft
Hydraulic Radius	1.2 ft
Top Width	10.99 ft

PL23-OUT35 (A-A) Post - 2yr

Results	
Normal Depth	1.9 ft
Critical Depth	2.0 ft
Critical Slope	0.024 ft/ft
Velocity	6.99 ft/s
Velocity Head	0.76 ft
Specific Energy	2.65 ft
Froude Number	1.063
Flow Type	Supercritical

GVF Input Data	
Downstream Depth	0.0 ft
Length	0.0 ft
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.0 ft
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	1.9 ft
Critical Depth	2.0 ft
Channel Slope	0.027 ft/ft
Critical Slope	0.024 ft/ft

PL23-OUT35 (A-A) Post - 10yr

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Channel Slope	0.027 ft/ft
Discharge	256.44 cfs

Section Definitions

Station (ft)	Elevation (ft)
0+00	155.00
0+02	154.00
0+03	153.00
0+04	152.00
0+05	151.00
0+06	150.00
0+09	149.50
0+13	150.00
0+15	151.00
0+16	152.00
0+17	153.00
0+19	154.00
0+25	155.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 155.00)	(0+25, 155.00)	0.040

Options	
Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results	
Normal Depth	3.0 ft
Roughness Coefficient	0.040
Elevation	152.49 ft
Elevation Range	149.5 to 155.0 ft
Flow Area	28.0 ft²
Wetted Perimeter	15.2 ft
Hydraulic Radius	1.8 ft
Top Width	13.25 ft

PL23-OUT35 (A-A) Post - 10yr

Results	
Normal Depth	3.0 ft
Critical Depth	3.2 ft
Critical Slope	0.022 ft/ft
Velocity	9.17 ft/s
Velocity Head	1.31 ft
Specific Energy	4.29 ft
Froude Number	1.112
Flow Type	Supercritical

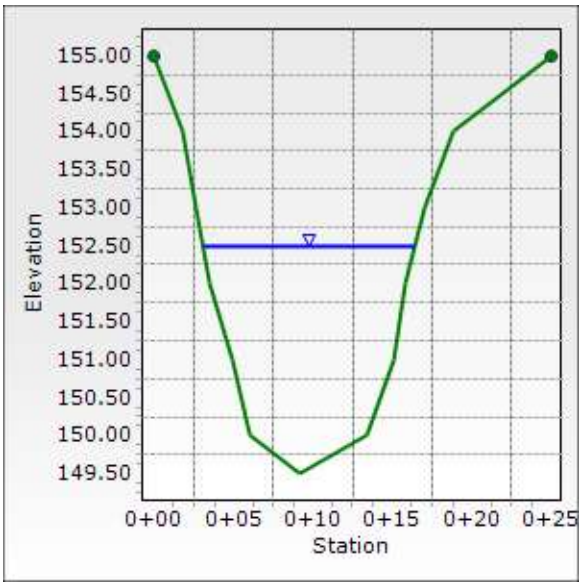
GVF Input Data	
Downstream Depth	0.0 ft
Length	0.0 ft
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.0 ft
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	3.0 ft
Critical Depth	3.2 ft
Channel Slope	0.027 ft/ft
Critical Slope	0.022 ft/ft

PL23-OUT35 (A-A) Post - 10yr

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Channel Slope	0.027 ft/ft
Normal Depth	3.0 ft
Discharge	256.44 cfs



Name of Project:	495-NEXT			Designed By:	JMON
State:	VA	**County:**	Fairfax County	Date:	03/09/22
Name of Culvert:	Pre Development			Checked By:	NVD
NOAA Station:	Vienna Tysons 44-8737			Date:	03/09/22
LOCATION:	PL23-OUT 35 B-B				
				UNITS	**ENGLISH**

RATIONAL METHOD - DATA:

DRAINAGE BASIN

SUBSHED #	Land Use Description	Area Acres	C	C A
	Business: Industrial and Commercial (0.80-0.90)			
	Apartments and Townhomes (0.65-0.75)			
	Schools (0.50-0.60)			
	Residential - lots 10,000 sq. ft. (0.40-0.50)			
	- lots 12,000 sq. ft. (0.40-0.45)			
	- lots 17,000 sq. ft. (0.35-0.45)			
	- lots ½ acre or more (0.30-0.40)	0.00	0.35	
	Parks, Cemeteries and Unimproved Areas (0.20-0.35)			
	Paved and Roof Areas (0.90)	0.00	0.90	
	Cultivated Areas (0.50-0.70)			
	Pasture (0.35-0.45)			
	Lawns (0.25-0.35)	0.00	0.30	
	Forest (0.20-0.30)	1.09	0.25	0.27
	Steep Grass (2:1) (0.40-0.70)			
	Shoulder and Ditch Areas (0.35-0.50)			
	Totals =	**1.09 Acres**	**0.25**	**0.27**

Time of Concentration (Tc)

Total Tc (Minutes) = 5.00

		2-Year	5-Year	10-Year	25-Year	50-Year	100-Year
Rainfall Intensity	Inches / Hour.	**5.18**	**6.00**	**6.76**	**7.64**	**8.28**	**8.89**
Aosorption Coefficient / Ground Saturation Correction Coefficient Cf		1.00	1.00	1.00	1.10	1.20	1.25
Peak Discharge	CFS.	**1.41**	**1.63**	**1.84**	**2.29**	**2.71**	**3.03**
Total Outfall Discharge	CFS.	**121.50**		**185.26**			
Total Discharge	CFS.	**122.91**		**187.10**			

Name of Project:	495-NEXT			Designed By:	JMON
State:	VA	**County:**	Fairfax County	Date:	03/09/22
Name of Culvert:	Post Development			Checked By:	NVD
NOAA Station:	Vienna Tysons 44-8737			Date:	03/09/22
LOCATION:	PL23-OUT 35 B-B				
				UNITS	**ENGLISH**

RATIONAL METHOD - DATA:

DRAINAGE BASIN

SUBSHED #	Land Use Description	Area Acres	C	C A
	Business: Industrial and Commercial (0.80-0.90)			
	Apartments and Townhomes (0.65-0.75)			
	Schools (0.50-0.60)			
	Residential - lots 10,000 sq. ft. (0.40-0.50)			
	- lots 12,000 sq. ft. (0.40-0.45)			
	- lots 17,000 sq. ft. (0.35-0.45)			
	- lots ½ acre or more (0.30-0.40)	0.00	0.35	
	Parks, Cemeteries and Unimproved Areas (0.20-0.35)			
	Paved and Roof Areas (0.90)	0.00	0.90	
	Cultivated Areas (0.50-0.70)			
	Pasture (0.35-0.45)			
	Lawns (0.25-0.35)	0.00	0.30	
	Forest (0.20-0.30)	1.09	0.25	0.27
	Steep Grass (2:1) (0.40-0.70)			
	Shoulder and Ditch Areas (0.35-0.50)			
	Totals =	**1.09 Acres**	**0.25**	**0.27**

Time of Concentration (Tc)

	Reach	Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Rational C		Tc (Minutes)
							Total Tc (Minutes) =	**5.00**

		2-Year	**5-Year**	**10-Year**	**25-Year**	**50-Year**	**100-Year**
Rainfall Intensity	Inches / Hour.	**5.18**	**6.00**	**6.76**	**7.64**	**8.28**	**8.89**
Aosorption Coefficient / Ground Saturation Correction Coefficient Cf		1.00	1.00	1.00	1.10	1.20	1.25
Peak Discharge	CFS.	**1.41**	**1.63**	**1.84**	**2.29**	**2.71**	**3.03**
Total Outfall Discharge	CFS.	**102.50**		**255.69**			
Total Discharge	CFS.	**103.91**		**257.53**			

PL23-OUT35 (B-B) Pre - 2yr

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Channel Slope	0.002 ft/ft
Discharge	122.91 cfs

Section Definitions

Station (ft)	Elevation (ft)
0+00	158.00
0+10	156.00
0+18	154.00
0+35	149.25
0+52	154.00
0+56	156.00
0+64	158.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 158.00)	(0+64, 158.00)	0.040

Options	
Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results	
Normal Depth	3.7 ft
Roughness Coefficient	0.040
Elevation	152.99 ft
Elevation Range	149.3 to 158.0 ft
Flow Area	50.0 ft²
Wetted Perimeter	27.8 ft
Hydraulic Radius	1.8 ft
Top Width	26.73 ft
Normal Depth	3.7 ft
Critical Depth	2.4 ft
Critical Slope	0.023 ft/ft
Velocity	2.46 ft/s
Velocity Head	0.09 ft
Specific Energy	3.83 ft

PL23-OUT35 (B-B) Pre - 2yr

Results	
Froude Number	0.317
Flow Type	Subcritical

GVF Input Data	
Downstream Depth	0.0 ft
Length	0.0 ft
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.0 ft
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	0.00 ft/s
Upstream Velocity	0.00 ft/s
Normal Depth	3.7 ft
Critical Depth	2.4 ft
Channel Slope	0.002 ft/ft
Critical Slope	0.023 ft/ft

PL23-OUT35 (B-B) Post - 2yr

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Channel Slope	0.002 ft/ft
Discharge	103.91 cfs

Section Definitions

Station (ft)	Elevation (ft)
0+00	158.00
0+10	156.00
0+18	154.00
0+35	149.25
0+52	154.00
0+56	156.00
0+64	158.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 158.00)	(0+64, 158.00)	0.040

Options	
Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results	
Normal Depth	3.5 ft
Roughness Coefficient	0.040
Elevation	152.76 ft
Elevation Range	149.3 to 158.0 ft
Flow Area	44.1 ft²
Wetted Perimeter	26.1 ft
Hydraulic Radius	1.7 ft
Top Width	25.10 ft
Normal Depth	3.5 ft
Critical Depth	2.2 ft
Critical Slope	0.024 ft/ft
Velocity	2.36 ft/s
Velocity Head	0.09 ft
Specific Energy	3.60 ft

PL23-OUT35 (B-B) Post - 2yr

Results	
Froude Number	0.314
Flow Type	Subcritical

GVF Input Data	
Downstream Depth	0.0 ft
Length	0.0 ft
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.0 ft
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	0.00 ft/s
Upstream Velocity	0.00 ft/s
Normal Depth	3.5 ft
Critical Depth	2.2 ft
Channel Slope	0.002 ft/ft
Critical Slope	0.024 ft/ft

PL23-OUT35 (B-B) Post - 10yr

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Channel Slope	0.002 ft/ft
Discharge	257.53 cfs

Section Definitions

Station (ft)	Elevation (ft)
0+00	158.00
0+10	156.00
0+18	154.00
0+35	149.25
0+52	154.00
0+56	156.00
0+64	158.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 158.00)	(0+64, 158.00)	0.040

Options	
Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results	
Normal Depth	4.9 ft
Roughness Coefficient	0.040
Elevation	154.18 ft
Elevation Range	149.3 to 158.0 ft
Flow Area	86.8 ft²
Wetted Perimeter	36.4 ft
Hydraulic Radius	2.4 ft
Top Width	35.02 ft
Normal Depth	4.9 ft
Critical Depth	3.2 ft
Critical Slope	0.021 ft/ft
Velocity	2.97 ft/s
Velocity Head	0.14 ft
Specific Energy	5.07 ft

PL23-OUT35 (B-B) Post - 10yr

Results	
Froude Number	0.332
Flow Type	Subcritical

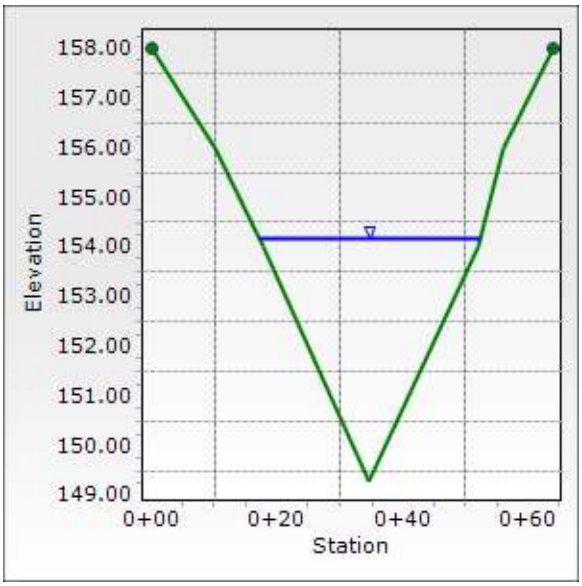
GVF Input Data	
Downstream Depth	0.0 ft
Length	0.0 ft
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.0 ft
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	0.00 ft/s
Upstream Velocity	0.00 ft/s
Normal Depth	4.9 ft
Critical Depth	3.2 ft
Channel Slope	0.002 ft/ft
Critical Slope	0.021 ft/ft

PL23-OUT35 (B-B) Post - 10yr

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Channel Slope	0.002 ft/ft
Normal Depth	4.9 ft
Discharge	257.53 cfs



Name of Project:	495-NEXT			Designed By:	JMON
State:	VA	**County:**	Fairfax County	Date:	03/09/22
Name of Culvert:	Pre Development			Checked By:	NVD
NOAA Station:	Vienna Tysons 44-8737			Date:	03/09/22
LOCATION:	PL23-OUT 35 C-C				
				UNITS	**ENGLISH**

RATIONAL METHOD - DATA:

DRAINAGE BASIN

SUBSHED #	Land Use Description	Area Acres	C	C A
	Business: Industrial and Commercial (0.80-0.90)			
	Apartments and Townhomes (0.65-0.75)			
	Schools (0.50-0.60)			
	Residential - lots 10,000 sq. ft. (0.40-0.50)			
	- lots 12,000 sq. ft. (0.40-0.45)			
	- lots 17,000 sq. ft. (0.35-0.45)			
	- lots ½ acre or more (0.30-0.40)	0.00	0.35	
	Parks, Cemeteries and Unimproved Areas (0.20-0.35)			
	Paved and Roof Areas (0.90)	0.00	0.90	
	Cultivated Areas (0.50-0.70)			
	Pasture (0.35-0.45)			
	Lawns (0.25-0.35)	0.00	0.30	
	Forest (0.20-0.30)	1.42	0.25	0.36
	Steep Grass (2:1) (0.40-0.70)			
	Shoulder and Ditch Areas (0.35-0.50)			
	Totals =	**1.42 Acres**	**0.25**	**0.36**

Time of Concentration (Tc)

Total Tc (Minutes) = 5.00

		2-Year	5-Year	10-Year	25-Year	50-Year	100-Year
Rainfall Intensity	Inches / Hour.	**5.18**	**6.00**	**6.76**	**7.64**	**8.28**	**8.89**
Aosorption Coefficient / Ground Saturation Correction Coefficient Cf		1.00	1.00	1.00	1.10	1.20	1.25
Peak Discharge	CFS.	**1.84**	**2.13**	**2.40**	**2.99**	**3.53**	**3.95**
Total Outfall Discharge	CFS.	**121.50**		**185.26**			
Total Discharge	CFS.	**123.34**		**187.66**			

Name of Project:	495-NEXT			Designed By:	JMON
State:	VA	**County:**	Fairfax County	Date:	03/09/22
Name of Culvert:	Post Development			Checked By:	NVD
NOAA Station:	Vienna Tysons 44-8737			Date:	03/09/22
LOCATION:	PL23-OUT 35 C-C				
				UNITS	**ENGLISH**

RATIONAL METHOD - DATA:

DRAINAGE BASIN

SUBSHED #	Land Use Description	Area Acres	C	C A
	Business: Industrial and Commercial (0.80-0.90)			
	Apartments and Townhomes (0.65-0.75)			
	Schools (0.50-0.60)			
	Residential - lots 10,000 sq. ft. (0.40-0.50)			
	- lots 12,000 sq. ft. (0.40-0.45)			
	- lots 17,000 sq. ft. (0.35-0.45)			
	- lots ½ acre or more (0.30-0.40)	0.00	0.35	
	Parks, Cemeteries and Unimproved Areas (0.20-0.35)			
	Paved and Roof Areas (0.90)	0.00	0.90	
	Cultivated Areas (0.50-0.70)			
	Pasture (0.35-0.45)			
	Lawns (0.25-0.35)	0.00	0.30	
	Forest (0.20-0.30)	1.42	0.25	0.36
	Steep Grass (2:1) (0.40-0.70)			
	Shoulder and Ditch Areas (0.35-0.50)			
	Totals =	**1.42 Acres**	**0.25**	**0.36**

Time of Concentration (Tc)

	Reach	Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Rational C		Tc (Minutes)
							Total Tc (Minutes) =	**5.00**

		2-Year	**5-Year**	**10-Year**	**25-Year**	**50-Year**	**100-Year**
Rainfall Intensity	Inches / Hour.	**5.18**	**6.00**	**6.76**	**7.64**	**8.28**	**8.89**
Aosorption Coefficient / Ground Saturation Correction Coefficient Cf		1.00	1.00	1.00	1.10	1.20	1.25
Peak Discharge	CFS.	**1.84**	**2.13**	**2.40**	**2.99**	**3.53**	**3.95**
Total Outfall Discharge	CFS.	**102.50**		**255.69**			
Total Discharge	CFS.	**104.34**		**258.09**			

PL23-OUT35 (C-C) Pre - 2yr

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Channel Slope	0.047 ft/ft
Discharge	123.34 cfs

Section Definitions

Station (ft)	Elevation (ft)
0+00	146.00
0+02	144.00
0+03	142.00
0+09	140.00
0+12	139.74
0+15	140.00
0+28	142.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 146.00)	(0+28, 142.00)	0.040

Options	
Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results	
Normal Depth	1.5 ft
Roughness Coefficient	0.040
Elevation	141.29 ft
Elevation Range	139.7 to 146.0 ft
Flow Area	16.6 ft²
Wetted Perimeter	18.7 ft
Hydraulic Radius	0.9 ft
Top Width	18.40 ft
Normal Depth	1.5 ft
Critical Depth	1.8 ft
Critical Slope	0.024 ft/ft
Velocity	7.43 ft/s
Velocity Head	0.86 ft
Specific Energy	2.40 ft

PL23-OUT35 (C-C) Pre - 2yr

Results	
Froude Number	1.379
Flow Type	Supercritical

GVF Input Data	
Downstream Depth	0.0 ft
Length	0.0 ft
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.0 ft
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	1.5 ft
Critical Depth	1.8 ft
Channel Slope	0.047 ft/ft
Critical Slope	0.024 ft/ft

PL23-OUT35 (C-C) Post - 2yr

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Channel Slope	0.047 ft/ft
Discharge	104.34 cfs

Section Definitions

Station (ft)	Elevation (ft)
0+00	146.00
0+02	144.00
0+03	142.00
0+09	140.00
0+12	139.74
0+15	140.00
0+28	142.00
0+30	144.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 146.00)	(0+30, 144.00)	0.040

Options	
Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results	
Normal Depth	1.4 ft
Roughness Coefficient	0.040
Elevation	141.18 ft
Elevation Range	139.7 to 146.0 ft
Flow Area	14.7 ft²
Wetted Perimeter	17.7 ft
Hydraulic Radius	0.8 ft
Top Width	17.37 ft
Normal Depth	1.4 ft
Critical Depth	1.7 ft
Critical Slope	0.024 ft/ft
Velocity	7.11 ft/s
Velocity Head	0.79 ft

PL23-OUT35 (C-C) Post - 2yr

Results	
Specific Energy	2.22 ft
Froude Number	1.364
Flow Type	Supercritical

GVF Input Data	
Downstream Depth	0.0 ft
Length	0.0 ft
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.0 ft
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	1.4 ft
Critical Depth	1.7 ft
Channel Slope	0.047 ft/ft
Critical Slope	0.024 ft/ft

PL23-OUT35 (C-C) Post - 10yr

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Channel Slope	0.047 ft/ft
Discharge	258.09 cfs

Section Definitions

Station (ft)	Elevation (ft)
0+00	146.00
0+02	144.00
0+03	142.00
0+09	140.00
0+12	139.74
0+15	140.00
0+28	142.00
0+30	144.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 146.00)	(0+30, 144.00)	0.040

Options	
Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results	
Normal Depth	2.1 ft
Roughness Coefficient	0.040
Elevation	141.86 ft
Elevation Range	139.7 to 146.0 ft
Flow Area	28.7 ft²
Wetted Perimeter	24.3 ft
Hydraulic Radius	1.2 ft
Top Width	23.84 ft
Normal Depth	2.1 ft
Critical Depth	2.5 ft
Critical Slope	0.021 ft/ft
Velocity	9.00 ft/s
Velocity Head	1.26 ft

PL23-OUT35 (C-C) Post - 10yr

Results	
Specific Energy	3.38 ft
Froude Number	1.446
Flow Type	Supercritical

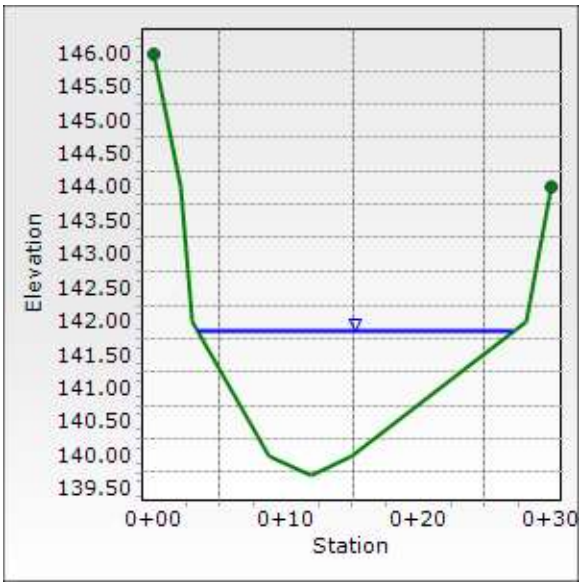
GVF Input Data	
Downstream Depth	0.0 ft
Length	0.0 ft
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.0 ft
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	2.1 ft
Critical Depth	2.5 ft
Channel Slope	0.047 ft/ft
Critical Slope	0.021 ft/ft

PL23-OUT35 (C-C) Post - 10yr

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Channel Slope	0.047 ft/ft
Normal Depth	2.1 ft
Discharge	258.09 cfs



INTERNAL ANALYSIS

LD-229
STORM SEWER DESIGN COMPUTATIONS

PROJECT: 495 NEXT
LOCATION:
COUNTY: Vienna Tysons Corner

Designed by: JMON
Checked by: NVD

STORM FREQUENCY **50**

UNITS **ENGLISH**

PIPE NO.	FROM POINT		TO POINT		DRAIN. AREA "A" Acre	RUNOFF COEFF. "C"	CA INCRE-MENT	CA ACCUM-ULATED	INLET TIME Minutes	RAIN FALL In/Hr	RUNOFF Lateral CFS	RUNOFF Total Q CFS	INVERT ELEVATIONS UPPER END	INVERT ELEVATIONS LOWER END	LENGTH of Pipe Ft.	SLOPE Ft./Ft.	SIZE (Dia. Or Span/Rise) In.	SHAPE	Number of Pipes	Capacity CFS	Friction Slope Ft./Ft.	NORMAL FLOW Depth of Flow, dn Ft.	NORMAL FLOW Area of Flow, An SqFt	NORMAL FLOW Hrn Ft.	NORMAL FLOW Vn Ft/Sec	NORMAL FLOW En Ft.	FLOW TIME INCRE-MENT Minutes	FLOW TIME ACCUMU-LATED Minutes	REMARKS
	REFERENCE	STA.	REFERENCE	STA.																									
	(1)		(2)		(3)	(4)	(5)	(6)	(7)	(8)		(9)	(10)	(11)	(12)	(13)	(14)			(15)								(17)	(17)	(18)
1610~X043	16-10	42+62.53	X043	291+09.08	-	-	-	-	-	-	-	291.39	178.52	167.11	435.97	0.02617	72	Circular	1	329.87	0.02110	4.38	22.12	1.80	13.17	7.08	0.55	5.55	
1716~1718	17-16	16+90	17-18	19+25	-	-	-	-	-	-	-	105.56	172.11	171.02	183.94	0.00593	60	Circular	1	200.56	0.00170	2.58	10.20	1.27	10.35	4.24	0.30	5.94	
1718~1719	17-18	19+25	17-19	21+66	-	-	-	-	-	-	-	105.56	170.92	170.32	101.89	0.00589	60	Circular	1	199.88	0.00170	2.58	10.23	1.28	10.32	4.24	0.17	6.11	
1719~17-22	17-19	21+66	17-22	24+20	-	-	-	-	-	-	-	105.56	170.22	169.62	112.91	0.00531	60	Circular	1	189.78	0.00170	2.66	10.64	1.30	9.92	4.19	0.19	6.30	
1722~E041	17-22	24+20	X041	29+06	-	-	-	-	-	-	-	201.93	163.77	151.44	404.34	0.03049	60	Circular	1	218.96	0.02680	3.79	15.96	1.51	12.66	6.27	0.53	6.83	
17L3~17L5	17L-03	52+85	17L-05	12+67	-	-	-	-	-	-	-	105.56	194.00	193.10	11.57	0.07779	60	Circular	1	349.75	0.00730	1.88	6.77	1.02	15.60	5.66	0.01	5.01	
17L5~1716	17L-05	12+67	17-16	16+90	-	-	-	-	-	-	-	105.56	185.11	172.21	422.27	0.03055	60	Circular	1	219.18	0.00730	2.45	9.55	1.23	11.06	4.34	0.64	5.65	
X043~X042	X043	291+11.55	X042	28+56.85	-	-	-	-	-	-	-	291.39	167.11	150.90	620.87	0.02611	72	Circular	1	329.49	0.02110	4.39	22.15	1.80	13.16	7.07	0.79	6.34	

Note: Computations above are based on the results obtained through the PondPack routing of PL23-OUT35. Due to the size of the drainage area, this outfall has been computed using the SCS Method. Local drainage computations will continue to be computed utilizing the Rational Method, as such discrepancies between flows may occur.

LD-229
STORM SEWER DESIGN COMPUTATIONS

PROJECT: 495 NEXT
LOCATION:
COUNTY: Vienna Tysons Corner

Designed by: JMON
Checked by: NVD

STORM FREQUENCY **100**

UNITS **ENGLISH**

PIPE NO.	FROM POINT REFERENCE (1)	FROM POINT STA. (1)	TO POINT REFERENCE (2)	TO POINT STA. (2)	DRAIN. AREA "A" Acre (3)	RUNOFF COEFF. "C" (4)	CA INCRE-MENT (5)	CA ACCUM-ULATED (6)	INLET TIME Minutes (7)	RAIN FALL In/Hr (8)	RUNOFF Lateral CFS	RUNOFF Total Q CFS (9)	INVERT ELEVATIONS UPPER END (10)	INVERT ELEVATIONS LOWER END (11)	LENGTH of Pipe Ft. (12)	SLOPE Ft./Ft. (13)	SIZE (Dia. Or Span/Rise) In. (14)	SHAPE	Number of Pipes	Capacity CFS (15)	Friction Slope Ft./Ft.	NORMAL FLOW Depth of Flow, dn Ft.	NORMAL FLOW Area of Flow, An SqFt	NORMAL FLOW Hrn Ft.	NORMAL FLOW Vn Ft/Sec (16)	NORMAL FLOW En Ft.	FLOW TIME INCRE-MENT Minutes (17)	FLOW TIME ACCUMU-LATED Minutes (17)	REMARKS (18)
1610~X043	16-10	42+62.53	X043	291+09.08	-	-	-	-	-	-	-	364.55	178.52	167.11	435.97	0.02617	72	Circular	1	329.87	0.03300	6.00	28.27	1.50	12.89	8.58	0.56	5.56	Pressure Flow
1716~1718	17-16	16+90	17-18	19+25	-	-	-	-	-	-	-	133.72	172.11	171.02	183.94	0.00593	60	Circular	1	200.56	0.00270	2.99	12.23	1.39	10.94	4.84	0.28	5.89	
1718~1719	17-18	19+25	17-19	21+66	-	-	-	-	-	-	-	133.72	170.92	170.32	101.89	0.00589	60	Circular	1	199.88	0.00270	2.99	12.26	1.39	10.91	4.84	0.16	6.05	
1719~17-22	17-19	21+66	17-22	24+20	-	-	-	-	-	-	-	133.72	170.22	169.62	112.91	0.00531	60	Circular	1	189.78	0.00270	3.10	12.77	1.41	10.47	4.80	0.18	6.23	
1722~E041	17-22	24+20	X041	29+06	-	-	-	-	-	-	-	274.75	163.77	151.44	404.34	0.03049	60	Circular	1	218.96	0.04960	5.00	19.64	1.25	13.99	8.04	0.48	6.71	Pressure Flow
17L3~17L5	17L-03	52+85	17L-05	12+67	-	-	-	-	-	-	-	133.72	194.00	193.10	11.57	0.07779	60	Circular	1	349.75	0.01180	2.14	8.05	1.13	16.62	6.43	0.01	5.01	
17L5~1716	17L-05	12+67	17-16	16+90	-	-	-	-	-	-	-	133.72	185.11	172.21	422.27	0.03055	60	Circular	1	219.18	0.01180	2.82	11.42	1.34	11.71	4.95	0.60	5.61	
X043~X042	X043	291+11.55	X042	28+56.85	-	-	-	-	-	-	-	364.55	167.11	150.90	620.87	0.02611	72	Circular	1	329.49	0.03300	6.00	28.27	1.50	12.89	8.58	0.80	6.37	Pressure Flow

Note: Computations above are based on the results obtained through the PondPack routing of PL23-OUT35. Due to the size of the drainage area, this outfall has been computed using the SCS Method. Local drainage computations will continue to be computed utilizing the Rational Method, as such discrepancies between flows may occur.

LD-347
HYDRAULIC GRADE LINE ANALYSIS

PROJECT: 495 NEXT

DESIGNED BY: JMON

Checked: NVD

INCIDENCE PROBABILITY **50** **Year**

INLET OR JUNCTION	STA.	INVERT EL. OUTFLOW PIPE	DEPTH OF FLOW OUTFLOW PIPE	OUTLET WATER SURFACE ELEV.	DIA. PIPE Do (In/mm)	DESIGN DISCH. Qo (CFS/CMS)	LENGTH PIPE Lo (Ft/M)	FRICTION SLOPE, Sfo (FT/FT) (M/M)	FRICTION LOSS Hf (Ft/M)	JUNCTION LOSS										SURFACE FLOW	Adj. Ht 1.3 Ht (Ft/M)	Inlet Shaping? Y/N	0.5 Ht (Ft/M)	FINAL H (Ft/M)	Inlet Water Surface Elevation	Top of MH Top of Inlet Elev. APPROX.	Adjustment?
										Vo	Contr. Ho (Ft/M)	Vi	Vi*2/2g	Hi (Expn) 0.35*MAX. (Vi2/2g)	SKEW Angle	K	Bend H (Ft/M)	Sum HL (Ft/M)									
(1)	(2)			(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)		(12)	(13)		(14)	(15)		(16)		(16)	(17)	(18)	(19)	
X041																								155.440		
17-22	24+20	151.440	5.00	155.440	60	201.929	404.34	0.02710	10.959	12.656	0.622	9.922	1.529	0.535	65.0	0.58	0.886	2.043	0.000	2.043	YES	1.022	11.981	167.557	194.900	O.K.
17-19	21+66	169.620	5.00	173.620	60	105.560	112.91	0.00172	0.194	9.922	0.382	10.319	1.653	0.579	55.0	0.52	0.868	1.829	0.000	1.829	YES	0.914	1.108	174.728	189.500	O.K.
17-18	19+25	170.320	5.00	174.728	60	105.560	101.89	0.00172	0.175	10.319	0.413	10.345	1.662	0.582	60.0	0.55	0.920	1.915	0.000	1.915	YES	0.958	1.133	175.861	190.000	O.K.
17-16	16+90	171.020	5.00	175.861	60	105.560	183.94	0.00172	0.316	10.345	0.415	11.058	1.899	0.665	55.0	0.52	0.996	2.076	0.000	2.076	YES	1.038	1.354	177.215	190.000	O.K.
17L-05	12+67	172.210	5.00	177.215	60	105.560	422.27	0.00741	3.128	11.058	0.475	15.596	3.777	1.322	0.0	0.00	0.000	1.797	0.000	1.797	YES	0.898	4.026	187.556	201.000	O.K.
17L-03	52+85	193.100	5.00	197.100	60	105.560	11.57	0.00741	0.086	15.596	0.944	0.000	0.000	0.000	0.0	0.00	0.000	0.944	0.000	0.944	NO	0.944	1.030	198.130	199.000	O.K.

Note: Computations above are based on the results obtained through the PondPack routing of PL23-OUT35. Due to the size of the drainage area, this outfall has been computed using the SCS Method. Local drainage computations will continue to be computed utilizing the Rational Method, as such discrepancies between flows may occur.

LD-347
HYDRAULIC GRADE LINE ANALYSIS

PROJECT: 495 NEXT

DESIGNED BY: JMON

Checked: NVD

INCIDENCE PROBABILITY **100** **Year**

INLET OR JUNCTION	STA.	INVERT EL. OUTFLOW PIPE	DEPTH OF FLOW OUTFLOW PIPE	OUTLET WATER SURFACE ELEV.	DIA. PIPE Do (In/mm)	DESIGN DISCH. Qo (CFS/CMS)	LENGTH PIPE Lo (Ft/M)	FRICTION SLOPE, Sfo (FT/FT) (M/M)	FRICTION LOSS Hf (Ft/M)	JUNCTION LOSS										SURFACE FLOW	Adj. Ht 1.3 Ht (Ft/M)	Inlet Shaping? Y/N	0.5 Ht (Ft/M)	FINAL H (Ft/M)	Inlet Water Surface Elevation	Top of MH Top of Inlet Elev. APPROX.	Adjustment?
										Vo	Contr. Ho (Ft/M)	Vi	Vi*2/2g	Hi (Expn) 0.35*MAX. (Vi2/2g)	SKEW Angle	K	Bend H (Ft/M)	Sum HL (Ft/M)									
(1)	(2)			(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)		(12)	(13)		(14)	(15)		(16)		(16)	(17)	(18)	(19)	
X041																								155.440		
17-22	24+20	151.440	5.00	156.440	60	274.749	404.34	0.05018	20.289	13.993	0.760	10.472	1.703	0.596	65.0	0.58	0.987	2.343	0.000	2.343	YES	1.172	21.461	177.901	194.900	O.K.
17-19	21+66	169.620	5.00	177.901	60	133.720	112.91	0.00276	0.311	10.472	0.426	10.907	1.847	0.647	55.0	0.52	0.969	2.042	0.000	2.042	YES	1.021	1.332	179.233	189.500	O.K.
17-18	19+25	170.320	5.00	179.233	60	133.720	101.89	0.00276	0.281	10.907	0.462	10.935	1.857	0.650	60.0	0.55	1.028	2.140	0.000	2.140	YES	1.070	1.351	180.584	190.000	O.K.
17-16	16+90	171.020	5.00	180.584	60	133.720	183.94	0.00276	0.507	10.935	0.464	11.713	2.130	0.746	55.0	0.52	1.118	2.328	0.000	2.328	YES	1.164	1.671	182.254	190.000	O.K.
17L-05	12+67	172.210	5.00	182.254	60	133.720	422.27	0.01189	5.019	11.713	0.533	16.620	4.289	1.501	0.0	0.00	0.000	2.034	0.000	2.034	YES	1.017	6.036	188.290	201.000	O.K.
17L-03	52+85	193.100	5.00	197.100	60	133.720	11.57	0.01189	0.138	16.620	1.072	0.000	0.000	0.000	0.0	0.00	0.000	1.072	0.000	1.072	NO	1.072	1.210	198.310	199.000	O.K.

Note: Computations above are based on the results obtained through the PondPack routing of PL23-OUT35. Due to the size of the drainage area, this outfall has been computed using the SCS Method. Local drainage computations will continue to be computed utilizing the Rational Method, as such discrepancies between flows may occur.

LD-347
HYDRAULIC GRADE LINE ANALYSIS

PROJECT: 495 NEXT

DESIGNED BY: JMON

Checked: NVD

INCIDENCE PROBABILITY **50** **Year**

INLET OR JUNCTION	STA.	INVERT EL. OUTFLOW PIPE	DEPTH OF FLOW OUTFLOW PIPE	OUTLET WATER SURFACE ELEV.	DIA. PIPE Do (In/mm)	DESIGN DISCH. Qo (CFS/CMS)	LENGTH PIPE Lo (Ft/M)	FRICTION SLOPE, Sfo (FT/FT) (M/M)	FRICTION LOSS Hf (Ft/M)	JUNCTION LOSS										SURFACE FLOW	Adj. Ht 1.3 Ht (Ft/M)	Inlet Shaping? Y/N	0.5 Ht (Ft/M)	FINAL H (Ft/M)	Inlet Water Surface Elevation	Top of MH Top of Inlet Elev. APPROX.	Adjustment?
										Vo	Contr. Ho (Ft/M)	Vi	Vi*2/2g	Hi (Expn) 0.35*MAX. (Vi2/2g)	SKEW Angle	K	Bend H (Ft/M)	Sum HL (Ft/M)									
(1)	(2)			(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)		(12)	(13)		(14)	(15)		(16)		(16)	(17)	(18)	(19)	
X042																								155.700		
X043	291+11.55	150.900	6.00	155.700	72	291.390	620.87	0.02134	13.252	13.158	0.672	13.171	2.694	0.943	0.0	0.00	0.000	1.615	0.000	1.615	YES	0.807	14.060	171.496	213.240	O.K.
16-10	42+62.53	167.110	6.00	171.910	72	291.390	435.97	0.02134	9.306	13.171	0.673	0.000	0.000	0.000	0.0	0.00	0.000	0.673	0.000	0.673	NO	0.673	9.979	182.902	184.520	O.K.

Note: Computations above are based on the results obtained through the PondPack routing of PL23-OUT35. Due to the size of the drainage area, this outfall has been computed using the SCS Method. Local drainage computations will continue to be computed utilizing the Rational Method, as such discrepancies between flows may occur.

LD-347
HYDRAULIC GRADE LINE ANALYSIS

PROJECT: 495 NEXT

DESIGNED BY: JMON

Checked: NVD

INCIDENCE PROBABILITY **100** **Year**

INLET OR JUNCTION	STA.	INVERT EL. OUTFLOW PIPE	DEPTH OF FLOW OUTFLOW PIPE	OUTLET WATER SURFACE ELEV.	DIA. PIPE Do (In/mm)	DESIGN DISCH. Qo (CFS/CMS)	LENGTH PIPE Lo (Ft/M)	FRICTION SLOPE, Sfo (FT/FT) (M/M)	FRICTION LOSS Hf (Ft/M)	JUNCTION LOSS										SURFACE FLOW	Adj. Ht 1.3 Ht (Ft/M)	Inlet Shaping? Y/N	0.5 Ht (Ft/M)	FINAL H (Ft/M)	Inlet Water Surface Elevation	Top of MH Top of Inlet Elev. APPROX.	Adjustment?
										Vo	Contr. Ho (Ft/M)	Vi	Vi*2/2g	Hi (Expn) 0.35*MAX. (Vi2/2g)	SKEW Angle	K	Bend H (Ft/M)	Sum HL (Ft/M)									
(1)	(2)			(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)		(12)	(13)		(14)	(15)		(16)		(16)	(17)	(18)	(19)	
X042																								155.700		
X043	291+11.55	150.900	6.00	156.900	72	364.550	620.87	0.03341	20.742	12.893	0.645	12.893	2.581	0.903	0.0	0.00	0.000	1.549	0.000	1.549	YES	0.774	21.517	178.417	213.240	O.K.
16-10	42+62.53	167.110	6.00	178.417	72	364.550	435.97	0.03341	14.565	12.893	0.645	0.000	0.000	0.000	0.0	0.00	0.000	0.645	0.000	0.645	NO	0.645	15.210	193.627	184.520	ADJUST

Note: Computations above are based on the results obtained through the PondPack routing of PL23-OUT35. Due to the size of the drainage area, this outfall has been computed using the SCS Method. Local drainage computations will continue to be computed utilizing the Rational Method, as such discrepancies between flows may occur.

APPENDIX C36
PL23-OUT36

Outfall PL23-OUT 36

Outfall PL23-OUT36 is an existing outfall at Interstate 495 station 722+52 left. The outfall consists of a natural channel flowing into the Potomac River. In existing conditions, the channel receives 7.57 acres of project (site) area. The total watershed drainage area at this outfall point is 7,398,400 acres (11560 square miles).

Development of this area will result in a decreased area to this outfall, due to the proposed grading, installation of a storm sewer system and roadway design. The resulting area to the outfall will be 7.32 acres of project (site) area.

Drainage Area:

The drainage areas and resulting changes are summarized in the table below:

PL23-OUT 36				
Drainage Area	**Watershed Area**	**Site Area**	**C (Site)**	**% of Total Watershed**
Existing	7398400 ac	7.57 ac	0.29	0.00010%
Proposed	7398400 ac	7.32 ac	0.33	0.00010%

Limits of Study:

The location of the outfall is shown in the included outfall drainage map. The point of analysis is at the end of the natural channel where it meets the Potomac River.

Easement Requirements:

No additional easements are required.

Channel and Flood Protection:

Under Section 11.7.5.1 and 11.7.5.2 of the VDOT drainage manual, channel and flood protection for an outfall must be analyzed to a point where the contributing site drainage area for the outfall is less than or equal to one percent of the total watershed area at that point. Outfall PL23-OUT36 is located where the contributing site area is 7.32 acres of the total watershed (7,398,400 acres) at the outfall limit, which represents 0.00010% of the watershed. As adequacy of all drainage structures within the limits of construction has been provided, no further analysis is required.

Internal Analysis

Drainage is conveyed to the outfall at PL23-OUT36 through a combination of storm sewer, culverts, and ditches. While some of these are included in the design of this plan, it can be observed that a portion of the area will exit the Limits of Disturbance and will enter several ditches and a culvert. These ditch sections and culvert have been analyzed within this section.

The overall flows to the channels and culvert will decrease or remain the same from existing to proposed conditions. A number of locations were not analyzed in the existing

condition due to the adequacy of the system in the proposed condition. The flow rates to the internal points of analysis are summarized below:

PL23-OUT36, Internal Analysis Points						
Analysis Point	Peak Flow Rate					
	2 Year			10 Year		
	Existing	Proposed	Net Change	Existing	Proposed	Net Change
Section A-A	-	1.46	-	-	1.91	-
Section B-B	-	1.59	-	-	2.07	-
Section C-C	-	1.69	-	-	2.21	-
Section D-D	51.48	51.46	-0.02	69.40	69.38	-0.02
Section E-E	51.44	51.43	-0.01	69.36	69.34	-0.02
Section F-F	51.60	51.58	-0.02	69.57	69.55	-0.02
Ex Culvert 015-014	11.90	11.30	-0.60	16.00	15.20	-0.80
Section G-G	-	13.86	-	-	18.66	-
Section H-H	-	14.00	-	-	18.85	-
Section I-I	7.52	7.52	0.00	10.13	10.13	0.00
Section J-J	8.17	8.16	-0.01	11.00	11.00	0.00
Section K-K	8.48	8.47	-0.01	11.43	11.42	-0.01

The receiving channels are either grass lined or paved, as shown below. Three cross sections were assessed in three of the analysis locations to determine compliance with channel protection requirements. The fourth location utilized a combination of culvert analysis and cross sections to determine compliance with channel protection requirements. Several of the velocities shown are within the permissible range.

Cross Section	Channel Protection - 2 Year Velocity				Outfall Adequate?
	Channel Lining	Max Permissible Velocity (ft/s)	Existing Velocity (ft/s)	Proposed Velocity (ft/s)	
A-A	Wheaton-Glenelg Complex	2.3	-	1.41	Yes
B-B	Wheaton-Glenelg Complex	2.3	-	1.57	Yes
C-C	Wheaton-Glenelg Complex	2.3	-	1.61	Yes
D-D	Codorus and Hatboro Soils	3.5	14.81	14.81	Yes
E-E	Codorus and Hatboro Soils	3.5	10.89	10.89	Yes
F-F	Codorus and Hatboro Soils	3.5	12.36	12.36	Yes
G-G	Paved	No Max	-	9.67	Yes
H-H	Paved	No Max	-	8.89	Yes
I-I	Glenelg Silt Loam	3.5	3.58	3.58	Yes
J-J	Glenelg Silt Loam	3.5	3.21	3.21	Yes
K-K	Glenelg Silt Loam	3.5	3.75	3.75	Yes
Pipe Run	**Pipe Material**	**Max Permissible Velocity (ft/s)**	**Existing Velocity (ft/s)**	**Proposed Velocity (ft/s)**	**Outfall Adequate?**
Ex Culvert (015-014)	Metal	No Max	6.45	6.37	Yes

Cross Sections A-A, B-B, C-C, G-G, H-H and J-J are within the allowable velocity ranges based on the permissible velocity. Ex Culvert (015-014) outfalls into an existing paved channel (analyzed with sections G-G and H-H), as such downstream erosion is not anticipated. Cross Sections D-D, E-E, F-F, I-I and K-K are well outside of the permissible velocity for the specified soil. As a site design has been developed to cause the pre-development rate from the 2 year storm to not increase (per section 11.7.5.1 of the VDOT Drainage Manual), these locations are adequate.

Flood Protection was also assessed for these cross sections and culvert, and all proposed flows are shown to be contained within the channel section.

Cross Section	Flood Protection - 10 Year Capacity		Outfall Adequate?
	Channel Depth (ft)	Normal Depth (ft)	
A-A	0.4	0.40	Yes
B-B	0.5	0.30	Yes
C-C	0.5	0.40	Yes
D-D	6.0	2.10	Yes
E-E	6.0	1.40	Yes
F-F	6.0	1.60	Yes
G-G	2.8	0.70	Yes
H-H	3.3	0.70	Yes
I-I	5.0	0.50	Yes
J-J	4.5	0.80	Yes
K-K	6.0	1.10	Yes

Pipe Run	Flood Protection - 10 Year Capacity						Outfall Adequate?
	Existing HW/D	Proposed HW/D	Max Allowable	Existing Freeboard*	Proposed Freeboard*	Minimum Freeboard	
Ex Culvert (015-014)	1.15	1.10	1.50	0.89	0.98	1.50	Yes

* Upstream freeboard has been utilized in this analysis.

As demonstrated by the computations above, the culvert does not meet freeboard requirements. Per 11.7.5.2, in the case of an inadequate channel, the designer may develop a site design that does not cause the peak runoff rate to increase in the 2 or 10 year storm event. As reductions of 0.60 cfs and 0.80 cfs have been achieved, no further calculations are necessary.

Final Opinion:

This outfall is a natural stormwater conveyance system. We have shown compliance with the channel and flood protection criteria, by analyzing the system to the 1% point, which is located at the Potomac River. As the contributing site area is less than 1% of the total watershed area, it is our opinion that this outfall is adequate.

Pre-Developed Outfall Map
PL23-36
I-495
Fairfax, VA

EXISTING CONTOURS

SITE AREA

PL23-OUT 36
SITE DA = 7.57 AC
WATERSHED DA = 7,398,400 AC

SCALE
0 250' 500'

Post-Developed Outfall Map
PL23-36
I-495
Fairfax, VA

EXISTING CONTOURS

SITE AREA

PL23-OUT 36
SITE DA = 7.32 AC
WATERSHED DA = 7,398,400 AC

SCALE
0 250' 500'

Name of Project:	495-NEXT			Designed By:	KRI
State:	VA	**County:**	Fairfax County	Date:	03/07/22
Name of Culvert:	Pre Development			Checked By:	NVD
NOAA Station:	Vienna Tysons 44-8737			Date:	03/07/22
LOCATION:	PL23-OUT 36				
				UNITS	**ENGLISH**

RATIONAL METHOD - DATA:

		DRAINAGE BASIN		
SUBSHED #	Land Use Description	Onsite Area Acres	C	C A
	Business: Industrial and Commercial (0.80-0.90)			
	Apartments and Townhomes (0.65-0.75)			
	Schools (0.50-0.60)			
	Residential - lots 10,000 sq. ft. (0.40-0.50)			
	- lots 12,000 sq. ft. (0.40-0.45)			
	- lots 17,000 sq. ft. (0.35-0.45)			
	- lots ½ acre or more (0.30-0.40)		0.35	
	Parks, Cemeteries and Unimproved Areas (0.20-0.35)			
	Paved and Roof Areas (0.90)	0.15	0.90	0.14
	Cultivated Areas (0.50-0.70)			
	Pasture (0.35-0.45)			
	Lawns (0.25-0.35)	3.44	0.30	1.03
	Forest (0.20-0.30)	3.99	0.25	1.00
	Steep Grass (2:1) (0.40-0.70)			
	Shoulder and Ditch Areas (0.35-0.50)			
	Totals =	**7.57 Ac.**	**0.29**	**2.16**

Site Contributing Drainage Area to Outfall: 7.57 acres

Total (Watershed) Drainage Area to Outfall: 7398400 acres

Site Percentage of Total (Watershed) Drainage Area: **0.00010%**

Name of Project:	495-NEXT			Designed By:	JMON
State:	VA	**County:**	Fairfax County	Date:	03/07/22
Name of Culvert:	Post Development			Checked By:	NVD
NOAA Station:	Vienna Tysons 44-8737			Date:	03/07/22
LOCATION:	PL23-OUT 36				
				UNITS	**ENGLISH**

RATIONAL METHOD - DATA:

		DRAINAGE BASIN		
SUBSHED #	Land Use Description	Onsite Area Acres	C	C A
	Business: Industrial and Commercial (0.80-0.90)			
	Apartments and Townhomes (0.65-0.75)			
	Schools (0.50-0.60)			
	Residential - lots 10,000 sq. ft. (0.40-0.50)			
	- lots 12,000 sq. ft. (0.40-0.45)			
	- lots 17,000 sq. ft. (0.35-0.45)			
	- lots ½ acre or more (0.30-0.40)		0.35	
	Parks, Cemeteries and Unimproved Areas (0.20-0.35)			
	Paved and Roof Areas (0.90)	0.42	0.90	0.38
	Cultivated Areas (0.50-0.70)			
	Pasture (0.35-0.45)			
	Lawns (0.25-0.35)	6.90	0.30	2.07
	Forest (0.20-0.30)		0.25	
	Steep Grass (2:1) (0.40-0.70)			
	Shoulder and Ditch Areas (0.35-0.50)			
	Totals =	**7.32 Ac.**	**0.33**	**2.45**

Site Contributing Drainage Area to Outfall:	7.32	acres
Total (Watershed) Drainage Area to Outfall:	7398400	acres
Site Percentage of Total (Watershed) Drainage Area:	**0.00010%**	

StreamStats Data-Collection Station Report

USGS Station Number	**01646502**
Station Name	**POTOMAC RIVER (ADJUSTED) NEAR WASH, DC**

Click here to link to available data on NWIS-Web for this site.

Descriptive Information

Station Type	Streamgage, continuous record
Location	Lat 38°56'59.2", long 77°07'39.5" referenced to North American Datum of 1983, Montgomery County, MD, Hydrologic Unit 02070008, on left bank just upstream from Little Falls Dam, 1 mi upstream from District of Columbia boundary line, 1.2 mi upstream from Chain Bridge, 1.8 mi east of Langley, Fairfax County, and at mile 117.4.
Gage	Record includes computed discharge at 01646500 POTOMAC RIVER NEAR WASHINGTON, DC along with furnished records of diversions. Datum of gage is 37.20 ft above North American Vertical Datum of 1988.
Regulation and Diversions	
Regulated?	Unknown
Period of Record	
Remarks	
Latitude (degrees NAD83)	38.94955517
Longitude (degrees NAD83)	-77.12747887
Hydrologic unit code	02070008
County	031-Montgomery
HCDN2009	No

Physical Characteristics

Characteristic Name	Value	Units	Citation Number
Descriptive Information			
Datum_of_Latitude_Longitude	NAD83	dimensionless	30
District_Code	24	dimensionless	30
Begin_date_of_record	3/1/1930	days	41
End_date_of_record	9/30/2003	days	41
Number_of_days_of_record	26877	days	41
Number_of_days_GT_0	26877	days	41
Basin Dimensional Characteristics			
Drainage_Area	11560	square miles	30

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Here's how you know

MENU

- Beta release

POTOMAC RIVER (ADJUSTED) NEAR WASH, DC

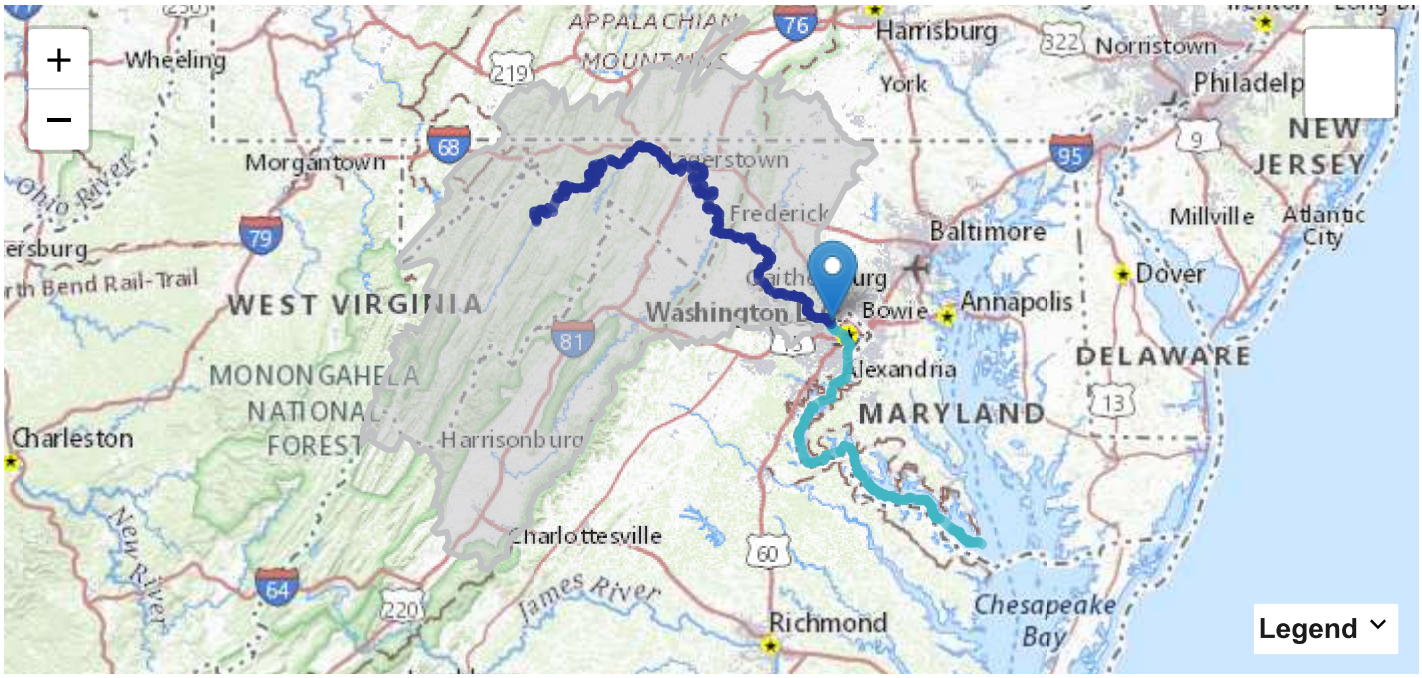
IMPORTANT Classic Page

Monitoring location 01646502 is associated with a STREAM in MONTGOMERY COUNTY, MARYLAND.
Water data back to 1930 are available online.

Retrieve data

Hydrograph Alert

No IV or field visit data is available.



l Map: National Boundaries Dataset, 3DEP Elevation Program, Geographic Names Information System, National Hydrography Dataset, Natio…

About the Network-Linked Data Index (NLDI)

INTERNAL ANALYSIS

PL23-OUT36 INTERNAL ANALYSIS
I-495 NEXT
Fairfax,VA

DRAINAGE AREA BOUNDARY

EXISTING CONTOURS

TIME OF CONCENTRATION

SCALE

0 250' 300'

Section C-C
DA=0.73
C=0.45

Section B-B
DA=0.68
C=0.45

Section A-A
DA=0.63
C=0.45

Section E-E
DA=48.67
C=0.38

Section D-D
DA=48.61
C=0.38

Section F-F
DA=48.95
C=0.38

Section H-H
DA=12.18
C=0.40

Section G-G
DA=12.04
C=0.40

Ex Culvert 015-014
DA=9.81
C=0.40

Section K-K
DA=8.46
C=0.36

Section J-J
DA=7.97
C=0.36

Section I-I
DA=7.03
C=0.38

Outfall PL23-OUT36 Section A-A, B-B, C-C: Looking Upstream

Outfall PL23-OUT36 Section A-A, B-B, C-C: Looking Downstream

Outfall PL23-OUT36 Section D-D, E-E, F-F: Looking Upstream

Outfall PL23-OUT36 Section D-D, E-E, F-F: Looking Downstream

Outfall PL23-OUT36 Section G-G, H-H: Looking Downstream

Outfall PL23-OUT36 Section I-I, J-J, K-K: Looking Upstream

Outfall PL23-OUT36 Section I-I, J-J, K-K: Looking Downstream

Name of Project:	495-NEXT			Designed By:	JMON
State:	VA	**County:**	Fairfax County	Date:	03/03/22
Name of Culvert:	Post Development			Checked By:	NVD
NOAA Station:	Vienna Tysons 44-8737			Date:	03/03/22
LOCATION:	PL23-OUT36 Internal Point of Analysis A-A				
				UNITS	**ENGLISH**

RATIONAL METHOD - DATA:

DRAINAGE BASIN

SUBSHED #	Land Use Description	Area Acres	C	C A
	Business: Industrial and Commercial (0.80-0.90)			
	Apartments and Townhomes (0.65-0.75)			
	Schools (0.50-0.60)			
	Residential - lots 10,000 sq. ft. (0.40-0.50)			
	- lots 12,000 sq. ft. (0.40-0.45)			
	- lots 17,000 sq. ft. (0.35-0.45)			
	- lots ½ acre or more (0.30-0.40)			
	Parks, Cemeteries and Unimproved Areas (0.20-0.35)			
	Paved and Roof Areas (0.90)	0.16	0.90	0.14
	Cultivated Areas (0.50-0.70)			
	Pasture (0.35-0.45)			
	Lawns (0.25-0.35)	0.47	0.30	0.14
	Forest (0.20-0.30)			
	Steep Grass (2:1) (0.40-0.70)			
	Shoulder and Ditch Areas (0.35-0.50)			
	Totals =	**0.63 Acres**	**0.45**	**0.28**

Time of Concentration (Tc)

	Reach	Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Rational C		Tc (Minutes)
							Total Tc (Minutes) =	**5.00**

		2-Year	**5-Year**	**10-Year**	**25-Year**	**50-Year**	**100-Year**
Rainfall Intensity	Inches / Hour.	**5.18**	**6.00**	**6.76**	**7.64**	**8.28**	**8.89**
Aosorption Coefficient / Ground Saturation Correction Coefficient Cf		1.00	1.00	1.00	1.10	1.20	1.25
Peak Discharge	CFS.	**1.46**	**1.69**	**1.91**	**2.37**	**2.81**	**3.14**

PL23-OUT36 (A-A) Post - 2yr

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Channel Slope	0.009 ft/ft
Discharge	1.46 cfs

Section Definitions

Station (ft)	Elevation (ft)
0+00	232.70
0+06	232.30
0+09	233.00
0+12	234.00
0+15	235.00
0+16	236.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 232.70)	(0+16, 236.00)	0.030

Options	
Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results	
Normal Depth	0.3 ft
Roughness Coefficient	0.030
Elevation	232.63 ft
Elevation Range	232.3 to 236.0 ft
Flow Area	1.0 ft²
Wetted Perimeter	6.4 ft
Hydraulic Radius	0.2 ft
Top Width	6.30 ft
Normal Depth	0.3 ft
Critical Depth	0.3 ft
Critical Slope	0.026 ft/ft
Velocity	1.41 ft/s
Velocity Head	0.03 ft
Specific Energy	0.36 ft
Froude Number	0.610

PL23-OUT36 (A-A) Post - 2yr

Results	
Flow Type	Subcritical
GVF Input Data	
Downstream Depth	0.0 ft
Length	0.0 ft
Number Of Steps	0
GVF Output Data	
Upstream Depth	0.0 ft
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	0.00 ft/s
Upstream Velocity	0.00 ft/s
Normal Depth	0.3 ft
Critical Depth	0.3 ft
Channel Slope	0.009 ft/ft
Critical Slope	0.026 ft/ft

PL23-OUT36 (A-A) Post - 10yr

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Channel Slope	0.009 ft/ft
Discharge	1.91 cfs

Section Definitions

Station (ft)	Elevation (ft)
0+00	232.70
0+06	232.30
0+09	233.00
0+12	234.00
0+15	235.00
0+16	236.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 232.70)	(0+16, 236.00)	0.030

Options	
Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results	
Normal Depth	0.4 ft
Roughness Coefficient	0.030
Elevation	232.66 ft
Elevation Range	232.3 to 236.0 ft
Flow Area	1.3 ft²
Wetted Perimeter	7.0 ft
Hydraulic Radius	0.2 ft
Top Width	6.97 ft
Normal Depth	0.4 ft
Critical Depth	0.3 ft
Critical Slope	0.025 ft/ft
Velocity	1.50 ft/s
Velocity Head	0.04 ft
Specific Energy	0.40 ft
Froude Number	0.620

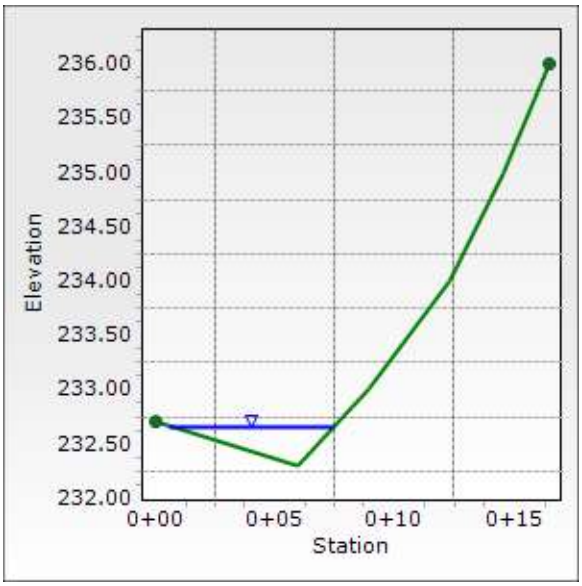
PL23-OUT36 (A-A) Post - 10yr

Results	
Flow Type	Subcritical
GVF Input Data	
Downstream Depth	0.0 ft
Length	0.0 ft
Number Of Steps	0
GVF Output Data	
Upstream Depth	0.0 ft
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	0.00 ft/s
Upstream Velocity	0.00 ft/s
Normal Depth	0.4 ft
Critical Depth	0.3 ft
Channel Slope	0.009 ft/ft
Critical Slope	0.025 ft/ft

PL23-OUT36 (A-A) Post - 10yr

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Channel Slope	0.009 ft/ft
Normal Depth	0.4 ft
Discharge	1.91 cfs



Name of Project:	495-NEXT			Designed By:	JMON
State:	VA	**County:**	Fairfax County	Date:	03/03/22
Name of Culvert:	Post Development			Checked By:	NVD
NOAA Station:	Vienna Tysons 44-8737			Date:	03/03/22
LOCATION:	PL23-OUT36 Internal Point of Analysis B-B				
				UNITS	**ENGLISH**

RATIONAL METHOD - DATA:

DRAINAGE BASIN

SUBSHED #	Land Use Description	Area Acres	C	C A
	Business: Industrial and Commercial (0.80-0.90)			
	Apartments and Townhomes (0.65-0.75)			
	Schools (0.50-0.60)			
	Residential - lots 10,000 sq. ft. (0.40-0.50)			
	- lots 12,000 sq. ft. (0.40-0.45)			
	- lots 17,000 sq. ft. (0.35-0.45)			
	- lots ½ acre or more (0.30-0.40)			
	Parks, Cemeteries and Unimproved Areas (0.20-0.35)			
	Paved and Roof Areas (0.90)	0.17	0.90	0.15
	Cultivated Areas (0.50-0.70)			
	Pasture (0.35-0.45)			
	Lawns (0.25-0.35)	0.51	0.30	0.15
	Forest (0.20-0.30)	0.00	0.25	0.00
	Steep Grass (2:1) (0.40-0.70)			
	Shoulder and Ditch Areas (0.35-0.50)			
	Totals =	**0.68 Acres**	**0.45**	**0.31**

Time of Concentration (Tc)

	Reach	Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Rational C		Tc (Minutes)
							Total Tc (Minutes) =	**5.00**

		2-Year	**5-Year**	**10-Year**	**25-Year**	**50-Year**	**100-Year**
Rainfall Intensity	Inches / Hour.	**5.18**	**6.00**	**6.76**	**7.64**	**8.28**	**8.89**
Aosorption Coefficient / Ground Saturation Correction Coefficient Cf		1.00	1.00	1.00	1.10	1.20	1.25
Peak Discharge	CFS.	**1.59**	**1.84**	**2.07**	**2.57**	**3.04**	**3.40**

PL23-OUT36 (B-B) Post - 2yr

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Channel Slope	0.012 ft/ft
Discharge	1.59 cfs

Section Definitions

Station (ft)	Elevation (ft)
0+00	232.20
0+03	232.00
0+06	231.70
0+09	232.00
0+12	233.00
0+15	234.00
0+16	235.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 232.20)	(0+16, 235.00)	0.030

Options	
Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results	
Normal Depth	0.3 ft
Roughness Coefficient	0.030
Elevation	232.01 ft
Elevation Range	231.7 to 235.0 ft
Flow Area	1.0 ft²
Wetted Perimeter	6.5 ft
Hydraulic Radius	0.2 ft
Top Width	6.44 ft
Normal Depth	0.3 ft
Critical Depth	0.3 ft
Critical Slope	0.026 ft/ft
Velocity	1.57 ft/s
Velocity Head	0.04 ft
Specific Energy	0.35 ft

PL23-OUT36 (B-B) Post - 2yr

Results	
Froude Number	0.699
Flow Type	Subcritical

GVF Input Data	
Downstream Depth	0.0 ft
Length	0.0 ft
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.0 ft
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	0.00 ft/s
Upstream Velocity	0.00 ft/s
Normal Depth	0.3 ft
Critical Depth	0.3 ft
Channel Slope	0.012 ft/ft
Critical Slope	0.026 ft/ft

PL23-OUT36 (B-B) Post - 10yr

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Channel Slope	0.012 ft/ft
Discharge	2.07 cfs

Section Definitions

Station (ft)	Elevation (ft)
0+00	232.20
0+03	232.00
0+06	231.70
0+09	232.00
0+12	233.00
0+15	234.00
0+16	235.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 232.20)	(0+16, 235.00)	0.030

Options	
Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results	
Normal Depth	0.3 ft
Roughness Coefficient	0.030
Elevation	232.04 ft
Elevation Range	231.7 to 235.0 ft
Flow Area	1.2 ft²
Wetted Perimeter	7.0 ft
Hydraulic Radius	0.2 ft
Top Width	6.93 ft
Normal Depth	0.3 ft
Critical Depth	0.3 ft
Critical Slope	0.025 ft/ft
Velocity	1.70 ft/s
Velocity Head	0.04 ft
Specific Energy	0.39 ft

PL23-OUT36 (B-B) Post - 10yr

Results	
Froude Number	0.713
Flow Type	Subcritical

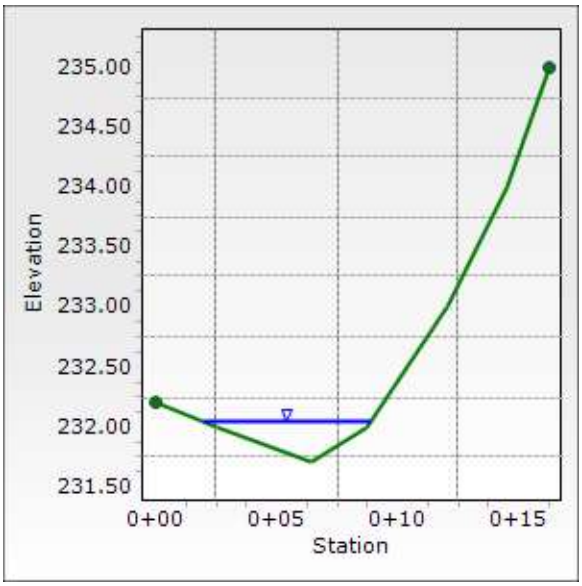
GVF Input Data	
Downstream Depth	0.0 ft
Length	0.0 ft
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.0 ft
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	0.00 ft/s
Upstream Velocity	0.00 ft/s
Normal Depth	0.3 ft
Critical Depth	0.3 ft
Channel Slope	0.012 ft/ft
Critical Slope	0.025 ft/ft

PL23-OUT36 (B-B) Post - 10yr

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Channel Slope	0.012 ft/ft
Normal Depth	0.3 ft
Discharge	2.07 cfs



Name of Project:	495-NEXT			Designed By:	JMON
State:	VA	**County:**	Fairfax County	Date:	03/03/22
Name of Culvert:	Post Development			Checked By:	NVD
NOAA Station:	Vienna Tysons 44-8737			Date:	03/03/22
LOCATION:	PL23-OUT36 Internal Point of Analysis C-C				
				UNITS	**ENGLISH**

RATIONAL METHOD - DATA:

DRAINAGE BASIN

SUBSHED #	Land Use Description	Area Acres	C	C A
	Business: Industrial and Commercial (0.80-0.90)			
	Apartments and Townhomes (0.65-0.75)			
	Schools (0.50-0.60)			
	Residential - lots 10,000 sq. ft. (0.40-0.50)			
	- lots 12,000 sq. ft. (0.40-0.45)			
	- lots 17,000 sq. ft. (0.35-0.45)			
	- lots ½ acre or more (0.30-0.40)			
	Parks, Cemeteries and Unimproved Areas (0.20-0.35)			
	Paved and Roof Areas (0.90)	0.18	0.90	0.16
	Cultivated Areas (0.50-0.70)			
	Pasture (0.35-0.45)			
	Lawns (0.25-0.35)	0.52	0.30	0.16
	Forest (0.20-0.30)	0.03	0.25	0.01
	Steep Grass (2:1) (0.40-0.70)			
	Shoulder and Ditch Areas (0.35-0.50)			
	Totals =	**0.73 Acres**	**0.45**	**0.33**

Time of Concentration (Tc)

	Reach	Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Rational C		Tc (Minutes)
							Total Tc (Minutes) =	**5.00**

		2-Year	**5-Year**	**10-Year**	**25-Year**	**50-Year**	**100-Year**
Rainfall Intensity	Inches / Hour.	**5.18**	**6.00**	**6.76**	**7.64**	**8.28**	**8.89**
Aosorption Coefficient / Ground Saturation Correction Coefficient Cf		1.00	1.00	1.00	1.10	1.20	1.25
Peak Discharge	CFS.	**1.69**	**1.96**	**2.21**	**2.74**	**3.24**	**3.63**

PL23-OUT36 (C-C) Post - 2yr

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Channel Slope	0.012 ft/ft
Discharge	1.69 cfs

Section Definitions

Station (ft)	Elevation (ft)
0+00	231.82
0+07	231.30
0+11	232.00
0+13	233.00
0+15	234.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 231.82)	(0+15, 234.00)	0.030

Options	
Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results	
Normal Depth	0.3 ft
Roughness Coefficient	0.030
Elevation	231.62 ft
Elevation Range	231.3 to 234.0 ft
Flow Area	1.1 ft²
Wetted Perimeter	6.5 ft
Hydraulic Radius	0.2 ft
Top Width	6.49 ft
Normal Depth	0.3 ft
Critical Depth	0.3 ft
Critical Slope	0.025 ft/ft
Velocity	1.61 ft/s
Velocity Head	0.04 ft
Specific Energy	0.36 ft
Froude Number	0.703
Flow Type	Subcritical

PL23-OUT36 (C-C) Post - 2yr

GVF Input Data	
Downstream Depth	0.0 ft
Length	0.0 ft
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.0 ft
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	0.00 ft/s
Upstream Velocity	0.00 ft/s
Normal Depth	0.3 ft
Critical Depth	0.3 ft
Channel Slope	0.012 ft/ft
Critical Slope	0.025 ft/ft

PL23-OUT36 (C-C) Post - 10yr

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Channel Slope	0.012 ft/ft
Discharge	2.21 cfs

Section Definitions

Station (ft)	Elevation (ft)
0+00	231.82
0+07	231.30
0+11	232.00
0+13	233.00
0+15	234.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 231.82)	(0+15, 234.00)	0.030

Options	
Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results	
Normal Depth	0.4 ft
Roughness Coefficient	0.030
Elevation	231.66 ft
Elevation Range	231.3 to 234.0 ft
Flow Area	1.3 ft²
Wetted Perimeter	7.2 ft
Hydraulic Radius	0.2 ft
Top Width	7.18 ft
Normal Depth	0.4 ft
Critical Depth	0.3 ft
Critical Slope	0.025 ft/ft
Velocity	1.72 ft/s
Velocity Head	0.05 ft
Specific Energy	0.40 ft
Froude Number	0.715
Flow Type	Subcritical

PL23-OUT36 (C-C) Post - 10yr

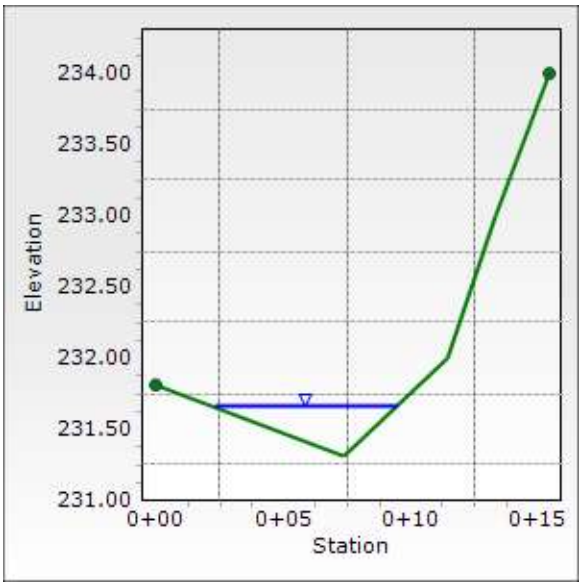
GVF Input Data	
Downstream Depth	0.0 ft
Length	0.0 ft
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.0 ft
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	0.00 ft/s
Upstream Velocity	0.00 ft/s
Normal Depth	0.4 ft
Critical Depth	0.3 ft
Channel Slope	0.012 ft/ft
Critical Slope	0.025 ft/ft

PL23-OUT36 (C-C) Post - 10yr

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Channel Slope	0.012 ft/ft
Normal Depth	0.4 ft
Discharge	2.21 cfs



Name of Project:	495-NEXT			Designed By:	JMON
State:	VA	**County:**	Fairfax County	Date:	03/03/22
Name of Culvert:	Pre Development			Checked By:	NVD
NOAA Station:	Vienna Tysons 44-8737			Date:	03/03/22
LOCATION:	PL23-OUT36 Internal Point of Analysis D-D			UNITS	**ENGLISH**

RATIONAL METHOD - DATA:

DRAINAGE BASIN

SUBSHED #	Land Use Description	Area Acres	C	C A
	Business: Industrial and Commercial (0.80-0.90)			
	Apartments and Townhomes (0.65-0.75)			
	Schools (0.50-0.60)			
	Residential - lots 10,000 sq. ft. (0.40-0.50)			
	- lots 12,000 sq. ft. (0.40-0.45)			
	- lots 17,000 sq. ft. (0.35-0.45)			
	- lots ½ acre or more (0.30-0.40)	3.04	0.35	1.06
	Parks, Cemeteries and Unimproved Areas (0.20-0.35)			
	Paved and Roof Areas (0.90)	8.38	0.90	7.54
	Cultivated Areas (0.50-0.70)			
	Pasture (0.35-0.45)			
	Lawns (0.25-0.35)	6.17	0.30	1.85
	Forest (0.20-0.30)	31.61	0.25	7.90
	Steep Grass (2:1) (0.40-0.70)			
	Shoulder and Ditch Areas (0.35-0.50)			
	Totals =	**49.20 Acres**	**0.37**	**18.36**

Time of Concentration (Tc)

		Reach	Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Rational C		Tc (Minutes)
Overland Flow (E.E. Seelye - VDOT Modified)									
	Soil / Surface Type/Land Cover		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Rational C		
	Residential	A-B	110.85	277.00	274.00	0.027	0.35		9.22
	Residential	B-C	21.61	274.00	270.00	0.185	0.35		3.22
	Residential	C-D	63.13	270.00	264.00	0.095	0.35		5.73
Shallow Concentrated Flow			Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Intercept Coeff.		
Short grass pasture		D-E	217.52	264.00	242.28	0.100	0.213		1.64
Channel Flow			Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Roadside Ditch		E-F	109.63	242.28	239.48	0.026	0.050	4.57	0.40
				Area =	12.00		Wetted P =	12.70	
Pipe Flow			Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
EX161 to EX157	Assumed Information After EX159	F-G	144.23	235.53	231.00	0.031	0.013	9.33	0.26
	Pipe Diameter (in) =		15	Area =	1.23		Wetted P =	3.93	
Channel Flow			Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Natural Channel		G-H	20.78	231.00	218.00	0.626	0.050	22.64	0.02
				Area =	12.00		Wetted P =	12.70	
Channel Flow			Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Roadside Ditch		H-I	164.16	218.00	206.78	0.068	0.050	7.48	0.37
				Area =	12.00		Wetted P =	12.70	
Channel Flow			Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Paved Ditch		I-J	364.56	206.78	186.44	0.056	0.013	26.00	0.23
				Area =	12.00		Wetted P =	12.70	
Channel Flow			Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Natural Channel		J-K	76.07	186.44	181.82	0.061	0.050	7.05	0.18
				Area =	12.00		Wetted P =	12.70	
Pipe Flow			Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
EX015 to EX014 (Metal Pipe)		K-L	204.75	181.82	175.43	0.031	0.027	6.13	0.56
	Pipe Diameter (in) =		24	Area =	3.14		Wetted P =	6.28	
Channel Flow			Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Paved Ditch		L-M	621.46	175.43	143.54	0.051	0.013	24.93	0.42
				Area =	12.00		Wetted P =	12.70	
Pipe Flow			Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
EX005 to EX004 (54"x 60" Metal Pipe)		M-N	356.81	143.54	110.27	0.093	0.027	18.18	0.33
	Pipe Diameter (in) =		54	Area =	15.90		Wetted P =	14.14	
Channel Flow			Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Natural Channel		N-O	165.26	110.27	83.00	0.165	0.040	14.53	0.19
				Area =	12.00		Wetted P =	12.70	
								Total Tc (Minutes) =	**22.76**

		2-Year	5-Year	10-Year	25-Year	50-Year	100-Year
Rainfall Intensity	Inches / Hour.	**2.80**	**3.31**	**3.78**	**4.33**	**4.72**	**5.10**
Aosorption Coefficient / Ground Saturation Correction Coefficient Cf		1.00	1.00	1.00	1.10	1.20	1.25
Peak Discharge	CFS.	**51.48**	**60.78**	**69.40**	**87.37**	**103.99**	**116.96**

Name of Project:	495-NEXT		Designed By: JMON
State:	VA	**County:** Fairfax County	Date: 03/03/22
Name of Culvert:	Post Development		Checked By: NVD
NOAA Station:	Vienna Tysons 44-8737		Date: 03/03/22
LOCATION:	PL23-OUT36 Internal Point of Analysis D-D		UNITS **ENGLISH**

RATIONAL METHOD - DATA:

DRAINAGE BASIN

SUBSHED #	Land Use Description	Area Acres	C	C A
	Business: Industrial and Commercial (0.80-0.90)			
	Apartments and Townhomes (0.65-0.75)			
	Schools (0.50-0.60)			
	Residential - lots 10,000 sq. ft. (0.40-0.50)			
	- lots 12,000 sq. ft. (0.40-0.45)			
	- lots 17,000 sq. ft. (0.35-0.45)			
	- lots ½ acre or more (0.30-0.40)	3.04	0.35	1.06
	Parks, Cemeteries and Unimproved Areas (0.20-0.35)			
	Paved and Roof Areas (0.90)	8.34	0.90	7.51
	Cultivated Areas (0.50-0.70)			
	Pasture (0.35-0.45)			
	Lawns (0.25-0.35)	9.49	0.30	2.85
	Forest (0.20-0.30)	27.74	0.25	6.93
	Steep Grass (2:1) (0.40-0.70)			
	Shoulder and Ditch Areas (0.35-0.50)			
	Totals =	**48.61 Acres**	**0.38**	**18.35**

Time of Concentration (Tc)

	Reach	Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Rational C		Tc (Minutes)
Overland Flow (E.E. Seelye - VDOT Modified)								
Soil / Surface Type/Land Cover		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Rational C		
Residential	A-B	110.85	277.00	274.00	0.027	0.35		9.22
Residential	B-C	21.61	274.00	270.00	0.185	0.35		3.22
Residential	C-D	63.13	270.00	264.00	0.095	0.35		5.73
Shallow Concentrated Flow		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Intercept Coeff.		
Short grass pasture	D-E	217.52	264.00	242.28	0.100	0.213		1.64
Channel Flow		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Roadside Ditch	E-F	109.63	242.28	239.48	0.026	0.050	4.57	0.40
			Area =	12.00		Wetted P =	12.70	
Pipe Flow		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
EX161 to EX157 Assumed Information After EX159	F-G	144.23	235.53	231.00	0.031	0.013	9.33	0.26
Pipe Diameter (in) =		15	Area =	1.23		Wetted P =	3.93	
Channel Flow		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Natural Channel	G-H	20.78	231.00	218.00	0.626	0.050	22.64	0.02
			Area =	12.00		Wetted P =	12.70	
Channel Flow		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Roadside Ditch	H-I	164.16	218.00	206.78	0.068	0.050	7.48	0.37
			Area =	12.00		Wetted P =	12.70	
Channel Flow		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Paved Ditch	I-J	364.56	206.78	186.44	0.056	0.013	26.00	0.23
			Area =	12.00		Wetted P =	12.70	
Channel Flow		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Natural Channel	J-K	76.07	186.44	181.82	0.061	0.050	7.05	0.18
			Area =	12.00		Wetted P =	12.70	
Pipe Flow		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
EX015 to EX014 (Metal Pipe)	K-L	204.75	181.82	175.43	0.031	0.027	6.13	0.56
Pipe Diameter (in) =		24	Area =	3.14		Wetted P =	6.28	
Channel Flow		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Paved Ditch	L-M	621.46	175.43	143.54	0.051	0.013	24.93	0.42
			Area =	12.00		Wetted P =	12.70	
Pipe Flow		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
EX005 to EX004 (54"x 60" Metal Pipe)	M-N	356.81	143.54	110.27	0.093	0.027	18.18	0.33
Pipe Diameter (in) =		54	Area =	15.90		Wetted P =	14.14	
Channel Flow		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Natural Channel	N-O	165.26	110.27	83.00	0.165	0.040	14.53	0.19
			Area =	12.00		Wetted P =	12.70	
							Total Tc (Minutes) =	**22.76**

	2-Year	5-Year	10-Year	25-Year	50-Year	100-Year
Rainfall Intensity Inches / Hour.	**2.80**	**3.31**	**3.78**	**4.33**	**4.72**	**5.10**
Aosorption Coefficient / Ground Saturation Correction Coefficient Cf	1.00	1.00	1.00	1.10	1.20	1.25
Peak Discharge CFS.	**51.46**	**60.76**	**69.38**	**87.35**	**103.95**	**116.92**

PL23-OUT36 (D-D) Pre - 2yr

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Channel Slope	0.286 ft/ft
Discharge	51.48 cfs

Section Definitions

Station (ft)	Elevation (ft)
0+00	89.00
0+01	88.00
0+02	87.00
0+04	86.00
0+05	85.00
0+07	84.00
0+08	83.00
0+08	84.00
0+09	85.00
0+10	86.00
0+10	87.00
0+12	88.00
0+14	89.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 89.00)	(0+14, 89.00)	0.040

Options	
Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results	
Normal Depth	1.9 ft
Roughness Coefficient	0.040
Elevation	84.88 ft
Elevation Range	83.0 to 89.0 ft
Flow Area	3.5 ft²
Wetted Perimeter	5.4 ft
Hydraulic Radius	0.6 ft
Top Width	3.75 ft

PL23-OUT36 (D-D) Pre - 2yr

Results	
Normal Depth	1.9 ft
Critical Depth	2.8 ft
Critical Slope	0.034 ft/ft
Velocity	14.81 ft/s
Velocity Head	3.41 ft
Specific Energy	5.29 ft
Froude Number	2.713
Flow Type	Supercritical

GVF Input Data	
Downstream Depth	0.0 ft
Length	0.0 ft
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.0 ft
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	1.9 ft
Critical Depth	2.8 ft
Channel Slope	0.286 ft/ft
Critical Slope	0.034 ft/ft

PL23-OUT36 (D-D) Post - 2yr

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Channel Slope	0.286 ft/ft
Discharge	51.46 cfs

Section Definitions

Station (ft)	Elevation (ft)
0+00	89.00
0+01	88.00
0+02	87.00
0+04	86.00
0+05	85.00
0+07	84.00
0+08	83.00
0+08	84.00
0+09	85.00
0+10	86.00
0+10	87.00
0+12	88.00
0+14	89.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 89.00)	(0+14, 89.00)	0.040

Options	
Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results	
Normal Depth	1.9 ft
Roughness Coefficient	0.040
Elevation	84.88 ft
Elevation Range	83.0 to 89.0 ft
Flow Area	3.5 ft²
Wetted Perimeter	5.4 ft
Hydraulic Radius	0.6 ft
Top Width	3.75 ft

PL23-OUT36 (D-D) Post - 2yr

Results	
Normal Depth	1.9 ft
Critical Depth	2.8 ft
Critical Slope	0.034 ft/ft
Velocity	14.81 ft/s
Velocity Head	3.41 ft
Specific Energy	5.29 ft
Froude Number	2.713
Flow Type	Supercritical

GVF Input Data	
Downstream Depth	0.0 ft
Length	0.0 ft
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.0 ft
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	1.9 ft
Critical Depth	2.8 ft
Channel Slope	0.286 ft/ft
Critical Slope	0.034 ft/ft

PL23-OUT36 (D-D) Post - 10yr

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Channel Slope	0.286 ft/ft
Discharge	69.38 cfs

Section Definitions

Station (ft)	Elevation (ft)
0+00	89.00
0+01	88.00
0+02	87.00
0+04	86.00
0+05	85.00
0+07	84.00
0+08	83.00
0+08	84.00
0+09	85.00
0+10	86.00
0+10	87.00
0+12	88.00
0+14	89.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 89.00)	(0+14, 89.00)	0.040

Options	
Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results	
Normal Depth	2.1 ft
Roughness Coefficient	0.040
Elevation	85.10 ft
Elevation Range	83.0 to 89.0 ft
Flow Area	4.3 ft²
Wetted Perimeter	6.0 ft
Hydraulic Radius	0.7 ft
Top Width	4.20 ft

PL23-OUT36 (D-D) Post - 10yr

Results	
Normal Depth	2.1 ft
Critical Depth	3.1 ft
Critical Slope	0.033 ft/ft
Velocity	15.95 ft/s
Velocity Head	3.95 ft
Specific Energy	6.05 ft
Froude Number	2.763
Flow Type	Supercritical

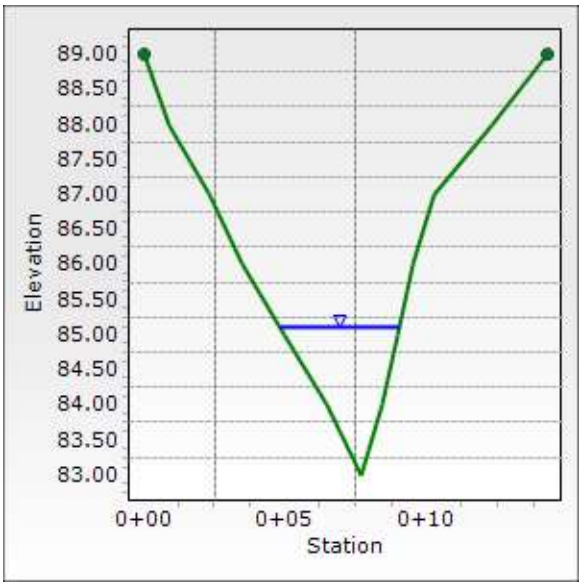
GVF Input Data	
Downstream Depth	0.0 ft
Length	0.0 ft
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.0 ft
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	2.1 ft
Critical Depth	3.1 ft
Channel Slope	0.286 ft/ft
Critical Slope	0.033 ft/ft

PL23-OUT36 (D-D) Post - 10yr

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Channel Slope	0.286 ft/ft
Normal Depth	2.1 ft
Discharge	69.38 cfs



Name of Project:	495-NEXT			Designed By:	JMON
State:	VA	**County:**	Fairfax County	Date:	03/03/22
Name of Culvert:	Pre Development			Checked By:	NVD
NOAA Station:	Vienna Tysons 44-8737			Date:	03/03/22
LOCATION:	PL23-OUT36 Internal Point of Analysis E-E				
				UNITS	**ENGLISH**

RATIONAL METHOD - DATA:

DRAINAGE BASIN

SUBSHED #	Land Use Description	Area Acres	C	C A
	Business: Industrial and Commercial (0.80-0.90)			
	Apartments and Townhomes (0.65-0.75)			
	Schools (0.50-0.60)			
	Residential - lots 10,000 sq. ft. (0.40-0.50)			
	- lots 12,000 sq. ft. (0.40-0.45)			
	- lots 17,000 sq. ft. (0.35-0.45)			
	- lots ½ acre or more (0.30-0.40)	3.04	0.35	1.06
	Parks, Cemeteries and Unimproved Areas (0.20-0.35)			
	Paved and Roof Areas (0.90)	8.38	0.90	7.54
	Cultivated Areas (0.50-0.70)			
	Pasture (0.35-0.45)			
	Lawns (0.25-0.35)	6.18	0.30	1.85
	Forest (0.20-0.30)	31.66	0.25	7.92
	Steep Grass (2:1) (0.40-0.70)			
	Shoulder and Ditch Areas (0.35-0.50)			
	Totals =	**49.26 Acres**	**0.37**	**18.37**

Time of Concentration (Tc)

		Reach	Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Rational C		Tc (Minutes)
Overland Flow (E.E. Seelye - VDOT Modified)									
	Soil / Surface Type/Land Cover		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Rational C		
	Residential	A-B	110.85	277.00	274.00	0.027	0.35		9.22
	Residential	B-C	21.61	274.00	270.00	0.185	0.35		3.22
	Residential	C-D	63.13	270.00	264.00	0.095	0.35		5.73
Shallow Concentrated Flow			Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Intercept Coeff.		
Short grass pasture		D-E	217.52	264.00	242.28	0.100	0.213		1.64
Channel Flow			Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Roadside Ditch		E-F	109.63	242.28	239.48	0.026	0.050	4.57	0.40
				Area =	12.00		Wetted P =	12.70	
Pipe Flow			Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
EX161 to EX157	Assumed Information After EX159	F-G	144.23	235.53	231.00	0.031	0.013	9.33	0.26
	Pipe Diameter (in) =		15	Area =	1.23		Wetted P =	3.93	
Channel Flow			Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Natural Channel		G-H	20.78	231.00	218.00	0.626	0.050	22.64	0.02
				Area =	12.00		Wetted P =	12.70	
Channel Flow			Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Roadside Ditch		H-I	164.16	218.00	206.78	0.068	0.050	7.48	0.37
				Area =	12.00		Wetted P =	12.70	
Channel Flow			Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Paved Ditch		I-J	364.56	206.78	186.44	0.056	0.013	26.00	0.23
				Area =	12.00		Wetted P =	12.70	
Channel Flow			Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Natural Channel		J-K	76.07	186.44	181.82	0.061	0.050	7.05	0.18
				Area =	12.00		Wetted P =	12.70	
Pipe Flow			Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
EX015 to EX014 (Metal Pipe)		K-L	204.75	181.82	175.43	0.031	0.027	6.13	0.56
	Pipe Diameter (in) =		24	Area =	3.14		Wetted P =	6.28	
Channel Flow			Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Paved Ditch		L-M	621.46	175.43	143.54	0.051	0.013	24.93	0.42
				Area =	12.00		Wetted P =	12.70	
Pipe Flow			Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
EX005 to EX004 (54"x 60" Metal Pipe)		M-N	356.81	143.54	110.27	0.093	0.027	18.18	0.33
	Pipe Diameter (in) =		54	Area =	15.90		Wetted P =	14.14	
Channel Flow			Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Natural Channel		N-O	214.85	110.27	76.00	0.160	0.040	14.29	0.25
				Area =	12.00		Wetted P =	12.70	
								Total Tc (Minutes) =	**22.82**

		2-Year	5-Year	10-Year	25-Year	50-Year	100-Year
Rainfall Intensity	Inches / Hour.	**2.80**	**3.31**	**3.78**	**4.32**	**4.71**	**5.09**
Aosorption Coefficient / Ground Saturation Correction Coefficient Cf		1.00	1.00	1.00	1.10	1.20	1.25
Peak Discharge	CFS.	**51.44**	**60.74**	**69.36**	**87.33**	**103.93**	**116.90**

Name of Project:	495-NEXT		Designed By: JMON
State:	VA	**County:** Fairfax County	Date: 03/03/22
Name of Culvert:	Post Development		Checked By: NVD
NOAA Station:	Vienna Tysons 44-8737		Date: 03/03/22
LOCATION:	PL23-OUT36 Internal Point of Analysis E-E		UNITS **ENGLISH**

RATIONAL METHOD - DATA:

DRAINAGE BASIN

SUBSHED #	Land Use Description	Area Acres	C	C A
	Business: Industrial and Commercial (0.80-0.90)			
	Apartments and Townhomes (0.65-0.75)			
	Schools (0.50-0.60)			
	Residential - lots 10,000 sq. ft. (0.40-0.50)			
	- lots 12,000 sq. ft. (0.40-0.45)			
	- lots 17,000 sq. ft. (0.35-0.45)			
	- lots ½ acre or more (0.30-0.40)	3.04	0.35	1.06
	Parks, Cemeteries and Unimproved Areas (0.20-0.35)			
	Paved and Roof Areas (0.90)	8.34	0.90	7.51
	Cultivated Areas (0.50-0.70)			
	Pasture (0.35-0.45)			
	Lawns (0.25-0.35)	9.50	0.30	2.85
	Forest (0.20-0.30)	27.79	0.25	6.95
	Steep Grass (2:1) (0.40-0.70)			
	Shoulder and Ditch Areas (0.35-0.50)			
	Totals =	**48.67 Acres**	**0.38**	**18.37**

Time of Concentration (Tc)

	Reach	Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Rational C		Tc (Minutes)
Overland Flow (E.E. Seelye - VDOT Modified)								
Soil / Surface Type/Land Cover		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Rational C		
Residential	A-B	110.85	277.00	274.00	0.027	0.35		9.22
Residential	B-C	21.61	274.00	270.00	0.185	0.35		3.22
Residential	C-D	63.13	270.00	264.00	0.095	0.35		5.73
Shallow Concentrated Flow		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Intercept Coeff.		
Short grass pasture	D-E	217.52	264.00	242.28	0.100	0.213		1.64
Channel Flow		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Roadside Ditch	E-F	109.63	242.28	239.48	0.026	0.050	4.57	0.40
			Area =	12.00		Wetted P =	12.70	
Pipe Flow		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
EX161 to EX157 Assumed Information After EX159	F-G	144.23	235.53	231.00	0.031	0.013	9.33	0.26
Pipe Diameter (in) =		15	Area =	1.23		Wetted P =	3.93	
Channel Flow		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Natural Channel	G-H	20.78	231.00	218.00	0.626	0.050	22.64	0.02
			Area =	12.00		Wetted P =	12.70	
Channel Flow		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Roadside Ditch	H-I	164.16	218.00	206.78	0.068	0.050	7.48	0.37
			Area =	12.00		Wetted P =	12.70	
Channel Flow		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Paved Ditch	I-J	364.56	206.78	186.44	0.056	0.013	26.00	0.23
			Area =	12.00		Wetted P =	12.70	
Channel Flow		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Natural Channel	J-K	76.07	186.44	181.82	0.061	0.050	7.05	0.18
			Area =	12.00		Wetted P =	12.70	
Pipe Flow		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
EX015 to EX014 (Metal Pipe)	K-L	204.75	181.82	175.43	0.031	0.027	6.13	0.56
Pipe Diameter (in) =		24	Area =	3.14		Wetted P =	6.28	
Channel Flow		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Paved Ditch	L-M	621.46	175.43	143.54	0.051	0.013	24.93	0.42
			Area =	12.00		Wetted P =	12.70	
Pipe Flow		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
EX005 to EX004 (54"x 60" Metal Pipe)	M-N	356.81	143.54	110.27	0.093	0.027	18.18	0.33
Pipe Diameter (in) =		54	Area =	15.90		Wetted P =	14.14	
Channel Flow		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Natural Channel	N-O	214.85	110.27	76.00	0.160	0.040	14.29	0.25
			Area =	12.00		Wetted P =	12.70	
							Total Tc (Minutes) =	**22.82**

	2-Year	5-Year	10-Year	25-Year	50-Year	100-Year
Rainfall Intensity Inches / Hour.	**2.80**	**3.31**	**3.78**	**4.32**	**4.71**	**5.09**
Aosorption Coefficient / Ground Saturation Correction Coefficient Cf	1.00	1.00	1.00	1.10	1.20	1.25
Peak Discharge CFS.	**51.43**	**60.72**	**69.34**	**87.30**	**103.90**	**116.87**

PL23-OUT36 (E-E) Pre - 2yr

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Channel Slope	0.153 ft/ft
Discharge	51.44 cfs

Section Definitions

Station (ft)	Elevation (ft)
0+00	82.00
0+01	81.00
0+02	80.00
0+03	79.00
0+05	78.00
0+06	77.00
0+08	76.00
0+12	77.00
0+13	78.00
0+13	79.00
0+14	80.00
0+14	81.00
0+16	82.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 82.00)	(0+16, 82.00)	0.040

Options	
Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results	
Normal Depth	1.3 ft
Roughness Coefficient	0.040
Elevation	77.25 ft
Elevation Range	76.0 to 82.0 ft
Flow Area	4.7 ft²
Wetted Perimeter	7.3 ft
Hydraulic Radius	0.6 ft
Top Width	6.65 ft

PL23-OUT36 (E-E) Pre - 2yr

Results	
Normal Depth	1.3 ft
Critical Depth	1.8 ft
Critical Slope	0.027 ft/ft
Velocity	10.89 ft/s
Velocity Head	1.84 ft
Specific Energy	3.10 ft
Froude Number	2.279
Flow Type	Supercritical

GVF Input Data	
Downstream Depth	0.0 ft
Length	0.0 ft
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.0 ft
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	1.3 ft
Critical Depth	1.8 ft
Channel Slope	0.153 ft/ft
Critical Slope	0.027 ft/ft

PL23-OUT36 (E-E) Post - 2yr

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Channel Slope	0.153 ft/ft
Discharge	51.43 cfs

Section Definitions

Station (ft)	Elevation (ft)
0+00	82.00
0+01	81.00
0+02	80.00
0+03	79.00
0+05	78.00
0+06	77.00
0+08	76.00
0+12	77.00
0+13	78.00
0+13	79.00
0+14	80.00
0+14	81.00
0+16	82.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 82.00)	(0+16, 82.00)	0.040

Options	
Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results	
Normal Depth	1.3 ft
Roughness Coefficient	0.040
Elevation	77.25 ft
Elevation Range	76.0 to 82.0 ft
Flow Area	4.7 ft²
Wetted Perimeter	7.3 ft
Hydraulic Radius	0.6 ft
Top Width	6.65 ft

PL23-OUT36 (E-E) Post - 2yr

Results	
Normal Depth	1.3 ft
Critical Depth	1.8 ft
Critical Slope	0.027 ft/ft
Velocity	10.89 ft/s
Velocity Head	1.84 ft
Specific Energy	3.10 ft
Froude Number	2.279
Flow Type	Supercritical

GVF Input Data	
Downstream Depth	0.0 ft
Length	0.0 ft
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.0 ft
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	1.3 ft
Critical Depth	1.8 ft
Channel Slope	0.153 ft/ft
Critical Slope	0.027 ft/ft

PL23-OUT36 (E-E) Post - 10yr

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Channel Slope	0.153 ft/ft
Discharge	69.34 cfs

Section Definitions

Station (ft)	Elevation (ft)
0+00	82.00
0+01	81.00
0+02	80.00
0+03	79.00
0+05	78.00
0+06	77.00
0+08	76.00
0+12	77.00
0+13	78.00
0+13	79.00
0+14	80.00
0+14	81.00
0+16	82.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 82.00)	(0+16, 82.00)	0.040

Options	
Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results	
Normal Depth	1.4 ft
Roughness Coefficient	0.040
Elevation	77.41 ft
Elevation Range	76.0 to 82.0 ft
Flow Area	5.8 ft²
Wetted Perimeter	7.7 ft
Hydraulic Radius	0.7 ft
Top Width	6.93 ft

PL23-OUT36 (E-E) Post - 10yr

Results	
Normal Depth	1.4 ft
Critical Depth	2.1 ft
Critical Slope	0.026 ft/ft
Velocity	12.00 ft/s
Velocity Head	2.24 ft
Specific Energy	3.64 ft
Froude Number	2.317
Flow Type	Supercritical

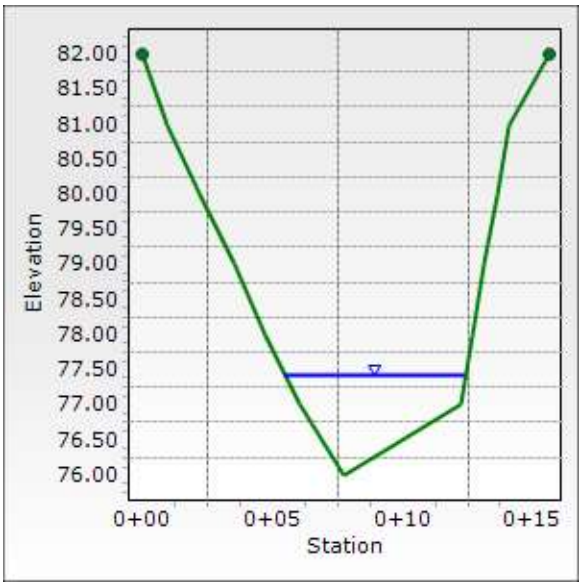
GVF Input Data	
Downstream Depth	0.0 ft
Length	0.0 ft
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.0 ft
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	1.4 ft
Critical Depth	2.1 ft
Channel Slope	0.153 ft/ft
Critical Slope	0.026 ft/ft

PL23-OUT36 (E-E) Post - 10yr

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Channel Slope	0.153 ft/ft
Normal Depth	1.4 ft
Discharge	69.34 cfs



Name of Project:	495-NEXT			Designed By:	JMON
State:	VA	**County:**	Fairfax County	Date:	03/03/22
Name of Culvert:	Pre Development			Checked By:	NVD
NOAA Station:	Vienna Tysons 44-8737			Date:	03/03/22
LOCATION:	PL23-OUT36 Internal Point of Analysis F-F				
				UNITS	**ENGLISH**

RATIONAL METHOD - DATA:

DRAINAGE BASIN

SUBSHED #	Land Use Description	Area Acres	C	C A
	Business: Industrial and Commercial (0.80-0.90)			
	Apartments and Townhomes (0.65-0.75)			
	Schools (0.50-0.60)			
	Residential - lots 10,000 sq. ft. (0.40-0.50)			
	- lots 12,000 sq. ft. (0.40-0.45)			
	- lots 17,000 sq. ft. (0.35-0.45)			
	- lots ½ acre or more (0.30-0.40)	3.04	0.35	1.06
	Parks, Cemeteries and Unimproved Areas (0.20-0.35)			
	Paved and Roof Areas (0.90)	8.39	0.90	7.55
	Cultivated Areas (0.50-0.70)			
	Pasture (0.35-0.45)			
	Lawns (0.25-0.35)	6.26	0.30	1.88
	Forest (0.20-0.30)	31.85	0.25	7.96
	Steep Grass (2:1) (0.40-0.70)			
	Shoulder and Ditch Areas (0.35-0.50)			
	Totals =	**49.54 Acres**	**0.37**	**18.45**

Time of Concentration (Tc)

		Reach	Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Rational C		Tc (Minutes)
Overland Flow (E.E. Seelye - VDOT Modified)									
	Soil / Surface Type/Land Cover		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Rational C		
	Residential	A-B	110.85	277.00	274.00	0.027	0.35		9.22
	Residential	B-C	21.61	274.00	270.00	0.185	0.35		3.22
	Residential	C-D	63.13	270.00	264.00	0.095	0.35		5.73
Shallow Concentrated Flow			Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Intercept Coeff.		
Short grass pasture		D-E	217.52	264.00	242.28	0.100	0.213		1.64
Channel Flow			Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Roadside Ditch		E-F	109.63	242.28	239.48	0.026	0.050	4.57	0.40
				Area =	12.00		Wetted P =	12.70	
Pipe Flow			Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
EX161 to EX157	Assumed Information After EX159	F-G	144.23	235.53	231.00	0.031	0.013	9.33	0.26
	Pipe Diameter (in) =		15	Area =	1.23		Wetted P =	3.93	
Channel Flow			Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Natural Channel		G-H	20.78	231.00	218.00	0.626	0.050	22.64	0.02
				Area =	12.00		Wetted P =	12.70	
Channel Flow			Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Roadside Ditch		H-I	164.16	218.00	206.78	0.068	0.050	7.48	0.37
				Area =	12.00		Wetted P =	12.70	
Channel Flow			Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Paved Ditch		I-J	364.56	206.78	186.44	0.056	0.013	26.00	0.23
				Area =	12.00		Wetted P =	12.70	
Channel Flow			Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Natural Channel		J-K	76.07	186.44	181.82	0.061	0.050	7.05	0.18
				Area =	12.00		Wetted P =	12.70	
Pipe Flow			Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
EX015 to EX014 (Metal Pipe)		K-L	204.75	181.82	175.43	0.031	0.027	6.13	0.56
	Pipe Diameter (in) =		24	Area =	3.14		Wetted P =	6.28	
Channel Flow			Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Paved Ditch		L-M	621.46	175.43	143.54	0.051	0.013	24.93	0.42
				Area =	12.00		Wetted P =	12.70	
Pipe Flow			Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
EX005 to EX004 (54"x 60" Metal Pipe)		M-N	356.81	143.54	110.27	0.093	0.027	18.18	0.33
	Pipe Diameter (in) =		54	Area =	15.90		Wetted P =	14.14	
Channel Flow			Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Natural Channel		N-O	265.15	110.27	68.00	0.159	0.040	14.28	0.31
				Area =	12.00		Wetted P =	12.70	
								Total Tc (Minutes) =	**22.88**

		2-Year	5-Year	10-Year	25-Year	50-Year	100-Year
Rainfall Intensity	Inches / Hour.	**2.80**	**3.30**	**3.77**	**4.32**	**4.71**	**5.08**
Aosorption Coefficient / Ground Saturation Correction Coefficient Cf		1.00	1.00	1.00	1.10	1.20	1.25
Peak Discharge	CFS.	**51.60**	**60.92**	**69.57**	**87.60**	**104.26**	**117.27**

Name of Project:	495-NEXT		Designed By: JMON
State:	VA	**County:** Fairfax County	Date: 03/03/22
Name of Culvert:	Post Development		Checked By: NVD
NOAA Station:	Vienna Tysons 44-8737		Date: 03/03/22
LOCATION:	PL23-OUT36 Internal Point of Analysis F-F		UNITS **ENGLISH**

RATIONAL METHOD - DATA:

DRAINAGE BASIN

SUBSHED #	Land Use Description	Area Acres	C	C A
	Business: Industrial and Commercial (0.80-0.90)			
	Apartments and Townhomes (0.65-0.75)			
	Schools (0.50-0.60)			
	Residential - lots 10,000 sq. ft. (0.40-0.50)			
	- lots 12,000 sq. ft. (0.40-0.45)			
	- lots 17,000 sq. ft. (0.35-0.45)			
	- lots ½ acre or more (0.30-0.40)	3.04	0.35	1.06
	Parks, Cemeteries and Unimproved Areas (0.20-0.35)			
	Paved and Roof Areas (0.90)	8.35	0.90	7.52
	Cultivated Areas (0.50-0.70)			
	Pasture (0.35-0.45)			
	Lawns (0.25-0.35)	9.58	0.30	2.87
	Forest (0.20-0.30)	27.98	0.25	6.99
	Steep Grass (2:1) (0.40-0.70)			
	Shoulder and Ditch Areas (0.35-0.50)			
	Totals =	**48.95 Acres**	**0.38**	**18.45**

Time of Concentration (Tc)

	Reach	Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Rational C		Tc (Minutes)
Overland Flow (E.E. Seelye - VDOT Modified)								
Soil / Surface Type/Land Cover		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Rational C		
Residential	A-B	110.85	277.00	274.00	0.027	0.35		9.22
Residential	B-C	21.61	274.00	270.00	0.185	0.35		3.22
Residential	C-D	63.13	270.00	264.00	0.095	0.35		5.73
Shallow Concentrated Flow		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Intercept Coeff.		
Short grass pasture	D-E	217.52	264.00	242.28	0.100	0.213		1.64
Channel Flow		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Roadside Ditch	E-F	109.63	242.28	239.48	0.026	0.050	4.57	0.40
			Area =	12.00		Wetted P =	12.70	
Pipe Flow		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
EX161 to EX157 Assumed Information After EX159	F-G	144.23	235.53	231.00	0.031	0.013	9.33	0.26
Pipe Diameter (in) =		15	Area =	1.23		Wetted P =	3.93	
Channel Flow		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Natural Channel	G-H	20.78	231.00	218.00	0.626	0.050	22.64	0.02
			Area =	12.00		Wetted P =	12.70	
Channel Flow		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Roadside Ditch	H-I	164.16	218.00	206.78	0.068	0.050	7.48	0.37
			Area =	12.00		Wetted P =	12.70	
Channel Flow		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Paved Ditch	I-J	364.56	206.78	186.44	0.056	0.013	26.00	0.23
			Area =	12.00		Wetted P =	12.70	
Channel Flow		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Natural Channel	J-K	76.07	186.44	181.82	0.061	0.050	7.05	0.18
			Area =	12.00		Wetted P =	12.70	
Pipe Flow		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
EX015 to EX014 (Metal Pipe)	K-L	204.75	181.82	175.43	0.031	0.027	6.13	0.56
Pipe Diameter (in) =		24	Area =	3.14		Wetted P =	6.28	
Channel Flow		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Paved Ditch	L-M	621.46	175.43	143.54	0.051	0.013	24.93	0.42
			Area =	12.00		Wetted P =	12.70	
Pipe Flow		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
EX005 to EX004 (54"x 60" Metal Pipe)	M-N	356.81	143.54	110.27	0.093	0.027	18.18	0.33
Pipe Diameter (in) =		54	Area =	15.90		Wetted P =	14.14	
Channel Flow		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Natural Channel	N-O	265.15	110.27	68.00	0.159	0.040	14.28	0.31
			Area =	12.00		Wetted P =	12.70	
							Total Tc (Minutes) =	**22.88**

	2-Year	5-Year	10-Year	25-Year	50-Year	100-Year
Rainfall Intensity Inches / Hour.	**2.80**	**3.30**	**3.77**	**4.32**	**4.71**	**5.08**
Aosorption Coefficient / Ground Saturation Correction Coefficient Cf	1.00	1.00	1.00	1.10	1.20	1.25
Peak Discharge CFS.	**51.58**	**60.91**	**69.55**	**87.57**	**104.23**	**117.23**

PL23-OUT36 (F-F) Pre - 2yr

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Channel Slope	0.187 ft/ft
Discharge	51.60 cfs

Section Definitions

Station (ft)	Elevation (ft)
0+00	74.00
0+01	73.00
0+02	72.00
0+03	71.00
0+04	70.00
0+06	69.00
0+09	68.00
0+10	69.00
0+11	70.00
0+12	71.00
0+13	72.00
0+14	73.00
0+15	74.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 74.00)	(0+15, 74.00)	0.040

Options	
Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results	
Normal Depth	1.4 ft
Roughness Coefficient	0.040
Elevation	69.39 ft
Elevation Range	68.0 to 74.0 ft
Flow Area	4.2 ft²
Wetted Perimeter	6.2 ft
Hydraulic Radius	0.7 ft
Top Width	5.47 ft

PL23-OUT36 (F-F) Pre - 2yr

Results	
Normal Depth	1.4 ft
Critical Depth	2.1 ft
Critical Slope	0.027 ft/ft
Velocity	12.36 ft/s
Velocity Head	2.37 ft
Specific Energy	3.76 ft
Froude Number	2.493
Flow Type	Supercritical

GVF Input Data	
Downstream Depth	0.0 ft
Length	0.0 ft
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.0 ft
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	1.4 ft
Critical Depth	2.1 ft
Channel Slope	0.187 ft/ft
Critical Slope	0.027 ft/ft

PL23-OUT36 (F-F) Post - 2yr

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Channel Slope	0.187 ft/ft
Discharge	51.58 cfs

Section Definitions

Station (ft)	Elevation (ft)
0+00	74.00
0+01	73.00
0+02	72.00
0+03	71.00
0+04	70.00
0+06	69.00
0+09	68.00
0+10	69.00
0+11	70.00
0+12	71.00
0+13	72.00
0+14	73.00
0+15	74.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 74.00)	(0+15, 74.00)	0.040

Options	
Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results	
Normal Depth	1.4 ft
Roughness Coefficient	0.040
Elevation	69.39 ft
Elevation Range	68.0 to 74.0 ft
Flow Area	4.2 ft²
Wetted Perimeter	6.2 ft
Hydraulic Radius	0.7 ft
Top Width	5.47 ft

PL23-OUT36 (F-F) Post - 2yr

Results	
Normal Depth	1.4 ft
Critical Depth	2.1 ft
Critical Slope	0.027 ft/ft
Velocity	12.36 ft/s
Velocity Head	2.37 ft
Specific Energy	3.76 ft
Froude Number	2.493
Flow Type	Supercritical

GVF Input Data	
Downstream Depth	0.0 ft
Length	0.0 ft
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.0 ft
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	1.4 ft
Critical Depth	2.1 ft
Channel Slope	0.187 ft/ft
Critical Slope	0.027 ft/ft

PL23-OUT36 (F-F) Post - 10yr

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Channel Slope	0.187 ft/ft
Discharge	69.55 cfs

Section Definitions

Station (ft)	Elevation (ft)
0+00	74.00
0+01	73.00
0+02	72.00
0+03	71.00
0+04	70.00
0+06	69.00
0+09	68.00
0+10	69.00
0+11	70.00
0+12	71.00
0+13	72.00
0+14	73.00
0+15	74.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 74.00)	(0+15, 74.00)	0.040

Options	
Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results	
Normal Depth	1.6 ft
Roughness Coefficient	0.040
Elevation	69.56 ft
Elevation Range	68.0 to 74.0 ft
Flow Area	5.2 ft²
Wetted Perimeter	6.8 ft
Hydraulic Radius	0.8 ft
Top Width	5.90 ft

PL23-OUT36 (F-F) Post - 10yr

Results	
Normal Depth	1.6 ft
Critical Depth	2.3 ft
Critical Slope	0.026 ft/ft
Velocity	13.45 ft/s
Velocity Head	2.81 ft
Specific Energy	4.37 ft
Froude Number	2.532
Flow Type	Supercritical

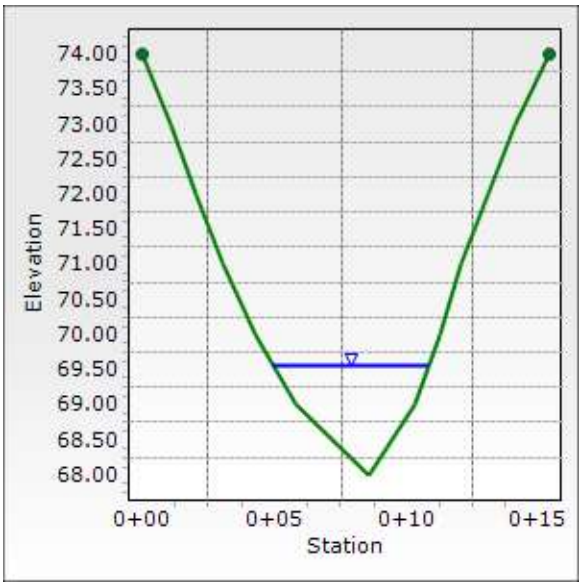
GVF Input Data	
Downstream Depth	0.0 ft
Length	0.0 ft
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.0 ft
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	1.6 ft
Critical Depth	2.3 ft
Channel Slope	0.187 ft/ft
Critical Slope	0.026 ft/ft

PL23-OUT36 (F-F) Post - 10yr

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Channel Slope	0.187 ft/ft
Normal Depth	1.6 ft
Discharge	69.55 cfs



Name of Project:	495-NEXT			Designed By:	JMON
State:	VA	**County:**	Fairfax County	Date:	03/03/22
Name of Culvert:	Pre Development			Checked By:	NVD
NOAA Station:	Vienna Tysons 44-8737			Date:	03/03/22
LOCATION:	PL23-OUT36 Internal Point of Analysis Ex Culvert 015-014			UNITS	**ENGLISH**

RATIONAL METHOD - DATA:

DRAINAGE BASIN

SUBSHED #	Land Use Description	Area Acres	C	C A
	Business: Industrial and Commercial (0.80-0.90)			
	Apartments and Townhomes (0.65-0.75)			
	Schools (0.50-0.60)			
	Residential - lots 10,000 sq. ft. (0.40-0.50)			
	- lots 12,000 sq. ft. (0.40-0.45)			
	- lots 17,000 sq. ft. (0.35-0.45)			
	- lots ½ acre or more (0.30-0.40)	1.60	0.35	0.56
	Parks, Cemeteries and Unimproved Areas (0.20-0.35)			
	Paved and Roof Areas (0.90)	1.95	0.90	1.75
	Cultivated Areas (0.50-0.70)			
	Pasture (0.35-0.45)			
	Lawns (0.25-0.35)	2.63	0.30	0.79
	Forest (0.20-0.30)	3.95	0.25	0.99
	Steep Grass (2:1) (0.40-0.70)			
	Shoulder and Ditch Areas (0.35-0.50)			
	Totals =	**10.12 Acres**	**0.40**	**4.09**

Time of Concentration (Tc)

		Reach	Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Rational C		Tc (Minutes)
Overland Flow (E.E. Seelye - VDOT Modified)									
	Soil / Surface Type/Land Cover		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Rational C		
	Residential	A-B	110.85	277.00	274.00	0.027	0.35		9.22
	Residential	B-C	21.61	274.00	270.00	0.185	0.35		3.22
	Residential	C-D	63.13	270.00	264.00	0.095	0.35		5.73
Shallow Concentrated Flow			Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Intercept Coeff.		
Short grass pasture		D-E	217.52	264.00	242.28	0.100	0.213		1.64
Channel Flow			Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Roadside Ditch		E-F	109.63	242.28	239.48	0.026	0.050	4.57	0.40
				Area =	12.00		Wetted P =	12.70	
Pipe Flow			Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
EX161 to EX157	Assumed Information After EX159	F-G	144.23	235.53	231.00	0.031	0.013	9.33	0.26
	Pipe Diameter (in) =		15	Area =	1.23		Wetted P =	3.93	
Channel Flow			Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Natural Channel		G-H	20.78	231.00	218.00	0.626	0.050	22.64	0.02
				Area =	12.00		Wetted P =	12.70	
Channel Flow			Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Roadside Ditch		H-I	164.16	218.00	206.78	0.068	0.050	7.48	0.37
				Area =	12.00		Wetted P =	12.70	
Channel Flow			Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Paved Ditch		I-J	364.56	206.78	186.44	0.056	0.013	26.00	0.23
				Area =	12.00		Wetted P =	12.70	
Channel Flow			Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Natural Channel		J-K	76.07	186.44	181.82	0.061	0.050	7.05	0.18
				Area =	12.00		Wetted P =	12.70	
								Total Tc (Minutes) =	**21.27**

		2-Year	**5-Year**	**10-Year**	**25-Year**	**50-Year**	**100-Year**
Rainfall Intensity	Inches / Hour.	**2.91**	**3.43**	**3.92**	**4.48**	**4.88**	**5.27**
Aosorption Coefficient / Ground Saturation Correction Coefficient Cf		1.00	1.00	1.00	1.10	1.20	1.25
Peak Discharge	CFS.	**11.90**	**14.03**	**16.00**	**20.13**	**23.94**	**26.90**

Name of Project:	495-NEXT			Designed By:	JMON
State:	VA	**County:**	Fairfax County	Date:	03/03/22
Name of Culvert:	Post Development			Checked By:	NVD
NOAA Station:	Vienna Tysons 44-8737			Date:	03/03/22
LOCATION:	PL23-OUT36 Internal Point of Analysis Ex Culvert 015-014			UNITS	**ENGLISH**

RATIONAL METHOD - DATA:

DRAINAGE BASIN

SUBSHED #	Land Use Description	Area Acres	C	C A
	Business: Industrial and Commercial (0.80-0.90)			
	Apartments and Townhomes (0.65-0.75)			
	Schools (0.50-0.60)			
	Residential - lots 10,000 sq. ft. (0.40-0.50)			
	- lots 12,000 sq. ft. (0.40-0.45)			
	- lots 17,000 sq. ft. (0.35-0.45)			
	- lots ½ acre or more (0.30-0.40)	1.60	0.35	0.56
	Parks, Cemeteries and Unimproved Areas (0.20-0.35)			
	Paved and Roof Areas (0.90)	1.69	0.90	1.52
	Cultivated Areas (0.50-0.70)			
	Pasture (0.35-0.45)			
	Lawns (0.25-0.35)	3.30	0.30	0.99
	Forest (0.20-0.30)	3.22	0.25	0.81
	Steep Grass (2:1) (0.40-0.70)			
	Shoulder and Ditch Areas (0.35-0.50)			
	Totals =	**9.81 Acres**	**0.40**	**3.88**

Time of Concentration (Tc)

		Reach	Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Rational C		Tc (Minutes)
Overland Flow (E.E. Seelye - VDOT Modified)									
	Soil / Surface Type/Land Cover		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Rational C		
	Residential	A-B	110.85	277.00	274.00	0.027	0.35		9.22
	Residential	B-C	21.61	274.00	270.00	0.185	0.35		3.22
	Residential	C-D	63.13	270.00	264.00	0.095	0.35		5.73
Shallow Concentrated Flow			Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Intercept Coeff.		
Short grass pasture		D-E	212.16	264.00	241.90	0.104	0.213		1.57
Channel Flow			Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Roadside Ditch		E-F	108.95	241.90	239.55	0.022	0.050	4.20	0.43
				Area =	12.00		Wetted P =	12.70	
Pipe Flow			Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
EX161 to EX157	Assumed Information After EX159	F-G	150.12	235.68	231.00	0.031	0.013	9.29	0.27
	Pipe Diameter (in) =		15	Area =	1.23		Wetted P =	3.93	
Channel Flow			Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Natural Channel		G-H	20.78	231.00	218.00	0.626	0.050	22.64	0.02
				Area =	12.00		Wetted P =	12.70	
Channel Flow			Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Roadside Ditch		H-I	164.16	218.00	206.78	0.068	0.050	7.48	0.37
				Area =	12.00		Wetted P =	12.70	
Channel Flow			Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Paved Ditch		I-J	364.56	206.78	186.44	0.056	0.013	26.00	0.23
				Area =	12.00		Wetted P =	12.70	
Channel Flow			Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Natural Channel		J-K	76.07	186.44	181.82	0.061	0.050	7.05	0.18
				Area =	12.00		Wetted P =	12.70	
								Total Tc (Minutes) =	**21.24**

	2-Year	5-Year	10-Year	25-Year	50-Year	100-Year
Rainfall Intensity Inches / Hour.	**2.91**	**3.44**	**3.92**	**4.48**	**4.88**	**5.27**
Aosorption Coefficient / Ground Saturation Correction Coefficient Cf	1.00	1.00	1.00	1.10	1.20	1.25
Peak Discharge CFS.	**11.30**	**13.33**	**15.20**	**19.12**	**22.73**	**25.55**

PROJECT	**I-495 NEXT**			**CULVERT DESIGN FORM LD-269**	
ROAD	**I-495 NB**	**COUNTY**	Fairfax	SHEET 1 OF 1	DESIGNER: JMON DATE: 3/3/2022
CULVERT	OUT36 Pre		VA	UNITS **ENGLISH**	REVIEWER: NVD DATE: 3/3/2022
NOAA Station	Vienna Tysons Corner				

HYDROLOGICAL DATA

Method: INPUT

Drainage Area: 10.12

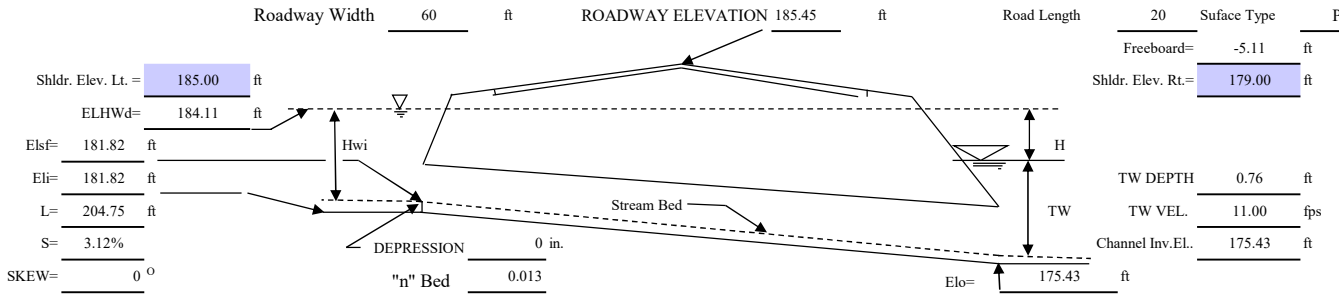
Time of Concentration 21.27

DESIGN FLOWS

R.I. (years)	FLOW (cfs)	
10	Design	16.00
2	Check	11.90
100	Max.	26.90

CULVERT DESCRIPTION:

TYPE: **Single/Multiple Conforming**



Inlet Edge Description:

Square edge w/headwall

Single / Multiple Conforming / Broken Back Culverts

MATERIAL	SHAPE	Size (in)	N	Mannings n	TOTAL FLOW Q cfs	FLOW PER BARREL Q/N cfs	HEADWATER CALCULATIONS: INLET CONTROL HWi/D	HWi ft	FALL ft	ELHWi ft	OUTLET CONTROL TW ft	dc ft	(dc+D)/2 ft	ho ft	ke	H ft	ELHWo ft	CONTROL HEADWATER ELEV ft	OUTLET VEL fps	MINIMUM SHOULDER ELEV. ft	COMMENTS
CMPMedCorr	Circular	24	1	0.027	16.00	16.0	1.15	2.29	0.00	184.11	0.76	1.44	1.72	1.72	0.50	3.63	180.78	184.11	6.85		
					11.90	11.9	0.92	1.85	0.00	183.67	0.68	1.24	1.62	1.62	0.50	2.76	179.81	183.67	6.45		
					26.90	26.9	1.87	3.74	0.00	185.56	0.93	1.81	1.91	1.90	0.50	3.63	180.96	185.56	7.93		

Broken Back Culvert

LENGTH	Elev.	SKEW O

TAILWATER DATA:

Channel Shape	Triangular	
Bottom Width, ft	0.00	"n" = 0.013
Side Slope Lt: (H:1V)	3.00	
Side Slope Rt: (H:1V)	2.00	
Channel Slope, ft/ft	0.0370	

Distance											
Elevation											
"n" =											

TAILWATER RESULTS:

Discharge cfs	Elevation ft	Flow depth ft	Velocity fps	Shear force PSF
Design	176.19	0.76	11.00	1.76
Check	176.11	0.68	10.21	1.58
Max.	176.36	0.93	12.52	2.14

ROADWAY DATA:

Roadway Width, ft	60
Surface Type	PAVED
Top of Road Elevation, ft	185.45
Length of Road, ft	20

ROADWAY OVERTOPPING:

Discharge cfs	Overtopping Discharge cfs	Overtopping Elevation ft
Design	0	0.00
Check	0	0.00
Max.	2	185.56

TECHNICAL FOOTNOTES:

(1) USE Q/NB FOR BOX CULVERTS

(2) HWi/D = HW/D OR HWi/D FROM DESIGN CHARTS

(3) FALL = HWI - (ELHWd - ELsf); FALL IS ZERO FOR CULVERTS ON GRADE

(4) ELhi = HWi + ELi (INVERT OF INLET CONTROL SECTION)

(5) TW BASED ON DOWNSTREAM CONTROL OR FLOW DEPTH IN CHANNEL

(6) ho = TW or (dc + D/2) (WHICHEVER IS GREATER)

(7) $H = [1 + ke + (29n^2L)/R^{1.33}]v^2/2g$

SUBSCRIPT DEFINITIONS:

HWd	DESIGN HEADWATER	i	INLET
HWi	HW IN INLET CONTROL	o	OUTLET
HWo	HW IN OUTLET CONTROL	sf	Streambed @ culvert face

COMMENTS / DISCUSSION:

CULVERT BARREL SELECTED

SIZE:	24"	n:	0.027
SHAPE:	Circular	MATERIAL:	CMP
ENTRANCE:	ES-1		

CULVERTSOFT by ENSOFTEC, INC.

PROJECT	**I-495 NEXT**			**CULVERT DESIGN FORM LD-269**	
ROAD	**I-495 NB**	**COUNTY**	Fairfax	SHEET 1 OF 1	DESIGNER: JMON DATE: 3/3/2022
CULVERT	OUT36 Post		VA	UNITS **ENGLISH**	REVIEWER: NVD DATE: 3/3/2022
NOAA Station	Vienna Tysons Corner				

HYDROLOGICAL DATA

Method: INPUT

Drainage Area: 9.81

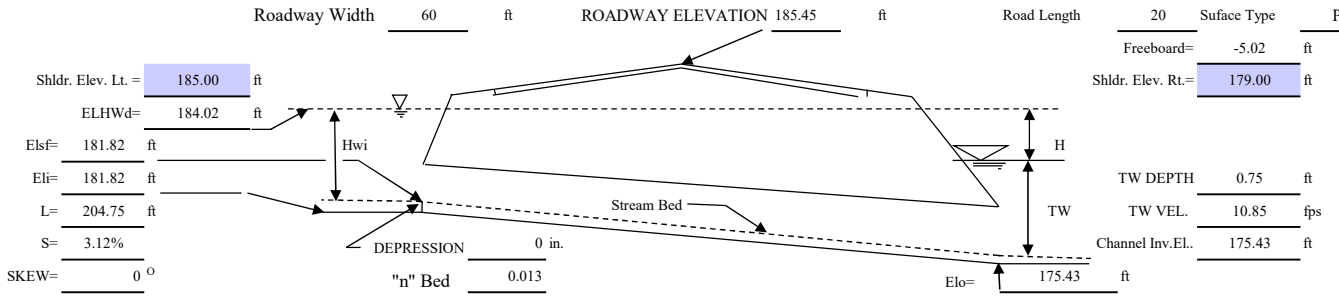
Time of Concentration 21.24

DESIGN FLOWS

R.I. (years)	FLOW (cfs)	
10	Design	15.20
2	Check	11.30
100	Max.	25.55

CULVERT DESCRIPTION:

TYPE: **Single/Multiple Conforming**



Inlet Edge Description:

Square edge w/headwall

Single / Multiple Conforming / Broken Back Culverts

MATERIAL	SHAPE	Size (in)	N	Mannings n	TOTAL FLOW Q cfs	FLOW PER BARREL Q/N cfs	HEADWATER CALCULATIONS: INLET CONTROL HWi/D	HWi ft	FALL ft	ELHWi ft	OUTLET CONTROL TW ft	dc ft	(dc+D)/2 ft	ho ft	ke	H ft	ELHWo ft	CONTROL HEADWATER ELEV ft	OUTLET VEL fps	MINIMUM SHOULDER ELEV. ft	COMMENTS
CMPMedCorr	Circular	24	1	0.027	15.20	15.2	1.10	2.20	0.00	184.02	0.75	1.41	1.71	1.70	0.50	3.63	180.76	184.02	6.79		
					11.30	11.3	0.89	1.78	0.00	183.60	0.67	1.21	1.61	1.60	0.50	2.49	179.53	183.60	6.37		
					25.55	25.6	1.85	3.69	0.00	185.51	0.91	1.78	1.89	1.89	0.50	3.63	180.95	185.51	7.86		

Broken Back Culvert

LENGTH	Elev.	SKEW O

TAILWATER DATA:

Channel Shape	Triangular	
Bottom Width, ft	0.00	"n" = 0.013
Side Slope Lt: (H:1V)	3.00	
Side Slope Rt: (H:1V)	2.00	
Channel Slope, ft/ft	0.0370	

Distance											
Elevation											
"n" =											

TAILWATER RESULTS:

	Discharge cfs	Elevation ft	Flow depth ft	Velocity fps	Shear force PSF
Design	176.18	0.75	10.85	1.73	
Check	176.10	0.67	10.08	1.55	
Max.	176.34	0.91	12.36	2.10	

ROADWAY DATA:

Roadway Width, ft	60
Surface Type	PAVED
Top of Road Elevation, ft	185.45
Length of Road, ft	20

ROADWAY OVERTOPPING:

	Discharge cfs	Overtopping Discharge cfs	Overtopping Elevation ft
Design	0	0.00	
Check	0	0.00	
Max.	1	185.51	

TECHNICAL FOOTNOTES:

(1) USE Q/NB FOR BOX CULVERTS

(2) HWi/D = HW/D OR HWi/D FROM DESIGN CHARTS

(3) FALL = HWI - (ELHWd - ELsf); FALL IS ZERO FOR CULVERTS ON GRADE

(4) ELhi = HWi + ELi (INVERT OF INLET CONTROL SECTION)

(5) TW BASED ON DOWNSTREAM CONTROL OR FLOW DEPTH IN CHANNEL

(6) ho = TW or (dc + D/2) (WHICHEVER IS GREATER)

(7) $H = [1 + ke + (29n^2L)/R^{1.33}]v^2/2g$

SUBSCRIPT DEFINITIONS:

HWd	DESIGN HEADWATER	i	INLET
HWi	HW IN INLET CONTROL	o	OUTLET
HWo	HW IN OUTLET CONTROL	sf	Streambed @ culvert face

COMMENTS / DISCUSSION:

CULVERT BARREL SELECTED

SIZE:	24"	n:	0.027
SHAPE:	Circular	MATERIAL:	CMP
ENTRANCE:	ES-1		

CULVERTSOFT by ENSOFTEC, INC.

Name of Project:	495-NEXT			Designed By:	JMON
State:	VA	**County:**	Fairfax County	Date:	03/03/22
Name of Culvert:	Post Development			Checked By:	NVD
NOAA Station:	Vienna Tysons 44-8737			Date:	03/03/22
LOCATION:	PL23-OUT36 Internal Point of Analysis G-G				
				UNITS	**ENGLISH**

RATIONAL METHOD - DATA:

DRAINAGE BASIN

SUBSHED #	Land Use Description	Area Acres	C	C A
	Business: Industrial and Commercial (0.80-0.90)			
	Apartments and Townhomes (0.65-0.75)			
	Schools (0.50-0.60)			
	Residential - lots 10,000 sq. ft. (0.40-0.50)			
	- lots 12,000 sq. ft. (0.40-0.45)			
	- lots 17,000 sq. ft. (0.35-0.45)			
	- lots ½ acre or more (0.30-0.40)	1.60	0.35	0.56
	Parks, Cemeteries and Unimproved Areas (0.20-0.35)			
	Paved and Roof Areas (0.90)	2.28	0.90	2.05
	Cultivated Areas (0.50-0.70)			
	Pasture (0.35-0.45)			
	Lawns (0.25-0.35)	3.67	0.30	1.10
	Forest (0.20-0.30)	4.49	0.25	1.12
	Steep Grass (2:1) (0.40-0.70)			
	Shoulder and Ditch Areas (0.35-0.50)			
	Totals =	**12.04 Acres**	**0.40**	**4.84**

Time of Concentration (Tc)

		Reach	Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Rational C		Tc (Minutes)
Overland Flow (E.E. Seelye - VDOT Modified)									
	Soil / Surface Type/Land Cover		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Rational C		
	Residential	A-B	110.85	277.00	274.00	0.027	0.35		9.22
	Residential	B-C	21.61	274.00	270.00	0.185	0.35		3.22
	Residential	C-D	63.13	270.00	264.00	0.095	0.35		5.73
Shallow Concentrated Flow			Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Intercept Coeff.		
Short grass pasture		D-E	217.52	264.00	242.28	0.100	0.213		1.64
Channel Flow			Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Roadside Ditch		E-F	109.63	242.28	239.48	0.026	0.050	4.57	0.40
				Area =	12.00		Wetted P =	12.70	
Pipe Flow			Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
EX161 to EX157	Assumed Information After EX159	F-G	144.23	235.53	231.00	0.031	0.013	9.33	0.26
	Pipe Diameter (in) =		15	Area =	1.23		Wetted P =	3.93	
Channel Flow			Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Natural Channel		G-H	20.78	231.00	218.00	0.626	0.050	22.64	0.02
				Area =	12.00		Wetted P =	12.70	
Channel Flow			Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Roadside Ditch		H-I	164.16	218.00	206.78	0.068	0.050	7.48	0.37
				Area =	12.00		Wetted P =	12.70	
Channel Flow			Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Paved Ditch		I-J	364.56	206.78	186.44	0.056	0.013	26.00	0.23
				Area =	12.00		Wetted P =	12.70	
Channel Flow			Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Natural Channel		J-K	76.07	186.44	181.82	0.061	0.050	7.05	0.18
				Area =	12.00		Wetted P =	12.70	
Pipe Flow			Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
EX015 to EX014 (Metal Pipe)		K-L	204.75	181.82	175.43	0.031	0.027	6.13	0.56
	Pipe Diameter (in) =		24	Area =	3.14		Wetted P =	6.28	
Channel Flow			Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Paved Ditch		L-M	51.45	175.43	174.14	0.025	0.013	17.43	0.05
				Area =	12.00		Wetted P =	12.70	
								Total Tc (Minutes) =	**21.87**

		2-Year	5-Year	10-Year	25-Year	50-Year	100-Year
Rainfall Intensity	Inches / Hour.	**2.87**	**3.38**	**3.86**	**4.41**	**4.81**	**5.20**
Aosorption Coefficient / Ground Saturation Correction Coefficient Cf		1.00	1.00	1.00	1.10	1.20	1.25
Peak Discharge	CFS.	**13.86**	**16.35**	**18.66**	**23.48**	**27.94**	**31.41**

PL23-OUT36 (G-G) Post - 2yr

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Channel Slope	0.037 ft/ft
Discharge	13.86 cfs

Section Definitions

Station (ft)	Elevation (ft)
0+00	177.00
0+04	176.00
0+06	175.00
0+09	174.20
0+12	175.00
0+14	176.00
0+16	177.00
0+18	178.00
0+20	179.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 177.00)	(0+20, 179.00)	0.013

Options	
Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results	
Normal Depth	0.6 ft
Roughness Coefficient	0.013
Elevation	174.80 ft
Elevation Range	174.2 to 179.0 ft
Flow Area	1.4 ft²
Wetted Perimeter	4.9 ft
Hydraulic Radius	0.3 ft
Top Width	4.79 ft
Normal Depth	0.6 ft
Critical Depth	0.9 ft
Critical Slope	0.003 ft/ft
Velocity	9.67 ft/s

PL23-OUT36 (G-G) Post - 2yr

Results	
Velocity Head	1.45 ft
Specific Energy	2.05 ft
Froude Number	3.117
Flow Type	Supercritical

GVF Input Data	
Downstream Depth	0.0 ft
Length	0.0 ft
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.0 ft
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	0.6 ft
Critical Depth	0.9 ft
Channel Slope	0.037 ft/ft
Critical Slope	0.003 ft/ft

PL23-OUT36 (G-G) Post - 10yr

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Channel Slope	0.037 ft/ft
Discharge	18.66 cfs

Section Definitions

Station (ft)	Elevation (ft)
0+00	177.00
0+04	176.00
0+06	175.00
0+09	174.20
0+12	175.00
0+14	176.00
0+16	177.00
0+18	178.00
0+20	179.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 177.00)	(0+20, 179.00)	0.013

Options	
Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results	
Normal Depth	0.7 ft
Roughness Coefficient	0.013
Elevation	174.87 ft
Elevation Range	174.2 to 179.0 ft
Flow Area	1.8 ft²
Wetted Perimeter	5.5 ft
Hydraulic Radius	0.3 ft
Top Width	5.36 ft
Normal Depth	0.7 ft
Critical Depth	1.1 ft
Critical Slope	0.003 ft/ft
Velocity	10.39 ft/s

PL23-OUT36 (G-G) Post - 10yr

Results	
Velocity Head	1.68 ft
Specific Energy	2.35 ft
Froude Number	3.165
Flow Type	Supercritical

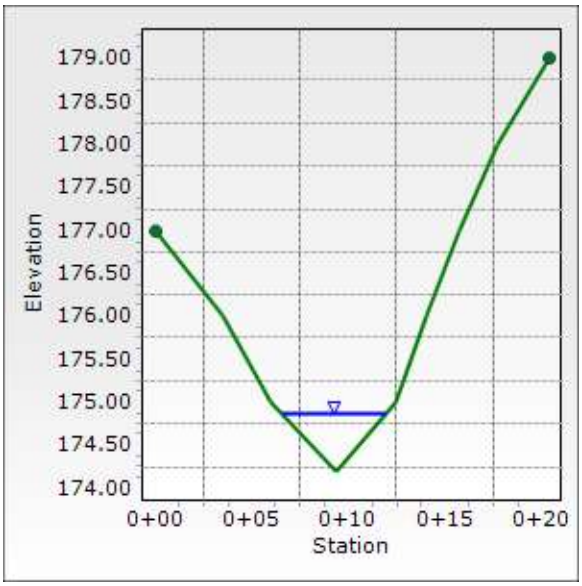
GVF Input Data	
Downstream Depth	0.0 ft
Length	0.0 ft
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.0 ft
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	0.7 ft
Critical Depth	1.1 ft
Channel Slope	0.037 ft/ft
Critical Slope	0.003 ft/ft

PL23-OUT36 (G-G) Post - 10yr

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Channel Slope	0.037 ft/ft
Normal Depth	0.7 ft
Discharge	18.66 cfs



Name of Project:	495-NEXT		Designed By: JMON
State:	VA	**County:** Fairfax County	Date: 03/03/22
Name of Culvert:	Post Development		Checked By: NVD
NOAA Station:	Vienna Tysons 44-8737		Date: 03/03/22
LOCATION:	PL23-OUT36 Internal Point of Analysis H-H		
			UNITS **ENGLISH**

RATIONAL METHOD - DATA:

DRAINAGE BASIN

SUBSHED #	Land Use Description	Area Acres	C	C A
	Business: Industrial and Commercial (0.80-0.90)			
	Apartments and Townhomes (0.65-0.75)			
	Schools (0.50-0.60)			
	Residential - lots 10,000 sq. ft. (0.40-0.50)			
	- lots 12,000 sq. ft. (0.40-0.45)			
	- lots 17,000 sq. ft. (0.35-0.45)			
	- lots ½ acre or more (0.30-0.40)	1.60	0.35	0.56
	Parks, Cemeteries and Unimproved Areas (0.20-0.35)			
	Paved and Roof Areas (0.90)	2.31	0.90	2.08
	Cultivated Areas (0.50-0.70)			
	Pasture (0.35-0.45)			
	Lawns (0.25-0.35)	3.69	0.30	1.11
	Forest (0.20-0.30)	4.58	0.25	1.15
	Steep Grass (2:1) (0.40-0.70)			
	Shoulder and Ditch Areas (0.35-0.50)			
	Totals =	**12.18 Acres**	**0.40**	**4.89**

Time of Concentration (Tc)

		Reach	Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Rational C		Tc (Minutes)
Overland Flow (E.E. Seelye - VDOT Modified)									
	Soil / Surface Type/Land Cover		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Rational C		
	Residential	A-B	110.85	277.00	274.00	0.027	0.35		9.22
	Residential	B-C	21.61	274.00	270.00	0.185	0.35		3.22
	Residential	C-D	63.13	270.00	264.00	0.095	0.35		5.73
Shallow Concentrated Flow			Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Intercept Coeff.		
Short grass pasture		D-E	217.52	264.00	242.28	0.100	0.213		1.64
Channel Flow			Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Roadside Ditch		E-F	109.63	242.28	239.48	0.026	0.050	4.57	0.40
				Area =	12.00		Wetted P =	12.70	
Pipe Flow			Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
EX161 to EX157	Assumed Information After EX159	F-G	144.23	235.53	231.00	0.031	0.013	9.33	0.26
	Pipe Diameter (in) =		15	Area =	1.23		Wetted P =	3.93	
Channel Flow			Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Natural Channel		G-H	20.78	231.00	218.00	0.626	0.050	22.64	0.02
				Area =	12.00		Wetted P =	12.70	
Channel Flow			Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Roadside Ditch		H-I	164.16	218.00	206.78	0.068	0.050	7.48	0.37
				Area =	12.00		Wetted P =	12.70	
Channel Flow			Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Paved Ditch		I-J	364.56	206.78	186.44	0.056	0.013	26.00	0.23
				Area =	12.00		Wetted P =	12.70	
Channel Flow			Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Natural Channel		J-K	76.07	186.44	181.82	0.061	0.050	7.05	0.18
				Area =	12.00		Wetted P =	12.70	
Pipe Flow			Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
EX015 to EX014 (Metal Pipe)		K-L	204.75	181.82	175.43	0.031	0.027	6.13	0.56
	Pipe Diameter (in) =		24	Area =	3.14		Wetted P =	6.28	
Channel Flow			Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Paved Ditch		L-M	101.59	175.43	172.60	0.028	0.013	18.37	0.09
				Area =	12.00		Wetted P =	12.70	
								Total Tc (Minutes) =	**21.92**

		2-Year	5-Year	10-Year	25-Year	50-Year	100-Year
Rainfall Intensity	Inches / Hour.	**2.86**	**3.38**	**3.86**	**4.41**	**4.81**	**5.19**
Aosorption Coefficient / Ground Saturation Correction Coefficient Cf		1.00	1.00	1.00	1.10	1.20	1.25
Peak Discharge	CFS.	**14.00**	**16.52**	**18.85**	**23.72**	**28.22**	**31.73**

PL23-OUT36 (H-H) Post - 2yr

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Channel Slope	0.028 ft/ft
Discharge	14.00 cfs

Section Definitions

Station (ft)	Elevation (ft)
0+00	175.85
0+09	175.00
0+12	174.00
0+15	173.00
0+17	172.60
0+19	173.00
0+21	174.00
0+22	175.00
0+24	176.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 175.85)	(0+24, 176.00)	0.013

Options	
Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results	
Normal Depth	0.6 ft
Roughness Coefficient	0.013
Elevation	173.18 ft
Elevation Range	172.6 to 176.0 ft
Flow Area	1.6 ft²
Wetted Perimeter	5.0 ft
Hydraulic Radius	0.3 ft
Top Width	4.81 ft
Normal Depth	0.6 ft
Critical Depth	0.9 ft
Critical Slope	0.003 ft/ft
Velocity	8.89 ft/s

PL23-OUT36 (H-H) Post - 2yr

Results	
Velocity Head	1.23 ft
Specific Energy	1.81 ft
Froude Number	2.741
Flow Type	Supercritical

GVF Input Data	
Downstream Depth	0.0 ft
Length	0.0 ft
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.0 ft
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	0.6 ft
Critical Depth	0.9 ft
Channel Slope	0.028 ft/ft
Critical Slope	0.003 ft/ft

PL23-OUT36 (H-H) Post - 10yr

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Channel Slope	0.028 ft/ft
Discharge	18.85 cfs

Section Definitions

Station (ft)	Elevation (ft)
0+00	175.85
0+09	175.00
0+12	174.00
0+15	173.00
0+17	172.60
0+19	173.00
0+21	174.00
0+22	175.00
0+24	176.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 175.85)	(0+24, 176.00)	0.013

Options	
Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results	
Normal Depth	0.7 ft
Roughness Coefficient	0.013
Elevation	173.26 ft
Elevation Range	172.6 to 176.0 ft
Flow Area	1.9 ft²
Wetted Perimeter	5.4 ft
Hydraulic Radius	0.4 ft
Top Width	5.18 ft
Normal Depth	0.7 ft
Critical Depth	1.0 ft
Critical Slope	0.003 ft/ft
Velocity	9.71 ft/s

PL23-OUT36 (H-H) Post - 10yr

Results	
Velocity Head	1.47 ft
Specific Energy	2.12 ft
Froude Number	2.798
Flow Type	Supercritical

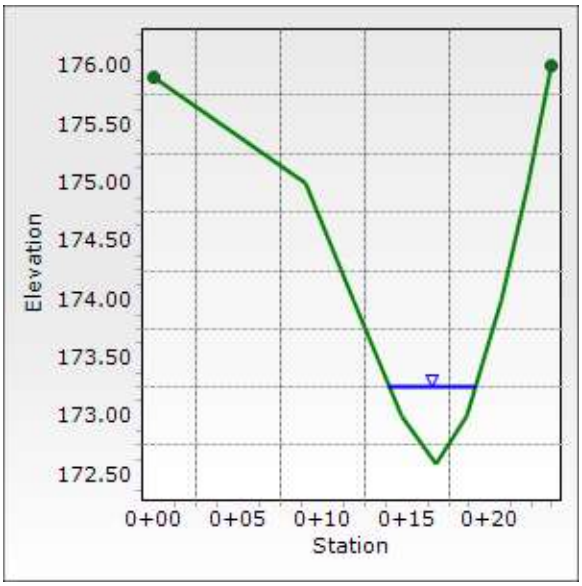
GVF Input Data	
Downstream Depth	0.0 ft
Length	0.0 ft
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.0 ft
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	0.7 ft
Critical Depth	1.0 ft
Channel Slope	0.028 ft/ft
Critical Slope	0.003 ft/ft

PL23-OUT36 (H-H) Post - 10yr

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Channel Slope	0.028 ft/ft
Normal Depth	0.7 ft
Discharge	18.85 cfs



Name of Project:	495-NEXT		Designed By: JMON
State:	VA	**County:** Fairfax County	Date: 03/03/22
Name of Culvert:	Pre Development		Checked By: NVD
NOAA Station:	Vienna Tysons 44-8737		Date: 03/03/22
LOCATION:	PL23-OUT36 Internal Point of Analysis I-I		

UNITS **ENGLISH**

RATIONAL METHOD - DATA:

DRAINAGE BASIN

SUBSHED #	Land Use Description	Area Acres	C	C A
	Business: Industrial and Commercial (0.80-0.90)			
	Apartments and Townhomes (0.65-0.75)			
	Schools (0.50-0.60)			
	Residential - lots 10,000 sq. ft. (0.40-0.50)			
	- lots 12,000 sq. ft. (0.40-0.45)			
	- lots 17,000 sq. ft. (0.35-0.45)			
	- lots ½ acre or more (0.30-0.40)	1.44	0.35	0.50
	Parks, Cemeteries and Unimproved Areas (0.20-0.35)			
	Paved and Roof Areas (0.90)	0.87	0.90	0.78
	Cultivated Areas (0.50-0.70)			
	Pasture (0.35-0.45)			
	Lawns (0.25-0.35)	1.78	0.30	0.53
	Forest (0.20-0.30)	3.32	0.25	0.83
	Steep Grass (2:1) (0.40-0.70)			
	Shoulder and Ditch Areas (0.35-0.50)			
	Totals =	**7.41 Acres**	**0.36**	**2.65**

Time of Concentration (Tc)

		Reach	Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Rational C		Tc (Minutes)
Overland Flow (E.E. Seelye - VDOT Modified)									
	Soil / Surface Type/Land Cover		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Rational C		
	Forest	A-B	48.93	269.10	267.00	0.043	0.25		8.39
	Forest	B-C	150.99	267.00	257.00	0.066	0.25		12.40
Channel Flow			Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Natural Channel		C-D	403.08	257.00	240.75	0.040	0.050	5.75	1.17
				Area =	12.00		Wetted P =	12.70	
Pipe Flow			Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Assumed Information		D-E	279.69	240.75	223.00	0.063	0.013	18.14	0.26
	Pipe Diameter (in) =		24	Area =	3.14		Wetted P =	6.28	
Channel Flow			Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Natural Channel		E-F	58.44	223.00	214.00	0.154	0.045	12.48	0.08
				Area =	12.00		Wetted P =	12.70	
								Total Tc (Minutes) =	**22.29**

	2-Year	5-Year	10-Year	25-Year	50-Year	100-Year
Rainfall Intensity Inches / Hour.	**2.84**	**3.35**	**3.82**	**4.37**	**4.77**	**5.15**
Aosorption Coefficient / Ground Saturation Correction Coefficient Cf	1.00	1.00	1.00	1.10	1.20	1.25
Peak Discharge CFS.	**7.52**	**8.88**	**10.13**	**12.75**	**15.17**	**17.06**

Name of Project:	495-NEXT		Designed By: JMON
State:	VA	**County:** Fairfax County	Date: 03/03/22
Name of Culvert:	Post Development		Checked By: NVD
NOAA Station:	Vienna Tysons 44-8737		Date: 03/03/22
LOCATION:	PL23-OUT36 Internal Point of Analysis I-I		
			UNITS **ENGLISH**

RATIONAL METHOD - DATA:

DRAINAGE BASIN

SUBSHED #	Land Use Description	Area Acres	C	C A
	Business: Industrial and Commercial (0.80-0.90)			
	Apartments and Townhomes (0.65-0.75)			
	Schools (0.50-0.60)		0.50	
	Residential - lots 10,000 sq. ft. (0.40-0.50)			
	- lots 12,000 sq. ft. (0.40-0.45)			
	- lots 17,000 sq. ft. (0.35-0.45)			
	- lots ½ acre or more (0.30-0.40)	1.44	0.35	0.50
	Parks, Cemeteries and Unimproved Areas (0.20-0.35)			
	Paved and Roof Areas (0.90)	1.02	0.90	0.92
	Cultivated Areas (0.50-0.70)			
	Pasture (0.35-0.45)			
	Lawns (0.25-0.35)	1.77	0.30	0.53
	Forest (0.20-0.30)	2.80	0.25	0.70
	Steep Grass (2:1) (0.40-0.70)			
	Shoulder and Ditch Areas (0.35-0.50)			
	Totals =	**7.03 Acres**	**0.38**	**2.65**

Time of Concentration (Tc)

	Reach	Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Rational C		Tc (Minutes)
Overland Flow (E.E. Seelye - VDOT Modified)								
Soil / Surface Type/Land Cover		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Rational C		
Forest	A-B	48.93	269.10	267.00	0.043	0.25		8.39
Forest	B-C	150.99	267.00	257.00	0.066	0.25		12.40
Channel Flow		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Natural Channel	C-D	405.99	257.00	241.50	0.038	0.050	5.59	1.21
			Area =	12.00		Wetted P =	12.70	
Pipe Flow		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Assumed Information	D-E	291.85	241.50	223.00	0.063	0.013	18.13	0.27
Pipe Diameter (in) =		24	Area =	3.14		Wetted P =	6.28	
Channel Flow		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Natural Channel	E-F	58.44	223.00	214.00	0.154	0.045	12.48	0.08
			Area =	12.00		Wetted P =	12.70	
							Total Tc (Minutes) =	**22.34**

	2-Year	5-Year	10-Year	25-Year	50-Year	100-Year
Rainfall Intensity Inches / Hour.	**2.83**	**3.34**	**3.82**	**4.37**	**4.76**	**5.14**
Aosorption Coefficient / Ground Saturation Correction Coefficient Cf	1.00	1.00	1.00	1.10	1.20	1.25
Peak Discharge CFS.	**7.52**	**8.87**	**10.13**	**12.75**	**15.17**	**17.06**

PL23-OUT36 (I-I) Pre - 2yr

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Channel Slope	0.042 ft/ft
Discharge	7.52 cfs

Section Definitions

Station (ft)	Elevation (ft)
0+00	119.00
0+02	118.00
0+03	117.00
0+04	116.00
0+05	115.00
0+06	114.00
0+10	114.00
0+11	115.00
0+12	116.00
0+13	117.00
0+14	118.00
0+15	119.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 119.00)	(0+15, 119.00)	0.045

Options	
Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results	
Normal Depth	0.5 ft
Roughness Coefficient	0.045
Elevation	114.46 ft
Elevation Range	114.0 to 119.0 ft
Flow Area	2.1 ft²
Wetted Perimeter	5.4 ft
Hydraulic Radius	0.4 ft
Top Width	5.02 ft
Normal Depth	0.5 ft

PL23-OUT36 (I-I) Pre - 2yr

Results	
Critical Depth	0.4 ft
Critical Slope	0.044 ft/ft
Velocity	3.58 ft/s
Velocity Head	0.20 ft
Specific Energy	0.65 ft
Froude Number	0.977
Flow Type	Subcritical

GVF Input Data	
Downstream Depth	0.0 ft
Length	0.0 ft
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.0 ft
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	0.5 ft
Critical Depth	0.4 ft
Channel Slope	0.042 ft/ft
Critical Slope	0.044 ft/ft

PL23-OUT36 (I-I) Post - 2yr

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Channel Slope	0.042 ft/ft
Discharge	7.52 cfs

Section Definitions

Station (ft)	Elevation (ft)
0+00	119.00
0+02	118.00
0+03	117.00
0+04	116.00
0+05	115.00
0+06	114.00
0+10	114.00
0+11	115.00
0+12	116.00
0+13	117.00
0+14	118.00
0+15	119.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 119.00)	(0+15, 119.00)	0.045

Options	
Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results	
Normal Depth	0.5 ft
Roughness Coefficient	0.045
Elevation	114.46 ft
Elevation Range	114.0 to 119.0 ft
Flow Area	2.1 ft²
Wetted Perimeter	5.4 ft
Hydraulic Radius	0.4 ft
Top Width	5.02 ft
Normal Depth	0.5 ft

PL23-OUT36 (I-I) Post - 2yr

Results	
Critical Depth	0.4 ft
Critical Slope	0.044 ft/ft
Velocity	3.58 ft/s
Velocity Head	0.20 ft
Specific Energy	0.65 ft
Froude Number	0.977
Flow Type	Subcritical

GVF Input Data	
Downstream Depth	0.0 ft
Length	0.0 ft
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.0 ft
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	0.5 ft
Critical Depth	0.4 ft
Channel Slope	0.042 ft/ft
Critical Slope	0.044 ft/ft

PL23-OUT36 (I-I) Post - 10yr

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Channel Slope	0.042 ft/ft
Discharge	10.13 cfs

Section Definitions

Station (ft)	Elevation (ft)
0+00	119.00
0+02	118.00
0+03	117.00
0+04	116.00
0+05	115.00
0+06	114.00
0+10	114.00
0+11	115.00
0+12	116.00
0+13	117.00
0+14	118.00
0+15	119.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 119.00)	(0+15, 119.00)	0.045

Options	
Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results	
Normal Depth	0.5 ft
Roughness Coefficient	0.045
Elevation	114.54 ft
Elevation Range	114.0 to 119.0 ft
Flow Area	2.6 ft²
Wetted Perimeter	5.7 ft
Hydraulic Radius	0.4 ft
Top Width	5.18 ft
Normal Depth	0.5 ft

PL23-OUT36 (I-I) Post - 10yr

Results	
Critical Depth	0.5 ft
Critical Slope	0.042 ft/ft
Velocity	3.97 ft/s
Velocity Head	0.24 ft
Specific Energy	0.79 ft
Froude Number	0.996
Flow Type	Subcritical

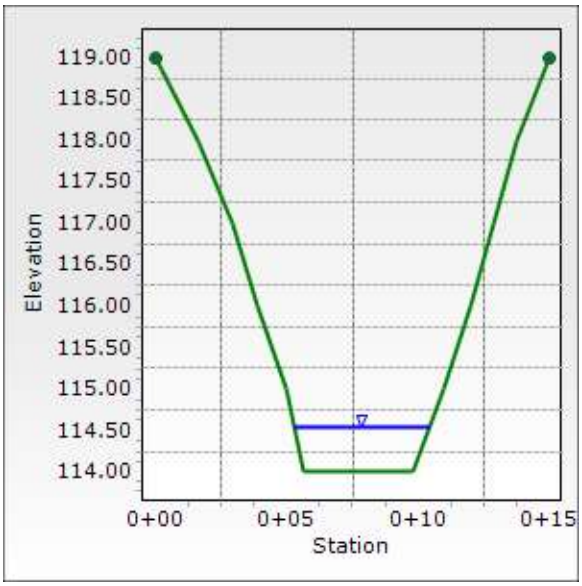
GVF Input Data	
Downstream Depth	0.0 ft
Length	0.0 ft
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.0 ft
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	0.5 ft
Critical Depth	0.5 ft
Channel Slope	0.042 ft/ft
Critical Slope	0.042 ft/ft

PL23-OUT36 (I-I) Post - 10yr

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Channel Slope	0.042 ft/ft
Normal Depth	0.5 ft
Discharge	10.13 cfs



Name of Project:	495-NEXT		Designed By: JMON
State:	VA	**County:** Fairfax County	Date: 03/03/22
Name of Culvert:	Pre Development		Checked By: NVD
NOAA Station:	Vienna Tysons 44-8737		Date: 03/03/22
LOCATION:	PL23-OUT36 Internal Point of Analysis J-J		
			UNITS **ENGLISH**

RATIONAL METHOD - DATA:

DRAINAGE BASIN

SUBSHED #	Land Use Description	Area Acres	C	C A
	Business: Industrial and Commercial (0.80-0.90)			
	Apartments and Townhomes (0.65-0.75)			
	Schools (0.50-0.60)			
	Residential - lots 10,000 sq. ft. (0.40-0.50)			
	- lots 12,000 sq. ft. (0.40-0.45)			
	- lots 17,000 sq. ft. (0.35-0.45)			
	- lots ½ acre or more (0.30-0.40)	1.44	0.35	0.50
	Parks, Cemeteries and Unimproved Areas (0.20-0.35)			
	Paved and Roof Areas (0.90)	0.87	0.90	0.78
	Cultivated Areas (0.50-0.70)			
	Pasture (0.35-0.45)			
	Lawns (0.25-0.35)	1.83	0.30	0.55
	Forest (0.20-0.30)	4.21	0.25	1.05
	Steep Grass (2:1) (0.40-0.70)			
	Shoulder and Ditch Areas (0.35-0.50)			
	Totals =	**8.35 Acres**	**0.35**	**2.89**

Time of Concentration (Tc)

		Reach	Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Rational C		Tc (Minutes)
Overland Flow (E.E. Seelye - VDOT Modified)									
	Soil / Surface Type/Land Cover		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Rational C		
	Forest	A-B	48.93	269.10	267.00	0.043	0.25		8.39
	Forest	B-C	150.99	267.00	257.00	0.066	0.25		12.40
Channel Flow			Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Natural Channel		C-D	403.08	257.00	240.75	0.040	0.050	5.75	1.17
				Area =	12.00		Wetted P =	12.70	
Pipe Flow			Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Assumed Information		D-E	279.69	240.75	223.00	0.063	0.013	18.14	0.26
	Pipe Diameter (in) =		24	Area =	3.14		Wetted P =	6.28	
Channel Flow			Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Natural Channel		E-F	133.98	223.00	209.55	0.100	0.045	10.07	0.22
				Area =	12.00		Wetted P =	12.70	
								Total Tc (Minutes) =	**22.44**

	2-Year	5-Year	10-Year	25-Year	50-Year	100-Year
Rainfall Intensity Inches / Hour.	**2.83**	**3.34**	**3.81**	**4.36**	**4.75**	**5.13**
Aosorption Coefficient / Ground Saturation Correction Coefficient Cf	1.00	1.00	1.00	1.10	1.20	1.25
Peak Discharge CFS.	**8.17**	**9.64**	**11.00**	**13.85**	**16.48**	**18.53**

Name of Project:	495-NEXT		Designed By: JMON
State:	VA	**County:** Fairfax County	Date: 03/03/22
Name of Culvert:	Post Development		Checked By: NVD
NOAA Station:	Vienna Tysons 44-8737		Date: 03/03/22
LOCATION:	PL23-OUT36 Internal Point of Analysis J-J		
			UNITS **ENGLISH**

RATIONAL METHOD - DATA:

DRAINAGE BASIN

SUBSHED #	Land Use Description	Area Acres	C	C A
	Business: Industrial and Commercial (0.80-0.90)			
	Apartments and Townhomes (0.65-0.75)			
	Schools (0.50-0.60)		0.50	
	Residential - lots 10,000 sq. ft. (0.40-0.50)			
	- lots 12,000 sq. ft. (0.40-0.45)			
	- lots 17,000 sq. ft. (0.35-0.45)			
	- lots ½ acre or more (0.30-0.40)	1.44	0.35	0.50
	Parks, Cemeteries and Unimproved Areas (0.20-0.35)			
	Paved and Roof Areas (0.90)	1.02	0.90	0.92
	Cultivated Areas (0.50-0.70)			
	Pasture (0.35-0.45)			
	Lawns (0.25-0.35)	1.82	0.30	0.55
	Forest (0.20-0.30)	3.69	0.25	0.92
	Steep Grass (2:1) (0.40-0.70)			
	Shoulder and Ditch Areas (0.35-0.50)			
	Totals =	**7.97 Acres**	**0.36**	**2.89**

Time of Concentration (Tc)

		Reach	Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Rational C		Tc (Minutes)
Overland Flow (E.E. Seelye - VDOT Modified)									
	Soil / Surface Type/Land Cover		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Rational C		
	Forest	A-B	48.93	269.10	267.00	0.043	0.25		8.39
	Forest	B-C	150.99	267.00	257.00	0.066	0.25		12.40
Channel Flow			Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Natural Channel		C-D	405.98	257.00	241.50	0.038	0.050	5.59	1.21
				Area =	12.00		Wetted P =	12.70	
Pipe Flow			Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Assumed Information		D-E	291.85	241.50	223.00	0.063	0.013	18.13	0.27
	Pipe Diameter (in) =		24	Area =	3.14		Wetted P =	6.28	
Channel Flow			Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Natural Channel		E-F	133.98	223.00	209.55	0.100	0.045	10.07	0.22
				Area =	12.00		Wetted P =	12.70	
								Total Tc (Minutes) =	**22.49**

		2-Year	5-Year	10-Year	25-Year	50-Year	100-Year
Rainfall Intensity	Inches / Hour.	**2.82**	**3.33**	**3.80**	**4.35**	**4.75**	**5.13**
Aosorption Coefficient / Ground Saturation Correction Coefficient Cf		1.00	1.00	1.00	1.10	1.20	1.25
Peak Discharge	CFS.	**8.16**	**9.63**	**11.00**	**13.84**	**16.47**	**18.52**

PL23-OUT36 (J-J) Pre - 2yr

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Channel Slope	0.030 ft/ft
Discharge	8.17 cfs

Section Definitions

Station (ft)	Elevation (ft)
0+00	215.00
0+01	214.00
0+01	213.00
0+02	212.00
0+02	211.00
0+03	210.00
0+06	209.50
0+08	210.00
0+09	211.00
0+10	212.00
0+11	213.00
0+12	214.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 215.00)	(0+12, 214.00)	0.045

Options	
Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results	
Normal Depth	0.7 ft
Roughness Coefficient	0.045
Elevation	210.21 ft
Elevation Range	209.5 to 215.0 ft
Flow Area	2.5 ft²
Wetted Perimeter	6.1 ft
Hydraulic Radius	0.4 ft
Top Width	5.74 ft
Normal Depth	0.7 ft

PL23-OUT36 (J-J) Pre - 2yr

Results	
Critical Depth	0.7 ft
Critical Slope	0.043 ft/ft
Velocity	3.21 ft/s
Velocity Head	0.16 ft
Specific Energy	0.87 ft
Froude Number	0.849
Flow Type	Subcritical

GVF Input Data	
Downstream Depth	0.0 ft
Length	0.0 ft
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.0 ft
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	0.7 ft
Critical Depth	0.7 ft
Channel Slope	0.030 ft/ft
Critical Slope	0.043 ft/ft

PL23-OUT36 (J-J) Post - 2yr

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Channel Slope	0.030 ft/ft
Discharge	8.16 cfs

Section Definitions

Station (ft)	Elevation (ft)
0+00	215.00
0+01	214.00
0+01	213.00
0+02	212.00
0+02	211.00
0+03	210.00
0+06	209.50
0+08	210.00
0+09	211.00
0+10	212.00
0+11	213.00
0+12	214.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 215.00)	(0+12, 214.00)	0.045

Options	
Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results	
Normal Depth	0.7 ft
Roughness Coefficient	0.045
Elevation	210.21 ft
Elevation Range	209.5 to 215.0 ft
Flow Area	2.5 ft²
Wetted Perimeter	6.1 ft
Hydraulic Radius	0.4 ft
Top Width	5.74 ft
Normal Depth	0.7 ft

PL23-OUT36 (J-J) Post - 2yr

Results	
Critical Depth	0.7 ft
Critical Slope	0.043 ft/ft
Velocity	3.21 ft/s
Velocity Head	0.16 ft
Specific Energy	0.87 ft
Froude Number	0.849
Flow Type	Subcritical

GVF Input Data	
Downstream Depth	0.0 ft
Length	0.0 ft
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.0 ft
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	0.7 ft
Critical Depth	0.7 ft
Channel Slope	0.030 ft/ft
Critical Slope	0.043 ft/ft

PL23-OUT36 (J-J) Post - 10yr

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Channel Slope	0.030 ft/ft
Discharge	11.00 cfs

Section Definitions

Station (ft)	Elevation (ft)
0+00	215.00
0+01	214.00
0+01	213.00
0+02	212.00
0+02	211.00
0+03	210.00
0+06	209.50
0+08	210.00
0+09	211.00
0+10	212.00
0+11	213.00
0+12	214.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 215.00)	(0+12, 214.00)	0.045

Options	
Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results	
Normal Depth	0.8 ft
Roughness Coefficient	0.045
Elevation	210.31 ft
Elevation Range	209.5 to 215.0 ft
Flow Area	3.1 ft²
Wetted Perimeter	6.3 ft
Hydraulic Radius	0.5 ft
Top Width	5.86 ft
Normal Depth	0.8 ft

PL23-OUT36 (J-J) Post - 10yr

Results	
Critical Depth	0.8 ft
Critical Slope	0.041 ft/ft
Velocity	3.56 ft/s
Velocity Head	0.20 ft
Specific Energy	1.00 ft
Froude Number	0.865
Flow Type	Subcritical

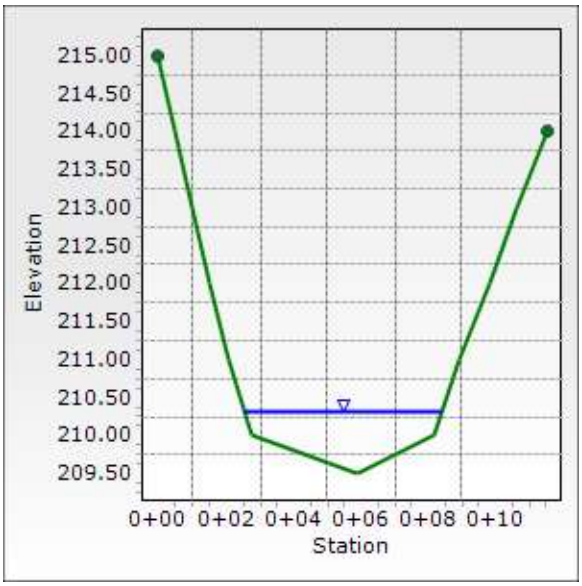
GVF Input Data	
Downstream Depth	0.0 ft
Length	0.0 ft
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.0 ft
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	0.8 ft
Critical Depth	0.8 ft
Channel Slope	0.030 ft/ft
Critical Slope	0.041 ft/ft

PL23-OUT36 (J-J) Post - 10yr

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Channel Slope	0.030 ft/ft
Normal Depth	0.8 ft
Discharge	11.00 cfs



Name of Project:	495-NEXT			Designed By:	JMON
State:	VA	**County:**	Fairfax County	Date:	03/03/22
Name of Culvert:	Pre Development			Checked By:	NVD
NOAA Station:	Vienna Tysons 44-8737			Date:	03/03/22
LOCATION:	PL23-OUT36 Internal Point of Analysis K-K				
				UNITS	**ENGLISH**

RATIONAL METHOD - DATA:

DRAINAGE BASIN

SUBSHED #	Land Use Description	Area Acres	C	C A
	Business: Industrial and Commercial (0.80-0.90)			
	Apartments and Townhomes (0.65-0.75)			
	Schools (0.50-0.60)			
	Residential - lots 10,000 sq. ft. (0.40-0.50)			
	- lots 12,000 sq. ft. (0.40-0.45)			
	- lots 17,000 sq. ft. (0.35-0.45)			
	- lots ½ acre or more (0.30-0.40)	1.44	0.35	0.50
	Parks, Cemeteries and Unimproved Areas (0.20-0.35)			
	Paved and Roof Areas (0.90)	0.87	0.90	0.78
	Cultivated Areas (0.50-0.70)			
	Pasture (0.35-0.45)			
	Lawns (0.25-0.35)	1.83	0.30	0.55
	Forest (0.20-0.30)	4.70	0.25	1.18
	Steep Grass (2:1) (0.40-0.70)			
	Shoulder and Ditch Areas (0.35-0.50)			
	Totals =	**8.84 Acres**	**0.34**	**3.01**

Time of Concentration (Tc)

	Reach		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Rational C		Tc (Minutes)
Overland Flow (E.E. Seelye - VDOT Modified)									
	Soil / Surface Type/Land Cover		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Rational C		
	Forest	A-B	48.93	269.10	267.00	0.043	0.25		8.39
	Forest	B-C	150.99	267.00	257.00	0.066	0.25		12.40
Channel Flow			Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Natural Channel		C-D	403.08	257.00	240.75	0.040	0.050	5.75	1.17
				Area =	12.00		Wetted P =	12.70	
Pipe Flow			Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Assumed Information		D-E	279.69	240.75	223.00	0.063	0.013	18.14	0.26
	Pipe Diameter (in) =		24	Area =	3.14		Wetted P =	6.28	
Channel Flow			Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Natural Channel		E-F	199.75	223.00	208.00	0.075	0.045	8.71	0.38
				Area =	12.00		Wetted P =	12.70	
								Total Tc (Minutes) =	**22.60**

	2-Year	5-Year	10-Year	25-Year	50-Year	100-Year
Rainfall Intensity Inches / Hour.	**2.82**	**3.32**	**3.80**	**4.34**	**4.74**	**5.11**
Aosorption Coefficient / Ground Saturation Correction Coefficient Cf	1.00	1.00	1.00	1.10	1.20	1.25
Peak Discharge CFS.	**8.48**	**10.01**	**11.43**	**14.38**	**17.12**	**19.25**

Name of Project:	495-NEXT		Designed By: JMON
State:	VA	**County:** Fairfax County	Date: 03/03/22
Name of Culvert:	Post Development		Checked By: NVD
NOAA Station:	Vienna Tysons 44-8737		Date: 03/03/22
LOCATION:	PL23-OUT36 Internal Point of Analysis K-K		
			UNITS **ENGLISH**

RATIONAL METHOD - DATA:

DRAINAGE BASIN

SUBSHED #	Land Use Description	Area Acres	C	C A
	Business: Industrial and Commercial (0.80-0.90)			
	Apartments and Townhomes (0.65-0.75)			
	Schools (0.50-0.60)		0.50	
	Residential - lots 10,000 sq. ft. (0.40-0.50)			
	- lots 12,000 sq. ft. (0.40-0.45)			
	- lots 17,000 sq. ft. (0.35-0.45)			
	- lots ½ acre or more (0.30-0.40)	1.44	0.35	0.50
	Parks, Cemeteries and Unimproved Areas (0.20-0.35)			
	Paved and Roof Areas (0.90)	1.02	0.90	0.92
	Cultivated Areas (0.50-0.70)			
	Pasture (0.35-0.45)			
	Lawns (0.25-0.35)	1.82	0.30	0.55
	Forest (0.20-0.30)	4.18	0.25	1.05
	Steep Grass (2:1) (0.40-0.70)			
	Shoulder and Ditch Areas (0.35-0.50)			
	Totals =	**8.46 Acres**	**0.36**	**3.01**

Time of Concentration (Tc)

		Reach	Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Rational C		Tc (Minutes)
Overland Flow (E.E. Seelye - VDOT Modified)									
	Soil / Surface Type/Land Cover		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Rational C		
	Forest	A-B	48.93	269.10	267.00	0.043	0.25		8.39
	Forest	B-C	150.99	267.00	257.00	0.066	0.25		12.40
Channel Flow			Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Natural Channel		C-D	405.98	257.00	241.50	0.038	0.050	5.59	1.21
				Area =	12.00		Wetted P =	12.70	
Pipe Flow			Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Assumed Information		D-E	291.85	241.50	223.00	0.063	0.013	18.13	0.27
	Pipe Diameter (in) =		24	Area =	3.14		Wetted P =	6.28	
Channel Flow			Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Natural Channel		E-F	199.75	223.00	208.00	0.075	0.045	8.71	0.38
				Area =	12.00		Wetted P =	12.70	
								Total Tc (Minutes) =	**22.65**

		2-Year	5-Year	10-Year	25-Year	50-Year	100-Year
Rainfall Intensity	Inches / Hour.	**2.81**	**3.32**	**3.79**	**4.34**	**4.73**	**5.11**
Aosorption Coefficient / Ground Saturation Correction Coefficient Cf		1.00	1.00	1.00	1.10	1.20	1.25
Peak Discharge	CFS.	**8.47**	**10.00**	**11.42**	**14.38**	**17.11**	**19.24**

PL23-OUT36 (K-K) Pre - 2yr

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Channel Slope	0.036 ft/ft
Discharge	8.48 cfs

Section Definitions

Station (ft)	Elevation (ft)
0+00	214.00
0+12	212.00
0+16	210.00
0+20	208.00
0+25	210.00
0+34	212.00
0+47	214.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 214.00)	(0+47, 214.00)	0.045

Options	
Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results	
Normal Depth	1.0 ft
Roughness Coefficient	0.045
Elevation	209.03 ft
Elevation Range	208.0 to 214.0 ft
Flow Area	2.3 ft²
Wetted Perimeter	4.9 ft
Hydraulic Radius	0.5 ft
Top Width	4.41 ft
Normal Depth	1.0 ft
Critical Depth	1.0 ft
Critical Slope	0.043 ft/ft
Velocity	3.75 ft/s
Velocity Head	0.22 ft
Specific Energy	1.24 ft

PL23-OUT36 (K-K) Pre - 2yr

Results	
Froude Number	0.924
Flow Type	Subcritical

GVF Input Data	
Downstream Depth	0.0 ft
Length	0.0 ft
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.0 ft
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	1.0 ft
Critical Depth	1.0 ft
Channel Slope	0.036 ft/ft
Critical Slope	0.043 ft/ft

PL23-OUT36 (K-K) Post - 2yr

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Channel Slope	0.036 ft/ft
Discharge	8.47 cfs

Section Definitions

Station (ft)	Elevation (ft)
0+00	214.00
0+12	212.00
0+16	210.00
0+20	208.00
0+25	210.00
0+34	212.00
0+47	214.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 214.00)	(0+47, 214.00)	0.045

Options	
Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results	
Normal Depth	1.0 ft
Roughness Coefficient	0.045
Elevation	209.02 ft
Elevation Range	208.0 to 214.0 ft
Flow Area	2.3 ft²
Wetted Perimeter	4.9 ft
Hydraulic Radius	0.5 ft
Top Width	4.41 ft
Normal Depth	1.0 ft
Critical Depth	1.0 ft
Critical Slope	0.043 ft/ft
Velocity	3.75 ft/s
Velocity Head	0.22 ft
Specific Energy	1.24 ft

PL23-OUT36 (K-K) Post - 2yr

Results	
Froude Number	0.924
Flow Type	Subcritical

GVF Input Data	
Downstream Depth	0.0 ft
Length	0.0 ft
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.0 ft
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	1.0 ft
Critical Depth	1.0 ft
Channel Slope	0.036 ft/ft
Critical Slope	0.043 ft/ft

PL23-OUT36 (K-K) Post - 10yr

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Channel Slope	0.036 ft/ft
Discharge	11.42 cfs

Section Definitions

Station (ft)	Elevation (ft)
0+00	214.00
0+12	212.00
0+16	210.00
0+20	208.00
0+25	210.00
0+34	212.00
0+47	214.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 214.00)	(0+47, 214.00)	0.045

Options	
Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results	
Normal Depth	1.1 ft
Roughness Coefficient	0.045
Elevation	209.15 ft
Elevation Range	208.0 to 214.0 ft
Flow Area	2.8 ft²
Wetted Perimeter	5.4 ft
Hydraulic Radius	0.5 ft
Top Width	4.93 ft
Normal Depth	1.1 ft
Critical Depth	1.1 ft
Critical Slope	0.041 ft/ft
Velocity	4.04 ft/s
Velocity Head	0.25 ft
Specific Energy	1.40 ft

PL23-OUT36 (K-K) Post - 10yr

Results	
Froude Number	0.942
Flow Type	Subcritical

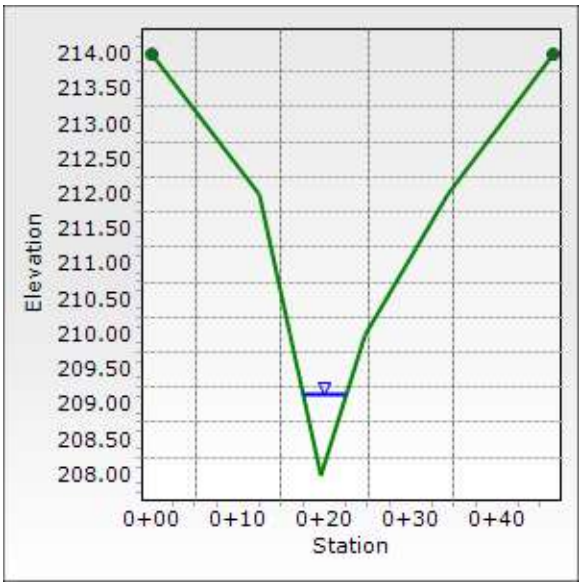
GVF Input Data	
Downstream Depth	0.0 ft
Length	0.0 ft
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.0 ft
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	1.1 ft
Critical Depth	1.1 ft
Channel Slope	0.036 ft/ft
Critical Slope	0.041 ft/ft

PL23-OUT36 (K-K) Post - 10yr

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Channel Slope	0.036 ft/ft
Normal Depth	1.1 ft
Discharge	11.42 cfs



APPENDIX C37
PL23-OUT37

Outfall PL23-OUT 37

Outfall PL23-OUT37 is an existing outfall at I-495 Northbound station 710+39 left. The outfall consists of a manmade stormwater conveyance system. In existing conditions, flow is conveyed through existing storm sewer and sheet flow to the point of analysis. The outfall prior to development is 1.55 acres.

Development of this area will result in an increased area to this outfall, due to the proposed roadway design and grading. The resulting area to the outfall will be 1.75 acres.

Drainage Area:

The drainage areas and resulting changes are summarized in the table below:

PL23-OUT 37			
Drainage Area	**Total Area**	**C (Total)**	**Tc**
Existing	1.55 ac	0.90	6.68 min
Proposed	1.75 ac	0.90	6.65 min

Limits of Study:

The location of the outfall is shown in the included outfall drainage map. The point of analysis is at existing structure 013.

Easement Requirements:

No additional easements are required.

Outfall Discharge:

All discharges were calculated using the Rational Method and are summarized below:

PL23-OUT 37		
Drainage Area	**Peak Flow Rate (Total)**	
	2 Year	10 Year
Existing	6.65 cfs	8.71 cfs
Proposed	7.53 cfs	9.86 cfs
Net Change	**0.87 cfs**	**1.15 cfs**

Channel Protection:

Under Section 11.7.5.1 of the VDOT drainage manual, areas draining to a manmade stormwater conveyance channel shall satisfy the channel protection criteria by providing conveyance of the 2 year storm without causing erosion of the system. As this outfall is concrete storm sewer, there is no maximum erosive velocity.

Pipe Run	Channel Protection - 2 Year Velocity			Outfall Adequate?
	Pipe Material	Max Permissible Velocity (ft/s)	Proposed Velocity (ft/s)	
EX013 to EX010	Concrete	No Max	10.45	Yes
EX010 to EX008	Concrete	No Max	10.70	Yes
EX008 to EX002	Concrete	No Max	10.88	Yes

Flood Protection:

Under Section 11.7.5.2 of the VDOT drainage manual, areas draining to a manmade stormwater conveyance channel shall satisfy the flood protection criteria by demonstrating that the peak flow rate from a 10 year storm will be contained within the system. Computations demonstrating the adequacy of the storm sewer downstream have been provided within this section. The results have been summarized below:

Pipe Run	Flood Protection - 10 Year Capacity		Outfall Adequate?
	Max Pipe Discharge (cfs)	Pipe Discharge (cfs)	
EX013 to EX010	19.83	9.86	Yes
EX010 to EX008	41.20	12.63	Yes
EX008 to EX002	38.59	15.94	Yes

Final Opinion:

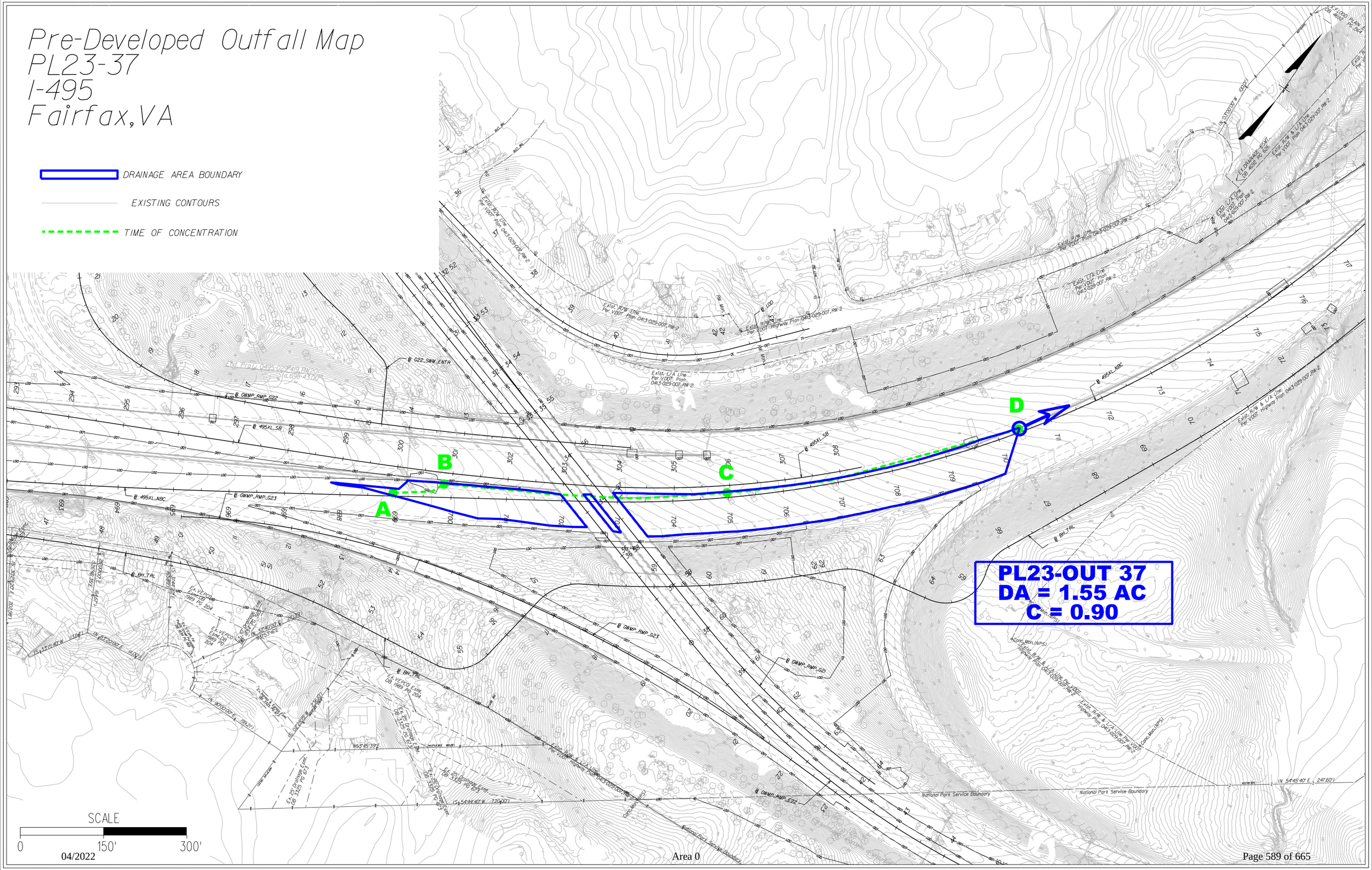
This outfall is a manmade stormwater conveyance system. We have shown compliance with the channel and flood protection criteria, by providing calculations demonstrating non-erosive velocities and demonstrating the drainage is contained within the system. It is therefore our opinion that this outfall is adequate.

Pre-Developed Outfall Map
PL23-37
I-495
Fairfax, VA

DRAINAGE AREA BOUNDARY

EXISTING CONTOURS

TIME OF CONCENTRATION



Post-Developed Outfall Map
PL23-37
I-495
Fairfax, VA

DRAINAGE AREA BOUNDARY

EXISTING CONTOURS

TIME OF CONCENTRATION

A

B

C

D

PL23-OUT 37
DA = 1.75 AC
C = 0.90

SCALE
0 150' 300'

Name of Project:	495-NEXT			Designed By:	KRI
State:	VA	**County:**	Fairfax County	Date:	09/03/21
Name of Culvert:	Pre Development			Checked By:	NVD
NOAA Station:	Vienna Tysons 44-8737			Date:	09/03/21
LOCATION:	PL23-OUT 37				
				UNITS	**ENGLISH**

RATIONAL METHOD - DATA:

DRAINAGE BASIN

SUBSHED #	Land Use Description	Area Acres	C	C A
	Business: Industrial and Commercial (0.80-0.90)			
	Apartments and Townhomes (0.65-0.75)			
	Schools (0.50-0.60)			
	Residential - lots 10,000 sq. ft. (0.40-0.50)			
	- lots 12,000 sq. ft. (0.40-0.45)			
	- lots 17,000 sq. ft. (0.35-0.45)			
	- lots ½ acre or more (0.30-0.40)			
	Parks, Cemeteries and Unimproved Areas (0.20-0.35)			
	Paved and Roof Areas (0.90)	1.55	0.90	1.39
	Cultivated Areas (0.50-0.70)			
	Pasture (0.35-0.45)			
	Lawns (0.25-0.35)		0.30	
	Forest (0.20-0.30)		0.25	
	Steep Grass (2:1) (0.40-0.70)			
	Shoulder and Ditch Areas (0.35-0.50)			
	Totals =	**1.55 Acres**	**0.90**	**1.39**

Time of Concentration (Tc)

		Reach	Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Rational C		Tc (Minutes)
Overland Flow (E.E. Seelye - VDOT Modified)									
	Soil / Surface Type/Land Cover		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Rational C		
	Paved	A-B	96.00	211.65	209.00	0.028	0.90		3.36
Shallow Concentrated Flow			Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Intercept Coeff.		
Paved		B-C	511.23	209.00	193.33	0.031	0.619		2.40
Pipe Flow			Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
EX019 to EX013		C-D	538.71	189.51	170.93	0.034	0.013	9.78	0.92
	Pipe Diameter (in) =		15	Area =	1.23		Wetted P =	3.93	
								Total Tc (Minutes) =	**6.68**

		2-Year	**5-Year**	**10-Year**	**25-Year**	**50-Year**	**100-Year**
Rainfall Intensity	Inches / Hour.	**4.78**	**5.54**	**6.25**	**7.08**	**7.67**	**8.23**
Aosorption Coefficient / Ground Saturation Correction Coefficient	Cf	1.00	1.00	1.00	1.10	1.20	1.25
Peak Discharge	CFS.	**6.65**	**7.72**	**8.71**	**10.84**	**12.82**	**14.33**

Name of Project:	495-NEXT			Designed By:	JMON
State:	VA	**County:**	Fairfax County	Date:	11/19/21
Name of Culvert:	Post Development			Checked By:	NVD
NOAA Station:	Vienna Tysons 44-8737			Date:	11/19/21
LOCATION:	PL23-OUT 37				
				UNITS	**ENGLISH**

RATIONAL METHOD - DATA:

DRAINAGE BASIN

SUBSHED #	Land Use Description	Area Acres	C	C A
	Business: Industrial and Commercial (0.80-0.90)			
	Apartments and Townhomes (0.65-0.75)			
	Schools (0.50-0.60)			
	Residential - lots 10,000 sq. ft. (0.40-0.50)			
	- lots 12,000 sq. ft. (0.40-0.45)			
	- lots 17,000 sq. ft. (0.35-0.45)			
	- lots ½ acre or more (0.30-0.40)	0.00	0.35	
	Parks, Cemeteries and Unimproved Areas (0.20-0.35)			
	Paved and Roof Areas (0.90)	1.75	0.90	1.57
	Cultivated Areas (0.50-0.70)			
	Pasture (0.35-0.45)			
	Lawns (0.25-0.35)	0.00	0.30	
	Forest (0.20-0.30)	0.00	0.25	
	Steep Grass (2:1) (0.40-0.70)			
	Shoulder and Ditch Areas (0.35-0.50)			
	Totals =	**1.75 Acres**	**0.90**	**1.57**

Time of Concentration (Tc)

		Reach	Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Rational C		Tc (Minutes)
Overland Flow (E.E. Seelye - VDOT Modified)									
	Soil / Surface Type/Land Cover		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Rational C		
	Paved	A-B	110.56	213.00	210.00	0.027	0.90		3.58
Shallow Concentrated Flow			Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Intercept Coeff.		
Paved		B-C	550.85	209.00	193.33	0.028	0.619		2.68
Pipe Flow			Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
EX019 to EX013		C-D	304.13	189.51	170.93	0.061	0.013	13.01	0.39
	Pipe Diameter (in) =		15	Area =	1.23		Wetted P =	3.93	
								Total Tc (Minutes) =	**6.65**

		2-Year	**5-Year**	**10-Year**	**25-Year**	**50-Year**	**100-Year**
Rainfall Intensity	Inches / Hour.	**4.78**	**5.55**	**6.26**	**7.08**	**7.68**	**8.24**
Aosorption Coefficient / Ground Saturation Correction Coefficient Cf		1.00	1.00	1.00	1.10	1.20	1.25
Peak Discharge	CFS.	**7.53**	**8.74**	**9.86**	**12.27**	**14.51**	**16.22**

Post-Developed Storm Drain Inlet Map
PL23-OUT37
I-495 NEXT
Fairfax, VA

DRAINAGE AREA BOUNDARY

EXISTING CONTOURS

TIME OF CONCENTRATION

SCALE
0 75' 150'

Ex 008
DA=0.61
C=0.90

Ex 010
DA=0.50
C=0.90

Ex 013
DA=1.75
C=0.90

A

B

C

D

LD-229
STORM SEWER DESIGN COMPUTATIONS

PROJECT: I-495 NEXT
LOCATION:
COUNTY: Vienna Tysons Corner

Designed by: JMON
Checked by: NVD

STORM FREQUENCY **2**

UNITS **ENGLISH**

PIPE NO.	FROM POINT REFERENCE	FROM POINT STA.	TO POINT REFERENCE	TO POINT STA.	DRAIN. AREA "A" Acre	RUNOFF COEFF. "C"	CA INCRE-MENT	CA ACCUM-ULATED	INLET TIME Minutes	RAIN FALL In/Hr	RUNOFF Lateral CFS	RUNOFF Total Q CFS	INVERT ELEVATIONS UPPER END	INVERT ELEVATIONS LOWER END	LENGTH of Pipe Ft.	SLOPE Ft./Ft.	SIZE (Dia. Or Span/Rise) In.	SHAPE	Number of Pipes	Capacity CFS	Friction Slope Ft./Ft.	NORMAL FLOW Depth of Flow, dn Ft.	NORMAL FLOW Area of Flow, An SqFt	NORMAL FLOW Hrn Ft.	NORMAL FLOW Vn Ft/Sec	NORMAL FLOW En Ft.	FLOW TIME INCRE-MENT Minutes	FLOW TIME ACCUMU-LATED Minutes	REMARKS
	(1)		(2)		(3)	(4)	(5)	(6)	(7)	(8)		(9)	(10)	(11)	(12)	(13)	(14)			(15)							(17)	(17)	(18)
EX008EX002	EX008		EX002		0.61	0.90	0.55	2.57	7.59	4.58	0.00	12.15	150.34	143.99	218.19	0.02910	24	Circular	1	38.59	0.00300	0.77	1.12	0.42	10.88	2.61	0.33	7.92	
EX010EX008	EX010		EX008		0.50	0.90	0.45	2.03	7.13	4.68	0.00	9.64	160.22	150.36	297.37	0.03316	24	Circular	1	41.20	0.00190	0.66	0.90	0.37	10.70	2.44	0.46	7.59	
EX013EX010	EX013		EX010		1.75	0.90	1.58	1.58	6.65	4.78	0.00	7.53	170.91	160.27	298.75	0.03562	18	Circular	1	19.83	0.00540	0.64	0.72	0.34	10.45	2.34	0.48	7.13	

LD-229
STORM SEWER DESIGN COMPUTATIONS

STORM FREQUENCY **10**

PROJECT: I-495 NEXT
LOCATION:
COUNTY: Vienna Tysons Corner

Designed by: JMON
Checked by: NVD

UNITS **ENGLISH**

PIPE NO.	FROM POINT REFERENCE	FROM POINT STA.	TO POINT REFERENCE	TO POINT STA.	DRAIN. AREA "A" Acre	RUNOFF COEFF. "C"	CA INCRE-MENT	CA ACCUM-ULATED	INLET TIME Minutes	RAIN FALL In/Hr	RUNOFF Lateral CFS	RUNOFF Total Q CFS	INVERT ELEVATIONS UPPER END	INVERT ELEVATIONS LOWER END	LENGTH of Pipe Ft.	SLOPE Ft./Ft.	SIZE (Dia. Or Span/Rise) In.	SHAPE	Number of Pipes	Capacity CFS	Friction Slope Ft./Ft.	NORMAL FLOW Depth of Flow, dn Ft.	NORMAL FLOW Area of Flow, An SqFt	NORMAL FLOW Hrn Ft.	NORMAL FLOW Vn Ft/Sec	NORMAL FLOW En Ft.	FLOW TIME INCRE-MENT Minutes	FLOW TIME ACCUMU-LATED Minutes	REMARKS
	(1)		(2)		(3)	(4)	(5)	(6)	(7)	(8)		(9)	(10)	(11)	(12)	(13)	(14)			(15)					(16)		(17)	(17)	(18)
EX008EX002	EX008		EX002		0.61	0.90	0.55	2.57	7.52	6.03	0.00	15.94	150.34	143.99	218.19	0.02910	24	Circular	1	38.59	0.00520	0.90	1.36	0.47	11.70	3.02	0.31	7.84	
EX010EX008	EX010		EX008		0.50	0.90	0.45	2.03	7.09	6.14	0.00	12.63	160.22	150.36	297.37	0.03316	24	Circular	1	41.20	0.00320	0.76	1.10	0.41	11.53	2.82	0.43	7.52	
EX013EX010	EX013		EX010		1.75	0.90	1.58	1.58	6.65	6.26	0.00	9.86	170.91	160.27	298.75	0.03562	18	Circular	1	19.83	0.00920	0.75	0.88	0.37	11.20	2.70	0.44	7.09	

APPENDIX C38
PL23-OUT38

Outfall PL23-OUT 38

Outfall PL23-OUT38 is an existing outfall at Balls Hill Road station 19+30 right. The outfall consists of a natural stormwater conveyance system. In existing conditions, flow is conveyed through existing channels, gutter flow and sheet flow to the point of analysis. The outfall prior to development is 0.19 acres.

Development of this area will result in a decreased area to this outfall, due to the realignment of Georgetown Pike. The resulting area to the outfall will be 0.18 acres.

Drainage Area:

The drainage areas and resulting changes are summarized in the table below:

PL23-OUT 38			
Drainage Area	**Total Area**	**C (Total)**	**Tc**
Existing	0.19 ac	0.51	5.00 min
Proposed	0.18 ac	0.53	5.00 min

Limits of Study:

The location of the outfall is shown in the included outfall drainage map. The point of analysis is within the existing channel along the east side of Balls Hill Road.

Easement Requirements:

No additional easements are required.

Outfall Discharge:

All discharges were calculated using the Rational Method and are summarized below:

PL23-OUT 38		
Drainage Area	**Peak Flow Rate (Total)**	
	2 Year	10 Year
Existing	0.50 cfs	0.65 cfs
Proposed	0.50 cfs	0.65 cfs
Net Change	**0.00 cfs**	**0.00 cfs**

Channel Description:

Outfall PL23-OUT38 is a natural channel consisting of a receiving channel and a metal culvert. Cross Sections were prepared utilizing topography prepared by Rinker Design Associates, P.C. and Fairfax County GIS.

Information on the existing culvert was taken from information available in the Infill Lot Grading Plan for Lot 65 (Fairfax County 3299-INF-005-1).

Channel Protection:

Under Section 11.7.5.1 of the VDOT drainage manual, areas draining to a natural stormwater conveyance channel shall satisfy the channel protection criteria by providing conveyance of the 2 year storm without causing erosion of the system. Calculations have been provided below supporting the 2 year velocities in the system:

Pipe Run	Channel Protection - 2 Year Velocity				Outfall Adequate?
	Pipe Material	Max Permissible Velocity (ft/s)	Existing Velocity (ft/s)	Proposed Velocity (ft/s)	
EX Culvert	Metal	No Max	4.77	4.77	Yes
Cross Section	**Channel Material**	**Max Permissible Velocity (ft/s)**	**Existing Velocity (ft/s)**	**Proposed Velocity (ft/s)**	**Outfall Adequate?**
A-A	Wheaton-Glenelg Complex	2.3	2.29	2.29	Yes
B-B	Wheaton-Meadowville Complex	2.3	1.57	1.56	Yes

All velocities are within the allowable range.

Flood Protection:

Under Section 11.7.5.2 of the VDOT drainage manual, areas draining to a natural stormwater conveyance channel shall satisfy the flood protection criteria by demonstrating that the peak flow rate from a 10 year storm will be contained within the system. The proposed flows to the channel have been analyzed and yield the following results:

Pipe Run	Flood Protection - 10 Year Capacity						Outfall Adequate?
	Existing HW/D	Proposed HW/D	Max Allowable	Existing Freeboard	Proposed Freeboard	Minimum Freeboard	
EX Culvert	0.69	0.69	1.50	1.57	1.57	1.50	Yes
Cross Section	**Flood Protection - 10 Year Capacity**						**Outfall Adequate?**
	Channel Depth (ft)			**Normal Depth (ft)**			
A-A	4.00			0.2			Yes
B-B	2.00			0.2			Yes

Final Opinion:

This outfall is a natural stormwater conveyance system. We have shown compliance with the channel protection criteria, by indicating non-erosive velocities. We have shown compliance with the flood protection criteria, by providing calculations demonstrating a reduction in the 2 and 10 year peak flow rates. It is therefore our opinion that this outfall is adequate.

Pre-Developed Outfall Map
PL23-38
I-495
Fairfax, VA

DRAINAGE AREA BOUNDARY

EXISTING CONTOURS

TIME OF CONCENTRATION

PL23-OUT 38
DA = 0.19 AC
C = 0.51

SCALE
0 25' 50'

Post-Developed Outfall Map
PL23-38
I-495
Fairfax, VA

DRAINAGE AREA BOUNDARY

EXISTING CONTOURS

TIME OF CONCENTRATION

PL23-OUT 38
DA = 0.18 AC
C = 0.53

SCALE
0 25' 50'

Name of Project:	495-NEXT			Designed By:	KRI
State:	VA	**County:**	Fairfax County	Date:	03/15/22
Name of Culvert:	Pre Development			Checked By:	NVD
NOAA Station:	Vienna Tysons 44-8737			Date:	03/15/22
LOCATION:	PL23-OUT 38				
				UNITS	**ENGLISH**

RATIONAL METHOD - DATA:

DRAINAGE BASIN

SUBSHED #	Land Use Description	Area Acres	C	C A
	Business: Industrial and Commercial (0.80-0.90)			
	Apartments and Townhomes (0.65-0.75)			
	Schools (0.50-0.60)			
	Residential - lots 10,000 sq. ft. (0.40-0.50)			
	- lots 12,000 sq. ft. (0.40-0.45)			
	- lots 17,000 sq. ft. (0.35-0.45)			
	- lots ½ acre or more (0.30-0.40)	0.10	0.35	0.03
	Parks, Cemeteries and Unimproved Areas (0.20-0.35)			
	Paved and Roof Areas (0.90)	0.06	0.90	0.05
	Cultivated Areas (0.50-0.70)			
	Pasture (0.35-0.45)			
	Lawns (0.25-0.35)	0.03	0.30	0.01
	Forest (0.20-0.30)		0.25	
	Steep Grass (2:1) (0.40-0.70)			
	Shoulder and Ditch Areas (0.35-0.50)			
	Totals =	**0.19 Acres**	**0.51**	**0.10**

Time of Concentration (Tc)

	Reach	Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Rational C		Tc (Minutes)
							Total Tc (Minutes) =	**5.00**

		2-Year	**5-Year**	**10-Year**	**25-Year**	**50-Year**	**100-Year**
Rainfall Intensity	Inches / Hour.	**5.18**	**6.00**	**6.76**	**7.64**	**8.28**	**8.89**
Aosorption Coefficient / Ground Saturation Correction Coefficient Cf		1.00	1.00	1.00	1.10	1.20	1.25
Peak Discharge	CFS.	**0.50**	**0.58**	**0.65**	**0.81**	**0.95**	**1.07**

Name of Project:	495-NEXT			Designed By:	JMON
State:	VA	**County:**	Fairfax County	Date:	03/15/22
Name of Culvert:	Post Development			Checked By:	NVD
NOAA Station:	Vienna Tysons 44-8737			Date:	03/15/22
LOCATION:	PL23-OUT 38				
				UNITS	**ENGLISH**

RATIONAL METHOD - DATA:

DRAINAGE BASIN

SUBSHED #	Land Use Description	Area Acres	C	C A
	Business: Industrial and Commercial (0.80-0.90)			
	Apartments and Townhomes (0.65-0.75)			
	Schools (0.50-0.60)		0.50	
	Residential - lots 10,000 sq. ft. (0.40-0.50)			
	- lots 12,000 sq. ft. (0.40-0.45)			
	- lots 17,000 sq. ft. (0.35-0.45)			
	- lots ½ acre or more (0.30-0.40)	0.00	0.35	
	Parks, Cemeteries and Unimproved Areas (0.20-0.35)			
	Paved and Roof Areas (0.90)	0.07	0.90	0.06
	Cultivated Areas (0.50-0.70)			
	Pasture (0.35-0.45)			
	Lawns (0.25-0.35)	0.11	0.30	0.03
	Forest (0.20-0.30)		0.25	
	Steep Grass (2:1) (0.40-0.70)			
	Shoulder and Ditch Areas (0.35-0.50)			
	Totals =	**0.18 Acres**	**0.53**	**0.10**

Time of Concentration (Tc)

	Reach	Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Rational C		Tc (Minutes)
							Total Tc (Minutes) =	**5.00**

		2-Year	**5-Year**	**10-Year**	**25-Year**	**50-Year**	**100-Year**
Rainfall Intensity	Inches / Hour.	**5.18**	**6.00**	**6.76**	**7.64**	**8.28**	**8.89**
Aosorption Coefficient / Ground Saturation Correction Coefficient Cf		1.00	1.00	1.00	1.10	1.20	1.25
Peak Discharge	CFS.	**0.50**	**0.58**	**0.65**	**0.81**	**0.95**	**1.07**

Outfall PL23-OUT38 Sections A-A, B-B: Looking Upstream

Outfall PL23-OUT38 Sections A-A, B-B: Looking Downstream

PL23-OUT38 Outlet Pipe/Cross Sections
I-495 NEXT
Fairfax,VA

DRAINAGE AREA BOUNDARY

EXISTING CONTOURS

TIME OF CONCENTRATION

SCALE
0 30' 60'

SECTION A-A

SECTION B-B

Ex Culvert
DA=0.45
C=0.42

BALLS HILL RD

Name of Project:	495-NEXT			Designed By:	JMON
State:	VA	**County:**	Fairfax County	Date:	03/15/22
Name of Culvert:	Pre Development			Checked By:	NVD
NOAA Station:	Vienna Tysons 44-8737			Date:	03/15/22
LOCATION:	PL23-OUT 38 EX Culvert				
				UNITS	**ENGLISH**

RATIONAL METHOD - DATA:

DRAINAGE BASIN

SUBSHED #	Land Use Description	Area Acres	C	C A
	Business: Industrial and Commercial (0.80-0.90)			
	Apartments and Townhomes (0.65-0.75)			
	Schools (0.50-0.60)			
	Residential - lots 10,000 sq. ft. (0.40-0.50)			
	- lots 12,000 sq. ft. (0.40-0.45)			
	- lots 17,000 sq. ft. (0.35-0.45)			
	- lots ½ acre or more (0.30-0.40)	0.22	0.35	0.08
	Parks, Cemeteries and Unimproved Areas (0.20-0.35)			
	Paved and Roof Areas (0.90)	0.07	0.90	0.06
	Cultivated Areas (0.50-0.70)			
	Pasture (0.35-0.45)			
	Lawns (0.25-0.35)	0.17	0.30	0.05
	Forest (0.20-0.30)	0.00	0.25	
	Steep Grass (2:1) (0.40-0.70)			
	Shoulder and Ditch Areas (0.35-0.50)			
	Totals =	**0.46 Acres**	**0.41**	**0.19**

Time of Concentration (Tc)

	Reach	Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Rational C		Tc (Minutes)
							Total Tc (Minutes) =	**5.00**

		2-Year	**5-Year**	**10-Year**	**25-Year**	**50-Year**	**100-Year**
Rainfall Intensity	Inches / Hour.	**5.18**	**6.00**	**6.76**	**7.64**	**8.28**	**8.89**
Aosorption Coefficient / Ground Saturation Correction Coefficient Cf		1.00	1.00	1.00	1.10	1.20	1.25
Peak Discharge	CFS.	**0.98**	**1.13**	**1.28**	**1.59**	**1.88**	**2.10**

Name of Project:	495-NEXT			Designed By:	JMON
State:	VA	**County:**	Fairfax County	Date:	03/15/22
Name of Culvert:	Post Development			Checked By:	NVD
NOAA Station:	Vienna Tysons 44-8737			Date:	03/15/22
LOCATION:	PL23-OUT 38 Ex Culvert				
				UNITS	**ENGLISH**

RATIONAL METHOD - DATA:

DRAINAGE BASIN

SUBSHED #	Land Use Description	Area Acres	C	C A
	Business: Industrial and Commercial (0.80-0.90)			
	Apartments and Townhomes (0.65-0.75)			
	Schools (0.50-0.60)		0.50	
	Residential - lots 10,000 sq. ft. (0.40-0.50)			
	- lots 12,000 sq. ft. (0.40-0.45)			
	- lots 17,000 sq. ft. (0.35-0.45)			
	- lots ½ acre or more (0.30-0.40)	0.12	0.35	0.04
	Parks, Cemeteries and Unimproved Areas (0.20-0.35)			
	Paved and Roof Areas (0.90)	0.08	0.90	0.07
	Cultivated Areas (0.50-0.70)			
	Pasture (0.35-0.45)			
	Lawns (0.25-0.35)	0.25	0.30	0.07
	Forest (0.20-0.30)		0.25	
	Steep Grass (2:1) (0.40-0.70)			
	Shoulder and Ditch Areas (0.35-0.50)			
	Totals =	**0.45 Acres**	**0.42**	**0.19**

Time of Concentration (Tc)

	Reach	Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Rational C		Tc (Minutes)
							Total Tc (Minutes) =	**5.00**

		2-Year	**5-Year**	**10-Year**	**25-Year**	**50-Year**	**100-Year**
Rainfall Intensity	Inches / Hour.	**5.18**	**6.00**	**6.76**	**7.64**	**8.28**	**8.89**
Aosorption Coefficient / Ground Saturation Correction Coefficient Cf		1.00	1.00	1.00	1.10	1.20	1.25
Peak Discharge	CFS.	**0.98**	**1.13**	**1.28**	**1.59**	**1.88**	**2.10**

PROJECT	**I-495 NEXT**			**CULVERT DESIGN FORM LD-269**	
ROAD		**COUNTY**	Fairfax	SHEET 1 OF 1	DESIGNER: JMON DATE: 3/15/2022
CULVERT	OUT38 Pre		VA	UNITS **ENGLISH**	REVIEWER: NVD DATE: 3/15/2022
NOAA Station	20+00 Vienna Tysons Corner				

HYDROLOGICAL DATA

Method: INPUT

Drainage Area: 0.46

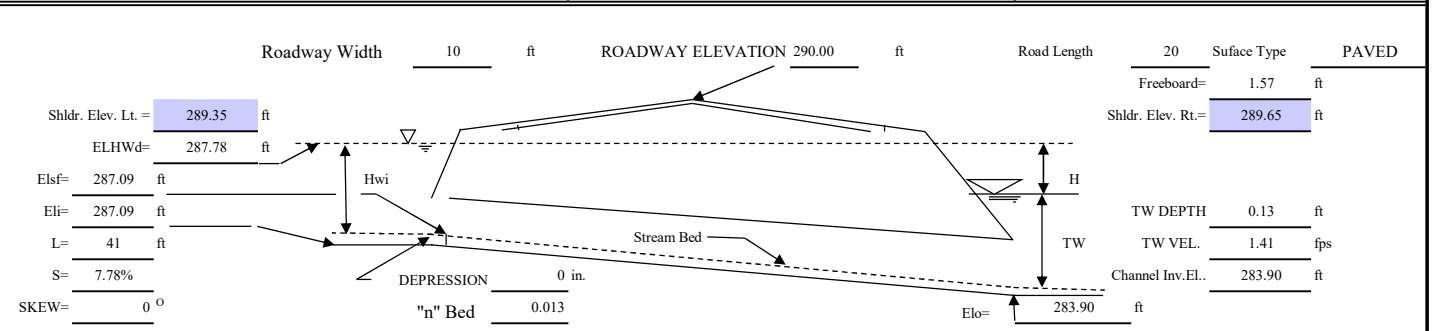
Time of Concentration 5

DESIGN FLOWS

R.I. (years)	FLOW (cfs)	
10	Design	1.28
2	Check	0.98
100	Max.	2.10

CULVERT DESCRIPTION:

TYPE: Single/Multiple Conforming



Inlet Edge Description:

Groove End Projecting

Single / Multiple Conforming / Broken Back Culverts

MATERIAL	SHAPE	Size (in)	N	Mannings n	TOTAL FLOW Q cfs	FLOW PER BARREL Q/N cfs	HEADWATER CALCULATIONS: INLET CONTROL HWi/D	HWi ft	FALL ft	ELHWi ft	OUTLET CONTROL TW ft	dc ft	(dc+D)/2 ft	ho ft	ke	H ft	ELHWo ft	CONTROL HEADWATER ELEV ft	OUTLET VEL fps	MINIMUM SHOULDER ELEV. ft	COMMENTS
CMPMedCorr	Circular	12	1	0.027	1.28	1.3	0.69	0.69	0.00	287.78	0.13	0.48	0.74	0.74	0.90	0.31	284.94	287.78	5.14		
					0.98	1.0	0.58	0.58	0.00	287.67	0.12	0.42	0.71	0.71	0.90	0.18	284.79	287.67	4.77		
					2.10	2.1	0.99	0.99	0.00	288.08	0.16	0.62	0.81	0.81	0.90	0.82	285.53	288.08	5.89		

Broken Back Culvert

LENGTH	Elev.	SKEW O

TAILWATER DATA:

Channel Shape: Irregular

Bottom Width, ft: 0.00 "n" = 0.035

Side Slope Lt: (H:1V): 0.00

Side Slope Rt: (H:1V): 0.00

Channel Slope, ft/ft: 0.0320

Distance	0.00	7.40	14.82	18.44	30.26
Elevation	286.00	284.00	283.90	284.00	286.00
"n" =	0.035	0.035	0.035	0.035	

TAILWATER RESULTS:

	Discharge cfs	Elevation ft	Flow depth ft	Velocity fps	Shear force PSF
Design	284.03	0.13	1.41	0.26	
Check	284.02	0.12	1.28	0.24	
Max.	284.06	0.16	1.71	0.32	

ROADWAY DATA:

Roadway Width, ft	10
Surface Type	PAVED
Top of Road Elevation, ft	290
Length of Road, ft	20

ROADWAY OVERTOPPING:

	Discharge cfs	Overtopping Discharge cfs	Overtopping Elevation ft
Design	0	0	0.00
Check	0	0	0.00
Max.	0	0	0.00

TECHNICAL FOOTNOTES:

(1) USE Q/NB FOR BOX CULVERTS

(2) HWi/D = HW/D OR HWi/D FROM DESIGN CHARTS

(3) FALL = HWI - (ELHWd - ELsf); FALL IS ZERO FOR CULVERTS ON GRADE

(4) ELhi = HWi + ELi (INVERT OF INLET CONTROL SECTION)

(5) TW BASED ON DOWNSTREAM CONTROL OR FLOW DEPTH IN CHANNEL

(6) ho = TW or (dc + D/2) (WHICHEVER IS GREATER)

(7) $H = [1 + ke + (29n^2L)/R^{1.33}]v^2/2g$

SUBSCRIPT DEFINITIONS:

HWd	DESIGN HEADWATER	i	INLET
HWi	HW IN INLET CONTROL	o	OUTLET
HWo	HW IN OUTLET CONTROL	sf	Streambed @ culvert face

COMMENTS / DISCUSSION:

CULVERT BARREL SELECTED

SIZE:	12"	n:	0.027
SHAPE:	Circular	MATERIAL:	CMP
ENTRANCE:	ES-1		

CULVERTSOFT by ENSOFTEC, INC.

PROJECT	**I-495 NEXT**			**CULVERT DESIGN FORM LD-269**	
ROAD		**COUNTY** Fairfax	SHEET 1 OF 1	DESIGNER: JMON	DATE: 3/15/2022
CULVERT	OUT38 Post	VA	UNITS **ENGLISH**	REVIEWER: NVD	DATE: 3/15/2022
NOAA Station	20+00 Vienna Tysons Corner				

HYDROLOGICAL DATA

Method: INPUT

Drainage Area: 0.45

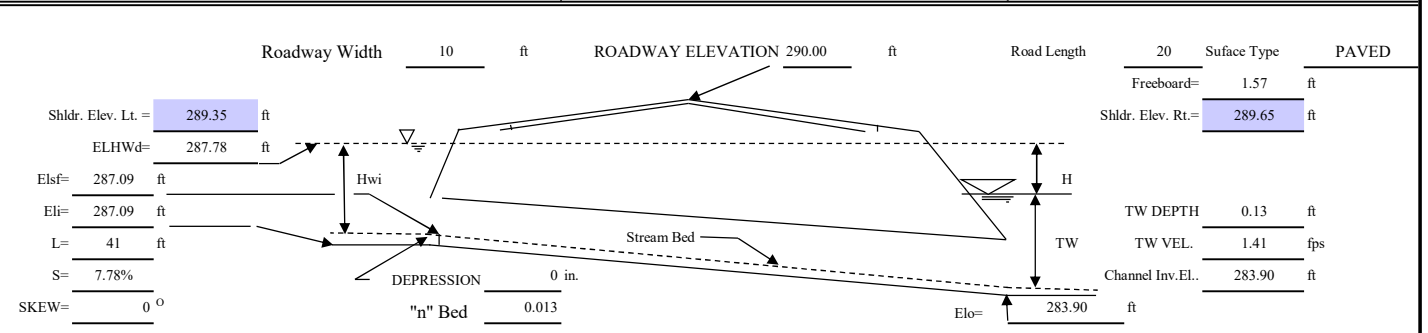
Time of Concentration 5

DESIGN FLOWS

R.I. (years)	FLOW (cfs)	
10	Design	1.28
2	Check	0.98
100	Max.	2.10

CULVERT DESCRIPTION:

TYPE: Single/Multiple Conforming



Inlet Edge Description:

Groove End Projecting

Single / Multiple Conforming / Broken Back Culverts

MATERIAL	SHAPE	Size (in)	N	Mannings n	TOTAL FLOW Q cfs	FLOW PER BARREL Q/N cfs	HEADWATER CALCULATIONS: INLET CONTROL HWi/D	HWi ft	FALL ft	ELHWi ft	OUTLET CONTROL TW ft	dc ft	(dc+D)/2 ft	ho ft	ke	H ft	ELHWo ft	CONTROL HEADWATER ELEV ft	OUTLET VEL fps	MINIMUM SHOULDER ELEV. ft	COMMENTS
CMPMedCorr	Circular	12	1	0.027	1.28	1.3	0.69	0.69	0.00	287.78	0.13	0.48	0.74	0.74	0.90	0.31	284.94	287.78	5.14		
					0.98	1.0	0.58	0.58	0.00	287.67	0.12	0.42	0.71	0.71	0.90	0.18	284.79	287.67	4.77		
					2.10	2.1	0.99	0.99	0.00	288.08	0.16	0.62	0.81	0.81	0.90	0.82	285.53	288.08	5.89		

Broken Back Culvert

LENGTH	Elev.	SKEW O

TAILWATER DATA:

Channel Shape: Irregular

Bottom Width, ft: 0.00 "n" = 0.035

Side Slope Lt: (H:1V): 0.00

Side Slope Rt: (H:1V): 0.00

Channel Slope, ft/ft: 0.0320

Distance	0.00	7.40	14.82	18.44	30.26
Elevation	286.00	284.00	283.90	284.00	286.00
"n" =	0.035	0.035	0.035	0.035	

TAILWATER RESULTS:

	Discharge cfs	Elevation ft	Flow depth ft	Velocity fps	Shear force PSF
Design	284.03	0.13	1.41	0.26	
Check	284.02	0.12	1.28	0.24	
Max.	284.06	0.16	1.71	0.32	

ROADWAY DATA:

Roadway Width, ft	10
Surface Type	PAVED
Top of Road Elevation, ft	290
Length of Road, ft	20

ROADWAY OVERTOPPING:

	Discharge cfs	Overtopping Discharge cfs	Overtopping Elevation ft
Design	0		0.00
Check	0		0.00
Max.	0		0.00

TECHNICAL FOOTNOTES:

(1) USE Q/NB FOR BOX CULVERTS

(2) HWi/D = HW/D OR HWi/D FROM DESIGN CHARTS

(3) FALL = HWI - (ELHWd - ELsf); FALL IS ZERO FOR CULVERTS ON GRADE

(4) ELhi = HWi + ELi (INVERT OF INLET CONTROL SECTION)

(5) TW BASED ON DOWNSTREAM CONTROL OR FLOW DEPTH IN CHANNEL

(6) ho = TW or (dc + D/2) (WHICHEVER IS GREATER)

(7) $H = [1 + ke + (29n^2L)/R^{1.33}]v^2/2g$

SUBSCRIPT DEFINITIONS:

HWd	DESIGN HEADWATER	i	INLET
HWi	HW IN INLET CONTROL	o	OUTLET
HWo	HW IN OUTLET CONTROL	sf	Streambed @ culvert face

COMMENTS / DISCUSSION:

CULVERT BARREL SELECTED

SIZE:	12"	n:	0.027
SHAPE:	Circular	MATERIAL:	CMP
ENTRANCE:	ES-1		

CULVERTSOFT by ENSOFTEC, INC.

Name of Project:	495-NEXT			Designed By:	JMON
State:	VA	**County:**	Fairfax County	Date:	03/15/22
Name of Culvert:	Pre Development			Checked By:	NVD
NOAA Station:	Vienna Tysons 44-8737			Date:	03/15/22
LOCATION:	PL23-OUT 38 A-A				
				UNITS	**ENGLISH**

RATIONAL METHOD - DATA:

DRAINAGE BASIN

SUBSHED #	Land Use Description	Area Acres	C	C A
	Business: Industrial and Commercial (0.80-0.90)			
	Apartments and Townhomes (0.65-0.75)			
	Schools (0.50-0.60)			
	Residential - lots 10,000 sq. ft. (0.40-0.50)			
	- lots 12,000 sq. ft. (0.40-0.45)			
	- lots 17,000 sq. ft. (0.35-0.45)			
	- lots ½ acre or more (0.30-0.40)	0.10	0.35	0.03
	Parks, Cemeteries and Unimproved Areas (0.20-0.35)			
	Paved and Roof Areas (0.90)	0.06	0.90	0.06
	Cultivated Areas (0.50-0.70)			
	Pasture (0.35-0.45)			
	Lawns (0.25-0.35)	0.06	0.30	0.02
	Forest (0.20-0.30)	0.00	0.25	
	Steep Grass (2:1) (0.40-0.70)			
	Shoulder and Ditch Areas (0.35-0.50)			
	Totals =	**0.22 Acres**	**0.49**	**0.11**

Time of Concentration (Tc)

	Reach	Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Rational C		Tc (Minutes)
							Total Tc (Minutes) =	**5.00**

		2-Year	**5-Year**	**10-Year**	**25-Year**	**50-Year**	**100-Year**
Rainfall Intensity	Inches / Hour.	**5.18**	**6.00**	**6.76**	**7.64**	**8.28**	**8.89**
Aosorption Coefficient / Ground Saturation Correction Coefficient Cf		1.00	1.00	1.00	1.10	1.20	1.25
Peak Discharge	CFS.	**0.55**	**0.64**	**0.72**	**0.89**	**1.06**	**1.18**

Name of Project:	495-NEXT			Designed By:	JMON
State:	VA	**County:**	Fairfax County	Date:	03/15/22
Name of Culvert:	Post Development			Checked By:	NVD
NOAA Station:	Vienna Tysons 44-8737			Date:	03/15/22
LOCATION:	PL23-OUT 38 A-A				
				UNITS	**ENGLISH**

RATIONAL METHOD - DATA:

DRAINAGE BASIN

SUBSHED #	Land Use Description	Area Acres	C	C A
	Business: Industrial and Commercial (0.80-0.90)			
	Apartments and Townhomes (0.65-0.75)			
	Schools (0.50-0.60)		0.50	
	Residential - lots 10,000 sq. ft. (0.40-0.50)			
	- lots 12,000 sq. ft. (0.40-0.45)			
	- lots 17,000 sq. ft. (0.35-0.45)			
	- lots ½ acre or more (0.30-0.40)	0.00	0.35	
	Parks, Cemeteries and Unimproved Areas (0.20-0.35)			
	Paved and Roof Areas (0.90)	0.07	0.90	0.07
	Cultivated Areas (0.50-0.70)			
	Pasture (0.35-0.45)			
	Lawns (0.25-0.35)	0.14	0.30	0.04
	Forest (0.20-0.30)		0.25	
	Steep Grass (2:1) (0.40-0.70)			
	Shoulder and Ditch Areas (0.35-0.50)			
	Totals =	**0.21 Acres**	**0.51**	**0.11**

Time of Concentration (Tc)

	Reach	Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Rational C		Tc (Minutes)
							Total Tc (Minutes) =	**5.00**

	2-Year	**5-Year**	**10-Year**	**25-Year**	**50-Year**	**100-Year**
Rainfall Intensity Inches / Hour.	**5.18**	**6.00**	**6.76**	**7.64**	**8.28**	**8.89**
Aosorption Coefficient / Ground Saturation Correction Coefficient Cf	1.00	1.00	1.00	1.10	1.20	1.25
Peak Discharge CFS.	**0.55**	**0.64**	**0.72**	**0.89**	**1.06**	**1.18**

PL23-OUT38 (A-A) Pre - 2yr

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Channel Slope	0.080 ft/ft
Discharge	0.55 cfs

Section Definitions

Station (ft)	Elevation (ft)
0+00	292.00
0+04	291.00
0+08	290.00
0+14	289.00
0+27	288.00
0+31	289.00
0+37	290.00
0+42	291.00
0+47	292.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 292.00)	(0+47, 292.00)	0.035

Options	
Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results	
Normal Depth	0.2 ft
Roughness Coefficient	0.035
Elevation	288.17 ft
Elevation Range	288.0 to 292.0 ft
Flow Area	0.2 ft²
Wetted Perimeter	2.9 ft
Hydraulic Radius	0.1 ft
Top Width	2.85 ft
Normal Depth	0.2 ft
Critical Depth	0.2 ft
Critical Slope	0.039 ft/ft
Velocity	2.29 ft/s

PL23-OUT38 (A-A) Pre - 2yr

Results	
Velocity Head	0.08 ft
Specific Energy	0.25 ft
Froude Number	1.390
Flow Type	Supercritical

GVF Input Data	
Downstream Depth	0.0 ft
Length	0.0 ft
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.0 ft
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	0.2 ft
Critical Depth	0.2 ft
Channel Slope	0.080 ft/ft
Critical Slope	0.039 ft/ft

PL23-OUT38 (A-A) Post - 2yr

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Channel Slope	0.080 ft/ft
Discharge	0.55 cfs

Section Definitions

Station (ft)	Elevation (ft)
0+00	292.00
0+04	291.00
0+08	290.00
0+14	289.00
0+27	288.00
0+31	289.00
0+37	290.00
0+42	291.00
0+47	292.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 292.00)	(0+47, 292.00)	0.035

Options	
Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results	
Normal Depth	0.2 ft
Roughness Coefficient	0.035
Elevation	288.17 ft
Elevation Range	288.0 to 292.0 ft
Flow Area	0.2 ft²
Wetted Perimeter	2.9 ft
Hydraulic Radius	0.1 ft
Top Width	2.85 ft
Normal Depth	0.2 ft
Critical Depth	0.2 ft
Critical Slope	0.039 ft/ft
Velocity	2.29 ft/s

PL23-OUT38 (A-A) Post - 2yr

Results	
Velocity Head	0.08 ft
Specific Energy	0.25 ft
Froude Number	1.390
Flow Type	Supercritical

GVF Input Data	
Downstream Depth	0.0 ft
Length	0.0 ft
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.0 ft
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	0.2 ft
Critical Depth	0.2 ft
Channel Slope	0.080 ft/ft
Critical Slope	0.039 ft/ft

PL23-OUT38 (A-A) Post - 10yr

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Channel Slope	0.080 ft/ft
Discharge	0.72 cfs

Section Definitions

Station (ft)	Elevation (ft)
0+00	292.00
0+04	291.00
0+08	290.00
0+14	289.00
0+27	288.00
0+31	289.00
0+37	290.00
0+42	291.00
0+47	292.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 292.00)	(0+47, 292.00)	0.035

Options	
Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results	
Normal Depth	0.2 ft
Roughness Coefficient	0.035
Elevation	288.19 ft
Elevation Range	288.0 to 292.0 ft
Flow Area	0.3 ft²
Wetted Perimeter	3.2 ft
Hydraulic Radius	0.1 ft
Top Width	3.15 ft
Normal Depth	0.2 ft
Critical Depth	0.2 ft
Critical Slope	0.038 ft/ft
Velocity	2.45 ft/s

PL23-OUT38 (A-A) Post - 10yr

Results	
Velocity Head	0.09 ft
Specific Energy	0.28 ft
Froude Number	1.418
Flow Type	Supercritical

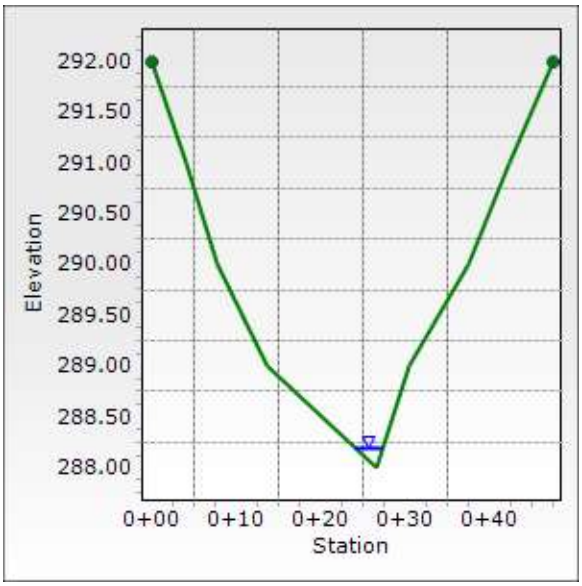
GVF Input Data	
Downstream Depth	0.0 ft
Length	0.0 ft
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.0 ft
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	0.2 ft
Critical Depth	0.2 ft
Channel Slope	0.080 ft/ft
Critical Slope	0.038 ft/ft

PL23-OUT38 (A-A) Post - 10yr

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Channel Slope	0.080 ft/ft
Normal Depth	0.2 ft
Discharge	0.72 cfs



Name of Project:	495-NEXT			Designed By:	JMON
State:	VA	**County:**	Fairfax County	Date:	03/15/22
Name of Culvert:	Pre Development			Checked By:	NVD
NOAA Station:	Vienna Tysons 44-8737			Date:	03/15/22
LOCATION:	PL23-OUT 38 B-B				
				UNITS	**ENGLISH**

RATIONAL METHOD - DATA:

DRAINAGE BASIN

SUBSHED #	Land Use Description	Area Acres	C	C A
	Business: Industrial and Commercial (0.80-0.90)			
	Apartments and Townhomes (0.65-0.75)			
	Schools (0.50-0.60)			
	Residential - lots 10,000 sq. ft. (0.40-0.50)			
	- lots 12,000 sq. ft. (0.40-0.45)			
	- lots 17,000 sq. ft. (0.35-0.45)			
	- lots ½ acre or more (0.30-0.40)	0.28	0.35	0.10
	Parks, Cemeteries and Unimproved Areas (0.20-0.35)			
	Paved and Roof Areas (0.90)	0.07	0.90	0.06
	Cultivated Areas (0.50-0.70)			
	Pasture (0.35-0.45)			
	Lawns (0.25-0.35)	0.21	0.30	0.06
	Forest (0.20-0.30)	0.00	0.25	
	Steep Grass (2:1) (0.40-0.70)			
	Shoulder and Ditch Areas (0.35-0.50)			
	Totals =	**0.56 Acres**	**0.40**	**0.22**

Time of Concentration (Tc)

	Reach	Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Rational C		Tc (Minutes)
							Total Tc (Minutes) =	**5.00**

		2-Year	**5-Year**	**10-Year**	**25-Year**	**50-Year**	**100-Year**
Rainfall Intensity	Inches / Hour.	**5.18**	**6.00**	**6.76**	**7.64**	**8.28**	**8.89**
Aosorption Coefficient / Ground Saturation Correction Coefficient Cf		1.00	1.00	1.00	1.10	1.20	1.25
Peak Discharge	CFS.	**1.15**	**1.33**	**1.50**	**1.86**	**2.20**	**2.46**

Name of Project:	495-NEXT			Designed By:	JMON
State:	VA	**County:**	Fairfax County	Date:	03/15/22
Name of Culvert:	Post Development			Checked By:	NVD
NOAA Station:	Vienna Tysons 44-8737			Date:	03/15/22
LOCATION:	PL23-OUT 38 B-B				
				UNITS	**ENGLISH**

RATIONAL METHOD - DATA:

DRAINAGE BASIN

SUBSHED #	Land Use Description	Area Acres	C	C A
	Business: Industrial and Commercial (0.80-0.90)			
	Apartments and Townhomes (0.65-0.75)			
	Schools (0.50-0.60)		0.50	
	Residential - lots 10,000 sq. ft. (0.40-0.50)			
	- lots 12,000 sq. ft. (0.40-0.45)			
	- lots 17,000 sq. ft. (0.35-0.45)			
	- lots ½ acre or more (0.30-0.40)	0.18	0.35	0.06
	Parks, Cemeteries and Unimproved Areas (0.20-0.35)			
	Paved and Roof Areas (0.90)	0.08	0.90	0.07
	Cultivated Areas (0.50-0.70)			
	Pasture (0.35-0.45)			
	Lawns (0.25-0.35)	0.29	0.30	0.09
	Forest (0.20-0.30)		0.25	
	Steep Grass (2:1) (0.40-0.70)			
	Shoulder and Ditch Areas (0.35-0.50)			
	Totals =	**0.55 Acres**	**0.40**	**0.22**

Time of Concentration (Tc)

	Reach	Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Rational C		Tc (Minutes)
							Total Tc (Minutes) =	**5.00**

	2-Year	**5-Year**	**10-Year**	**25-Year**	**50-Year**	**100-Year**
Rainfall Intensity Inches / Hour.	**5.18**	**6.00**	**6.76**	**7.64**	**8.28**	**8.89**
Aosorption Coefficient / Ground Saturation Correction Coefficient Cf	1.00	1.00	1.00	1.10	1.20	1.25
Peak Discharge CFS.	**1.14**	**1.32**	**1.49**	**1.85**	**2.19**	**2.45**

PL23-OUT38 (B-B) Pre - 2yr

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Channel Slope	0.032 ft/ft
Discharge	1.15 cfs

Section Definitions

Station (ft)	Elevation (ft)
0+00	286.00
0+19	284.00
0+35	282.00
1+02	284.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 286.00)	(1+02, 284.00)	0.035

Options	
Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results	
Normal Depth	0.2 ft
Roughness Coefficient	0.035
Elevation	282.19 ft
Elevation Range	282.0 to 286.0 ft
Flow Area	0.7 ft²
Wetted Perimeter	7.8 ft
Hydraulic Radius	0.1 ft
Top Width	7.80 ft
Normal Depth	0.2 ft
Critical Depth	0.2 ft
Critical Slope	0.040 ft/ft
Velocity	1.57 ft/s
Velocity Head	0.04 ft
Specific Energy	0.23 ft
Froude Number	0.900
Flow Type	Subcritical

PL23-OUT38 (B-B) Pre - 2yr

GVF Input Data	
Downstream Depth	0.0 ft
Length	0.0 ft
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.0 ft
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	0.00 ft/s
Upstream Velocity	0.00 ft/s
Normal Depth	0.2 ft
Critical Depth	0.2 ft
Channel Slope	0.032 ft/ft
Critical Slope	0.040 ft/ft

PL23-OUT38 (B-B) Post - 2yr

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Channel Slope	0.032 ft/ft
Discharge	1.14 cfs

Section Definitions

Station (ft)	Elevation (ft)
0+00	286.00
0+19	284.00
0+35	282.00
1+02	284.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 286.00)	(1+02, 284.00)	0.035

Options	
Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results	
Normal Depth	0.2 ft
Roughness Coefficient	0.035
Elevation	282.19 ft
Elevation Range	282.0 to 286.0 ft
Flow Area	0.7 ft²
Wetted Perimeter	7.8 ft
Hydraulic Radius	0.1 ft
Top Width	7.77 ft
Normal Depth	0.2 ft
Critical Depth	0.2 ft
Critical Slope	0.040 ft/ft
Velocity	1.56 ft/s
Velocity Head	0.04 ft
Specific Energy	0.23 ft
Froude Number	0.900
Flow Type	Subcritical

PL23-OUT38 (B-B) Post - 2yr

GVF Input Data	
Downstream Depth	0.0 ft
Length	0.0 ft
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.0 ft
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	0.00 ft/s
Upstream Velocity	0.00 ft/s
Normal Depth	0.2 ft
Critical Depth	0.2 ft
Channel Slope	0.032 ft/ft
Critical Slope	0.040 ft/ft

PL23-OUT38 (B-B) Post - 10yr

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Channel Slope	0.032 ft/ft
Discharge	1.49 cfs

Section Definitions

Station (ft)	Elevation (ft)
0+00	286.00
0+19	284.00
0+35	282.00
1+02	284.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 286.00)	(1+02, 284.00)	0.035

Options	
Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results	
Normal Depth	0.2 ft
Roughness Coefficient	0.035
Elevation	282.21 ft
Elevation Range	282.0 to 286.0 ft
Flow Area	0.9 ft²
Wetted Perimeter	8.6 ft
Hydraulic Radius	0.1 ft
Top Width	8.58 ft
Normal Depth	0.2 ft
Critical Depth	0.2 ft
Critical Slope	0.039 ft/ft
Velocity	1.68 ft/s
Velocity Head	0.04 ft
Specific Energy	0.25 ft
Froude Number	0.918
Flow Type	Subcritical

PL23-OUT38 (B-B) Post - 10yr

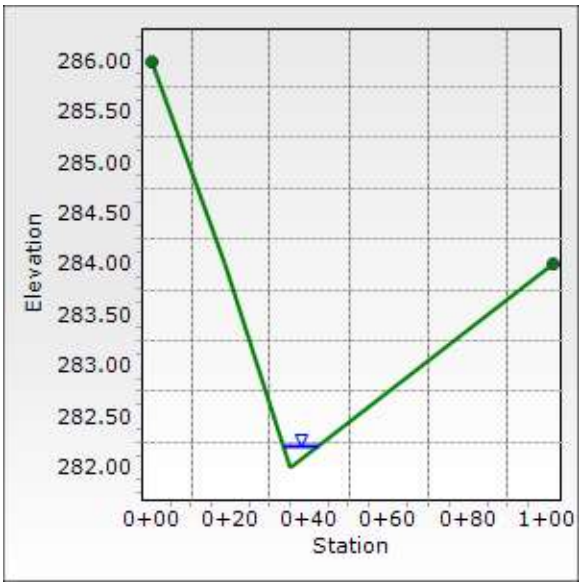
GVF Input Data	
Downstream Depth	0.0 ft
Length	0.0 ft
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.0 ft
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	0.00 ft/s
Upstream Velocity	0.00 ft/s
Normal Depth	0.2 ft
Critical Depth	0.2 ft
Channel Slope	0.032 ft/ft
Critical Slope	0.039 ft/ft

PL23-OUT38 (B-B) Post - 10yr

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Channel Slope	0.032 ft/ft
Normal Depth	0.2 ft
Discharge	1.49 cfs



APPENDIX C39
PL23-OUT39

Outfall PL23-OUT 39

Outfall PL23-OUT39 is an existing outfall at I-495 Southbound station 280+00 left. The outfall consists of an area of uncontrolled sheet flow. The outfall prior to development is 1.38 acres.

Development of this area will result in a reduced area to this outfall, due to the realignment of Live Oak Drive. The resulting area to the outfall will be 1.11 acres.

Drainage Area:

The drainage areas and resulting changes are summarized in the table below:

PL23-OUT 39			
Drainage Area	**Total Area**	**C (Total)**	**Tc**
Existing	1.38 ac	0.39	5.00 min
Proposed	1.11 ac	0.38	5.00 min

Limits of Study:

The location of the outfall is shown in the included outfall drainage map. The point of analysis is at the site limits.

Easement Requirements:

No additional easements are required.

Outfall Discharge:

All discharges were calculated using the Rational Method and are summarized below:

PL23-OUT 39		
Drainage Area	**Peak Flow Rate (Total)**	
	2 Year	10 Year
Existing	2.76 cfs	3.60 cfs
Proposed	2.20 cfs	2.87 cfs
Net Change	**-0.56 cfs**	**-0.73 cfs**

Final Opinion:

Area of increased volume of sheet flow must be identified and evaluated for potential impacts. As this outfall demonstrates a decreased volume of sheet flow, no further calculations are necessary. It is therefore our opinion that this outfall is adequate.

Pre-Developed Outfall Map
PL23-39
I-495
Fairfax, VA

DRAINAGE AREA BOUNDARY

EXISTING CONTOURS

TIME OF CONCENTRATION

PL23-OUT 39
DA = 1.38 AC
C = 0.39

SCALE
0 50' 100'

Post-Developed Outfall Map
PL23-39
I-495
Fairfax, VA

DRAINAGE AREA BOUNDARY

EXISTING CONTOURS

TIME OF CONCENTRATION

PL23-OUT 39
DA = 1.11 AC
C = 0.38

SCALE
0 50' 100'

Name of Project:	495-NEXT			Designed By:	KRI
State:	VA	**County:**	Fairfax County	Date:	01/24/22
Name of Culvert:	Pre Development			Checked By:	NVD
NOAA Station:	Vienna Tysons 44-8737			Date:	01/24/22
LOCATION:	PL23-OUT 39				
				UNITS	**ENGLISH**

RATIONAL METHOD - DATA:

DRAINAGE BASIN

SUBSHED #	Land Use Description	Area Acres	C	C A
	Business: Industrial and Commercial (0.80-0.90)			
	Apartments and Townhomes (0.65-0.75)			
	Schools (0.50-0.60)			
	Residential - lots 10,000 sq. ft. (0.40-0.50)			
	- lots 12,000 sq. ft. (0.40-0.45)			
	- lots 17,000 sq. ft. (0.35-0.45)			
	- lots ½ acre or more (0.30-0.40)		0.35	
	Parks, Cemeteries and Unimproved Areas (0.20-0.35)			
	Paved and Roof Areas (0.90)	0.26	0.90	0.23
	Cultivated Areas (0.50-0.70)			
	Pasture (0.35-0.45)			
	Lawns (0.25-0.35)	0.37	0.30	0.11
	Forest (0.20-0.30)	0.75	0.25	0.19
	Steep Grass (2:1) (0.40-0.70)			
	Shoulder and Ditch Areas (0.35-0.50)			
	Totals =	**1.38 Acres**	**0.39**	**0.53**

Time of Concentration (Tc)

	Reach	Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Rational C		Tc (Minutes)
							Total Tc (Minutes) =	**5.00**

		2-Year	**5-Year**	**10-Year**	**25-Year**	**50-Year**	**100-Year**
Rainfall Intensity	Inches / Hour.	**5.18**	**6.00**	**6.76**	**7.64**	**8.28**	**8.89**
Aosorption Coefficient / Ground Saturation Correction Coefficient Cf		1.00	1.00	1.00	1.10	1.20	1.25
Peak Discharge	CFS.	**2.76**	**3.20**	**3.60**	**4.48**	**5.30**	**5.93**

Name of Project:	495-NEXT			Designed By:	JMON
State:	VA	**County:**	Fairfax County	Date:	01/24/22
Name of Culvert:	Post Development			Checked By:	NVD
NOAA Station:	Vienna Tysons 44-8737			Date:	01/24/22
LOCATION:	PL23-OUT 39				
				UNITS	**ENGLISH**

RATIONAL METHOD - DATA:

DRAINAGE BASIN

SUBSHED #	Land Use Description	Area Acres	C	C A
	Business: Industrial and Commercial (0.80-0.90)			
	Apartments and Townhomes (0.65-0.75)			
	Schools (0.50-0.60)		0.50	
	Residential - lots 10,000 sq. ft. (0.40-0.50)			
	- lots 12,000 sq. ft. (0.40-0.45)			
	- lots 17,000 sq. ft. (0.35-0.45)			
	- lots ½ acre or more (0.30-0.40)		0.35	
	Parks, Cemeteries and Unimproved Areas (0.20-0.35)			
	Paved and Roof Areas (0.90)	0.21	0.90	0.19
	Cultivated Areas (0.50-0.70)			
	Pasture (0.35-0.45)			
	Lawns (0.25-0.35)	0.26	0.30	0.08
	Forest (0.20-0.30)	0.65	0.25	0.16
	Steep Grass (2:1) (0.40-0.70)			
	Shoulder and Ditch Areas (0.35-0.50)			
	Totals =	**1.11 Acres**	**0.38**	**0.42**

Time of Concentration (Tc)

	Reach	Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Rational C		Tc (Minutes)
							Total Tc (Minutes) =	**5.00**

		2-Year	**5-Year**	**10-Year**	**25-Year**	**50-Year**	**100-Year**
Rainfall Intensity	Inches / Hour.	**5.18**	**6.00**	**6.76**	**7.64**	**8.28**	**8.89**
Aosorption Coefficient / Ground Saturation Correction Coefficient Cf		1.00	1.00	1.00	1.10	1.20	1.25
Peak Discharge	CFS.	**2.20**	**2.55**	**2.87**	**3.57**	**4.22**	**4.72**

APPENDIX C40
PL23-OUT40

Outfall PL23-OUT 40

Outfall PL23-OUT40 is an existing outfall at George Washington Parkway station 54+84 left. The outfall consists of a natural stormwater conveyance system. In existing conditions, flow is conveyed through existing channels and storm sewer to the point of analysis. The outfall prior to development is 1.17 acres.

Development of this area will result in increased area to this outfall, due to proposed roadway grading. The resulting area to the outfall will be 1.19 acres.

Drainage Area:

The drainage areas and resulting changes are summarized in the table below:

PL23-OUT 40			
Drainage Area	**Total Area**	**C (Total)**	**Tc**
Existing	1.17 ac	0.49	14.69 min
Proposed	1.19 ac	0.48	14.69 min

Limits of Study:

The location of the outfall is shown in the included outfall drainage map. The point of analysis is at existing structure.

Easement Requirements:

No additional easements are required.

Outfall Discharge:

All discharges were calculated using the Rational Method and are summarized below:

PL23-OUT 40		
Drainage Area	**Peak Flow Rate (Total)**	
	2 Year	10 Year
Existing	2.00 cfs	2.66 cfs
Proposed	2.00 cfs	2.66 cfs
Net Change	**0.00 cfs**	**0.00 cfs**

Channel Description:

The channel at Outfall PL23-OUT 40 is a natural channel consisting of a concrete storm sewer and receiving channel. Cross Sections were prepared utilizing topography prepared by Rinker Design Associates, P.C. and Fairfax County GIS.

Channel Protection:

Under Section 11.7.5.1 of the VDOT drainage manual, areas draining to a natural stormwater conveyance channel shall satisfy the channel protection criteria by providing

conveyance of the 2 year storm without causing erosion of the system. Calculations have been provided below supporting the 2 year velocities in the system:

Pipe Run	Channel Protection - 2 Year Velocity				Outfall Adequate?
	Pipe Material	Max Permissible Velocity (ft/s)	Existing Velocity (ft/s)	Proposed Velocity (ft/s)	
Ex Pipe	Concrete	No Max	9.13	9.13	Yes
Cross Section	Channel Material	Max Permissible Velocity (ft/s)	Existing Velocity (ft/s)	Proposed Velocity (ft/s)	Outfall Adequate?
A-A	Glenelg Silt Loam	3.5	3.37	3.37	Yes
B-B	Glenelg Silt Loam	3.5	2.37	2.37	Yes

Flood Protection:

Under Section 11.7.5.2 of the VDOT drainage manual, areas draining to a natural stormwater conveyance channel shall satisfy the flood protection criteria by demonstrating that the peak flow rate from a 10 year storm will be contained within the existing channel. The post developed flows to the channel have been analyzed and yield the following results:

Pipe Run	Flood Protection - 10 Year Capacity		Outfall Adequate?
	Max Pipe Discharge (cfs)	Pipe Discharge (cfs)	
Ex Pipe	27.77	2.66	Yes
Cross Section	Channel Depth (ft)	Normal Depth (ft)	Outfall Adequate?
A-A	3.4	0.40	Yes
B-B	2.5	0.40	Yes

Final Opinion:

This outfall is a natural stormwater conveyance system. We have shown compliance with the channel protection criteria by providing calculations demonstrating non-erosive velocities. We have shown compliance with the flood protection criteria, by demonstrating the peak discharge from a 10 year storm will be contained within the existing channel. It is therefore our opinion that this outfall is adequate.

Pre-Developed Outfall Map
PL23-40
I-495
Fairfax, VA

DRAINAGE AREA BOUNDARY

EXISTING CONTOURS

TIME OF CONCENTRATION

PL23-OUT 40
DA = 1.17 AC
C = 0.49

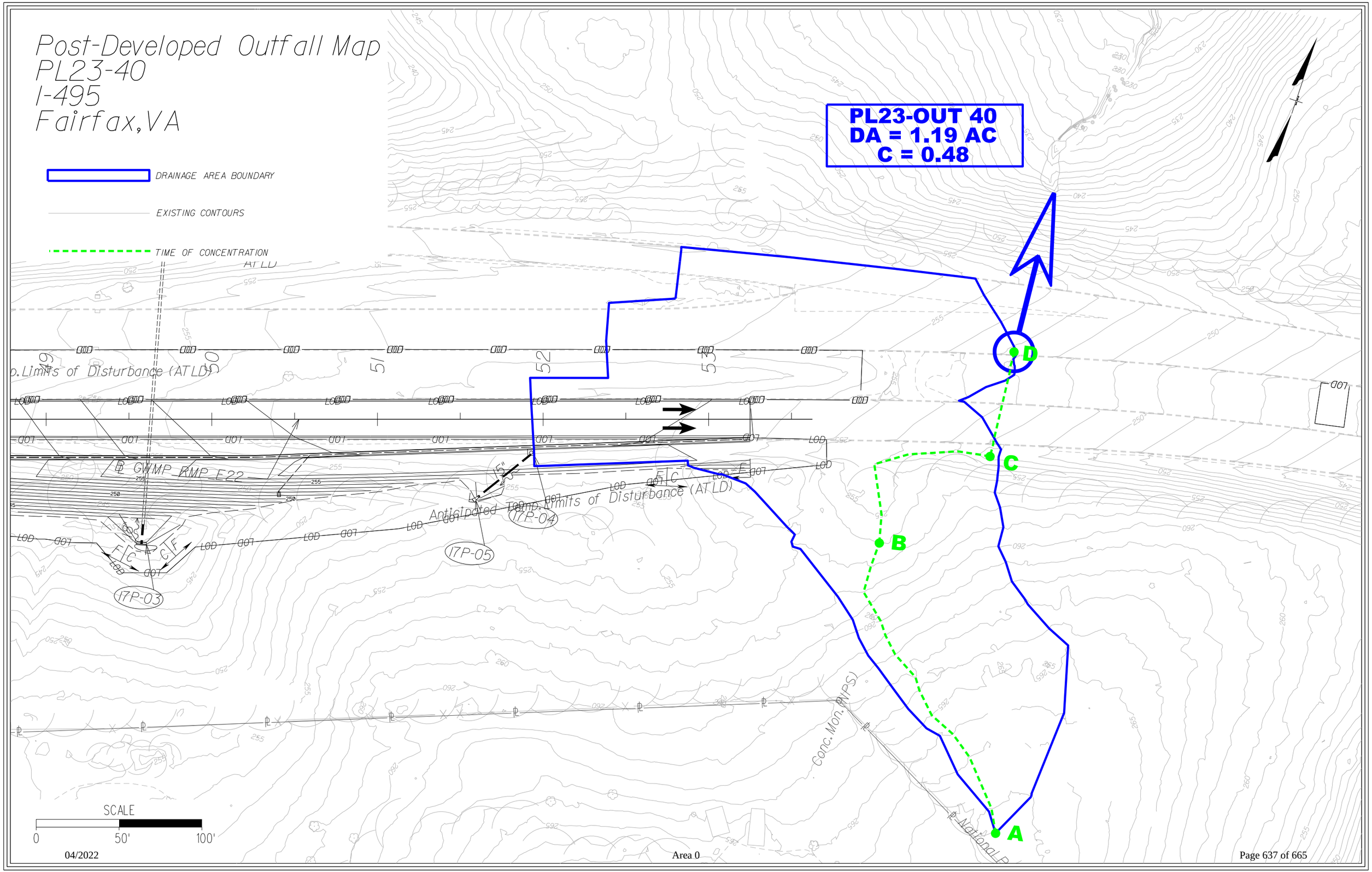
A

B

C

D

SCALE
0 50' 100'


Post-Developed Outfall Map
PL23-40
I-495
Fairfax, VA
DRAINAGE AREA BOUNDARY
EXISTING CONTOURS
TIME OF CONCENTRATION
PL23-OUT 40
DA = 1.19 AC
C = 0.48
A
B
C
D
Limits of Disturbance (ATLD)
Anticipated Temp. Limits of Disturbance (ATLD)
GWMP RMP E22
17P-03
17P-04
17P-05
Conc. Mon. (NPS)
SCALE
0
50'
100'

Name of Project:	495-NEXT			Designed By:	JMON
State:	VA	**County:**	Fairfax County	Date:	03/01/22
Name of Culvert:	Pre Development			Checked By:	NVD
NOAA Station:	Vienna Tysons 44-8737			Date:	03/01/22
LOCATION:	PL23-OUT 40				
				UNITS	**ENGLISH**

RATIONAL METHOD - DATA:

DRAINAGE BASIN

SUBSHED #	Land Use Description	Area Acres	C	C A
	Business: Industrial and Commercial (0.80-0.90)			
	Apartments and Townhomes (0.65-0.75)			
	Schools (0.50-0.60)			
	Residential - lots 10,000 sq. ft. (0.40-0.50)			
	- lots 12,000 sq. ft. (0.40-0.45)			
	- lots 17,000 sq. ft. (0.35-0.45)			
	- lots ½ acre or more (0.30-0.40)			
	Parks, Cemeteries and Unimproved Areas (0.20-0.35)			
	Paved and Roof Areas (0.90)	0.40	0.90	0.36
	Cultivated Areas (0.50-0.70)			
	Pasture (0.35-0.45)			
	Lawns (0.25-0.35)	0.28	0.30	0.08
	Forest (0.20-0.30)	0.49	0.25	0.12
	Steep Grass (2:1) (0.40-0.70)			
	Shoulder and Ditch Areas (0.35-0.50)			
	Totals =	**1.17 Acres**	**0.49**	**0.57**

Time of Concentration (Tc)

			Reach	Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Rational C		Tc (Minutes)
Overland Flow (E.E. Seelye - VDOT Modified)										
	Soil / Surface Type/Land Cover			Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Rational C		
	Forest		A-B	200.00	268.50	256.00	0.063	0.25		14.11
Channel Flow				Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Natural Channel			B-C	119.02	256.00	251.15	0.041	0.050	5.78	0.34
					Area =	12.00		Wetted P =	12.70	
Pipe Flow				Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
EX019 to EX013			C-D	64.88	251.15	250.76	0.006	0.013	4.61	0.23
		Pipe Diameter (in) =		18	Area =	1.77		Wetted P =	4.71	
									Total Tc (Minutes) =	**14.69**

		2-Year	5-Year	10-Year	25-Year	50-Year	100-Year
Rainfall Intensity	Inches / Hour.	**3.51**	**4.12**	**4.68**	**5.32**	**5.79**	**6.22**
Aosorption Coefficient / Ground Saturation Correction Coefficient Cf		1.00	1.00	1.00	1.10	1.20	1.25
Peak Discharge	CFS.	**2.00**	**2.35**	**2.66**	**3.33**	**3.95**	**4.43**

Name of Project:	495-NEXT			Designed By:	JMON
State:	VA	**County:**	Fairfax County	Date:	03/14/22
Name of Culvert:	Post Development			Checked By:	NVD
NOAA Station:	Vienna Tysons 44-8737			Date:	03/14/22
LOCATION:	PL23-OUT 40				
				UNITS	**ENGLISH**

RATIONAL METHOD - DATA:

DRAINAGE BASIN

SUBSHED #	Land Use Description	Area Acres	C	C A
	Business: Industrial and Commercial (0.80-0.90)			
	Apartments and Townhomes (0.65-0.75)			
	Schools (0.50-0.60)			
	Residential - lots 10,000 sq. ft. (0.40-0.50)			
	- lots 12,000 sq. ft. (0.40-0.45)			
	- lots 17,000 sq. ft. (0.35-0.45)			
	- lots ½ acre or more (0.30-0.40)			
	Parks, Cemeteries and Unimproved Areas (0.20-0.35)			
	Paved and Roof Areas (0.90)	0.40	0.90	0.36
	Cultivated Areas (0.50-0.70)			
	Pasture (0.35-0.45)			
	Lawns (0.25-0.35)	0.30	0.30	0.09
	Forest (0.20-0.30)	0.49	0.25	0.12
	Steep Grass (2:1) (0.40-0.70)			
	Shoulder and Ditch Areas (0.35-0.50)			
	Totals =	**1.19 Acres**	**0.48**	**0.57**

Time of Concentration (Tc)

			Reach	Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Rational C		Tc (Minutes)
Overland Flow (E.E. Seelye - VDOT Modified)										
	Soil / Surface Type/Land Cover			Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Rational C		
	Forest		A-B	200.00	268.50	256.00	0.063	0.25		14.11
Channel Flow				Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Natural Channel			B-C	119.02	256.00	251.15	0.041	0.050	5.78	0.34
					Area =	12.00		Wetted P =	12.70	
Pipe Flow				Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Assumed Information			C-D	64.88	251.15	250.76	0.006	0.013	4.61	0.23
		Pipe Diameter (in) =		18	Area =	1.77		Wetted P =	4.71	
									Total Tc (Minutes) =	**14.69**

		2-Year	**5-Year**	**10-Year**	**25-Year**	**50-Year**	**100-Year**
Rainfall Intensity	Inches / Hour.	**3.51**	**4.12**	**4.68**	**5.32**	**5.79**	**6.22**
Aosorption Coefficient / Ground Saturation Correction Coefficient Cf		1.00	1.00	1.00	1.10	1.20	1.25
Peak Discharge	CFS.	**2.00**	**2.34**	**2.66**	**3.33**	**3.95**	**4.43**

INTERNAL ANALYSIS

PL23-OUT40 Outlet Pipe/Cross Sections
I-495 NEXT
Fairfax,VA

DRAINAGE AREA BOUNDARY

EXISTING CONTOURS

TIME OF CONCENTRATION

SCALE

0 50' 100'

SECTION B-B

SECTION A-A

Ex Str.
DA=1.19
C=0.48

A

B

C

D

E

F

17P-03

17P-04

17P-05

Outfall PL23-OUT40 Sections A-A, B-B: Looking Upstream

Outfall PL23-OUT40 Sections A-A, B-B: Looking Downstream

Name of Project:	495-NEXT			Designed By:	JMON
State:	VA	**County:**	Fairfax County	Date:	03/01/22
Name of Culvert:	Pre Development			Checked By:	NVD
NOAA Station:	Vienna Tysons 44-8737			Date:	03/01/22
LOCATION:	PL23-OUT40 Ex Pipe			UNITS	**ENGLISH**

RATIONAL METHOD - DATA:

DRAINAGE BASIN

SUBSHED #	Land Use Description	Area Acres	C	C A
	Business: Industrial and Commercial (0.80-0.90)			
	Apartments and Townhomes (0.65-0.75)			
	Schools (0.50-0.60)			
	Residential - lots 10,000 sq. ft. (0.40-0.50)			
	- lots 12,000 sq. ft. (0.40-0.45)			
	- lots 17,000 sq. ft. (0.35-0.45)			
	- lots ½ acre or more (0.30-0.40)			
	Parks, Cemeteries and Unimproved Areas (0.20-0.35)			
	Paved and Roof Areas (0.90)	0.40	0.90	0.36
	Cultivated Areas (0.50-0.70)			
	Pasture (0.35-0.45)			
	Lawns (0.25-0.35)	0.28	0.30	0.08
	Forest (0.20-0.30)	0.49	0.25	0.12
	Steep Grass (2:1) (0.40-0.70)			
	Shoulder and Ditch Areas (0.35-0.50)			
	Totals =	**1.17 Acres**	**0.49**	**0.57**

Time of Concentration (Tc)

			Reach	Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Rational C		Tc (Minutes)
Overland Flow (E.E. Seelye - VDOT Modified)										
	Soil / Surface Type/Land Cover			Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Rational C		
	Forest		A-B	200.00	268.50	256.00	0.063	0.25		14.11
Channel Flow				Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Natural Channel			B-C	119.02	256.00	251.15	0.041	0.050	5.78	0.34
					Area =	12.00		Wetted P =	12.70	
Pipe Flow				Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Assumed Information			C-D	64.88	251.15	250.76	0.006	0.013	4.61	0.23
		Pipe Diameter (in) =		18	Area =	1.77		Wetted P =	4.71	
									Total Tc (Minutes) =	**14.69**

		2-Year	**5-Year**	**10-Year**	**25-Year**	**50-Year**	**100-Year**
Rainfall Intensity	Inches / Hour.	**3.51**	**4.12**	**4.68**	**5.32**	**5.79**	**6.22**
Aosorption Coefficient / Ground Saturation Correction Coefficient	Cf	1.00	1.00	1.00	1.10	1.20	1.25
Peak Discharge	CFS.	**2.00**	**2.35**	**2.66**	**3.33**	**3.95**	**4.43**

LD-229
STORM SEWER DESIGN COMPUTATIONS

PROJECT: I-495 NEXT
LOCATION:
COUNTY: Vienna Tysons Corner

Designed by: JMON
Checked by: NVD

STORM FREQUENCY **2**

UNITS **ENGLISH**

Pre-Developed Conditions

PIPE NO.	FROM POINT REFERENCE	FROM POINT STA.	TO POINT REFERENCE	TO POINT STA.	DRAIN. AREA "A" Acre	RUNOFF COEFF. "C"	CA INCRE-MENT	CA ACCUM-ULATED	INLET TIME Minutes	RAIN FALL In/Hr	RUNOFF Lateral CFS	RUNOFF Total Q CFS	INVERT ELEVATIONS UPPER END	INVERT ELEVATIONS LOWER END	LENGTH of Pipe Ft.	SLOPE Ft./Ft.	SIZE (Dia. Or Span/Rise) In.	SHAPE	Number of Pipes	Capacity CFS	Friction Slope Ft./Ft.	NORMAL FLOW Depth of Flow, dn Ft.	NORMAL FLOW Area of Flow, An SqFt	NORMAL FLOW Hrn Ft.	NORMAL FLOW Vn Ft/Sec	NORMAL FLOW En Ft.	FLOW TIME INCRE-MENT Minutes	FLOW TIME ACCUMU -LATED Minutes	REMARKS
	(1)		(2)		(3)	(4)	(5)	(6)	(7)	(8)		(9)	(10)	(11)	(12)	(13)	(14)			(15)					(16)		(17)	(17)	(18)
EX1~EX2	EX1		EX2		-	-	-	-	-	-	-	2.00	246.14	239.20	99.30	0.06989	18	Circular	1	27.77	0.00040	0.27	0.22	0.17	9.13	1.57	0.18	5.18	

Name of Project:	495-NEXT		Designed By: JMON
State:	VA	**County:** Fairfax County	Date: 03/01/22
Name of Culvert:	Pre Development		Checked By: NVD
NOAA Station:	Vienna Tysons 44-8737		Date: 03/01/22
LOCATION:	PL23-OUT40 A-A		
			UNITS **ENGLISH**

RATIONAL METHOD - DATA:

DRAINAGE BASIN

SUBSHED #	Land Use Description	Area Acres	C	C A
	Business: Industrial and Commercial (0.80-0.90)			
	Apartments and Townhomes (0.65-0.75)			
	Schools (0.50-0.60)			
	Residential - lots 10,000 sq. ft. (0.40-0.50)			
	- lots 12,000 sq. ft. (0.40-0.45)			
	- lots 17,000 sq. ft. (0.35-0.45)			
	- lots ½ acre or more (0.30-0.40)			
	Parks, Cemeteries and Unimproved Areas (0.20-0.35)			
	Paved and Roof Areas (0.90)	0.40	0.90	0.36
	Cultivated Areas (0.50-0.70)			
	Pasture (0.35-0.45)			
	Lawns (0.25-0.35)	0.30	0.30	0.09
	Forest (0.20-0.30)	0.58	0.25	0.15
	Steep Grass (2:1) (0.40-0.70)			
	Shoulder and Ditch Areas (0.35-0.50)			
	Totals =	**1.28 Acres**	**0.47**	**0.60**

Time of Concentration (Tc)

	Reach	Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Rational C		Tc (Minutes)
Overland Flow (E.E. Seelye - VDOT Modified)								
Soil / Surface Type/Land Cover		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Rational C		
Forest	A-B	200.00	268.50	256.00	0.063	0.25		14.11
Channel Flow		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Natural Channel	B-C	119.02	256.00	251.15	0.041	0.050	5.78	0.34
			Area =	12.00		Wetted P =	12.70	
Pipe Flow		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Assumed Information	C-D	64.88	251.15	250.76	0.006	0.013	4.61	0.23
Pipe Diameter (in) =		18	Area =	1.77		Wetted P =	4.71	
Pipe Flow		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Assumed Information	D-E	99.30	250.76	239.00	0.118	0.013	20.46	0.08
Pipe Diameter (in) =		18	Area =	1.77		Wetted P =	4.71	
Channel Flow		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Natural Channel	E-F	50.33	239.00	228.60	0.207	0.045	14.45	0.06
			Area =	12.00		Wetted P =	12.70	
							Total Tc (Minutes) =	**14.82**

	2-Year	5-Year	10-Year	25-Year	50-Year	100-Year
Rainfall Intensity Inches / Hour.	**3.50**	**4.10**	**4.66**	**5.30**	**5.76**	**6.20**
Aosorption Coefficient / Ground Saturation Correction Coefficient Cf	1.00	1.00	1.00	1.10	1.20	1.25
Peak Discharge CFS.	**2.09**	**2.45**	**2.79**	**3.49**	**4.13**	**4.63**

PL23-OUT40 (A-A) Pre - 2yr

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Channel Slope	0.091 ft/ft
Discharge	2.09 cfs

Section Definitions

Station (ft)	Elevation (ft)
0+00	232.00
0+00	231.00
0+01	230.00
0+01	229.00
0+04	228.62
0+11	233.00
0+19	234.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 232.00)	(0+19, 234.00)	0.045

Options	
Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results	
Normal Depth	0.4 ft
Roughness Coefficient	0.045
Elevation	229.02 ft
Elevation Range	228.6 to 234.0 ft
Flow Area	0.6 ft²
Wetted Perimeter	3.2 ft
Hydraulic Radius	0.2 ft
Top Width	3.00 ft
Normal Depth	0.4 ft
Critical Depth	0.4 ft
Critical Slope	0.051 ft/ft
Velocity	3.37 ft/s
Velocity Head	0.18 ft
Specific Energy	0.58 ft

PL23-OUT40 (A-A) Pre - 2yr

Results	
Froude Number	1.306
Flow Type	Supercritical

GVF Input Data	
Downstream Depth	0.0 ft
Length	0.0 ft
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.0 ft
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	0.4 ft
Critical Depth	0.4 ft
Channel Slope	0.091 ft/ft
Critical Slope	0.051 ft/ft

Name of Project:	495-NEXT		Designed By: JMON
State:	VA	**County:** Fairfax County	Date: 03/01/22
Name of Culvert:	Pre Development		Checked By: NVD
NOAA Station:	Vienna Tysons 44-8737		Date: 03/01/22
LOCATION:	PL23-OUT40 B-B		
			UNITS **ENGLISH**

RATIONAL METHOD - DATA:

DRAINAGE BASIN

SUBSHED #	Land Use Description	Area Acres	C	C A
	Business: Industrial and Commercial (0.80-0.90)			
	Apartments and Townhomes (0.65-0.75)			
	Schools (0.50-0.60)			
	Residential - lots 10,000 sq. ft. (0.40-0.50)			
	- lots 12,000 sq. ft. (0.40-0.45)			
	- lots 17,000 sq. ft. (0.35-0.45)			
	- lots ½ acre or more (0.30-0.40)			
	Parks, Cemeteries and Unimproved Areas (0.20-0.35)			
	Paved and Roof Areas (0.90)	0.40	0.90	0.36
	Cultivated Areas (0.50-0.70)			
	Pasture (0.35-0.45)			
	Lawns (0.25-0.35)	0.32	0.30	0.10
	Forest (0.20-0.30)	0.91	0.25	0.23
	Steep Grass (2:1) (0.40-0.70)			
	Shoulder and Ditch Areas (0.35-0.50)			
	Totals =	**1.63 Acres**	**0.42**	**0.69**

Time of Concentration (Tc)

	Reach	Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Rational C		Tc (Minutes)
Overland Flow (E.E. Seelye - VDOT Modified)								
Soil / Surface Type/Land Cover		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Rational C		
Forest	A-B	200.00	268.50	256.00	0.063	0.25		14.11
Channel Flow		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Natural Channel	B-C	119.02	256.00	251.15	0.041	0.050	5.78	0.34
			Area =	12.00		Wetted P =	12.70	
Pipe Flow		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Assumed Information	C-D	64.88	251.15	250.76	0.006	0.013	4.61	0.23
Pipe Diameter (in) =		18	Area =	1.77		Wetted P =	4.71	
Pipe Flow		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Assumed Information	D-E	99.30	250.76	239.00	0.118	0.013	20.46	0.08
Pipe Diameter (in) =		18	Area =	1.77		Wetted P =	4.71	
Channel Flow		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Natural Channel	E-F	106.26	239.00	228.60	0.098	0.045	9.95	0.18
			Area =	12.00		Wetted P =	12.70	
							Total Tc (Minutes) =	**14.94**

		2-Year	5-Year	10-Year	25-Year	50-Year	100-Year
Rainfall Intensity	Inches / Hour.	**3.49**	**4.09**	**4.64**	**5.28**	**5.74**	**6.18**
Aosorption Coefficient / Ground Saturation Correction Coefficient Cf		1.00	1.00	1.00	1.10	1.20	1.25
Peak Discharge	CFS.	**2.39**	**2.81**	**3.19**	**3.99**	**4.73**	**5.31**

PL23-OUT40 (B-B) Pre - 2yr

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Channel Slope	0.029 ft/ft
Discharge	2.39 cfs

Section Definitions

Station (ft)	Elevation (ft)
0+00	229.00
0+02	228.00
0+04	227.00
0+05	226.47
0+07	226.50
0+08	227.00
0+10	228.00
0+15	229.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 229.00)	(0+15, 229.00)	0.045

Options	
Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results	
Normal Depth	0.4 ft
Roughness Coefficient	0.045
Elevation	226.83 ft
Elevation Range	226.5 to 229.0 ft
Flow Area	1.0 ft²
Wetted Perimeter	3.7 ft
Hydraulic Radius	0.3 ft
Top Width	3.50 ft
Normal Depth	0.4 ft
Critical Depth	0.3 ft
Critical Slope	0.050 ft/ft
Velocity	2.37 ft/s
Velocity Head	0.09 ft

PL23-OUT40 (B-B) Pre - 2yr

Results	
Specific Energy	0.44 ft
Froude Number	0.777
Flow Type	Subcritical

GVF Input Data	
Downstream Depth	0.0 ft
Length	0.0 ft
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.0 ft
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	0.4 ft
Critical Depth	0.3 ft
Channel Slope	0.029 ft/ft
Critical Slope	0.050 ft/ft

Name of Project:	495-NEXT			Designed By:	JMON
State:	VA	**County:**	Fairfax County	Date:	03/01/22
Name of Culvert:	Post Development			Checked By:	NVD
NOAA Station:	Vienna Tysons 44-8737			Date:	03/01/22
LOCATION:	PL23-OUT40 Ex Pipe				
				UNITS	**ENGLISH**

RATIONAL METHOD - DATA:

DRAINAGE BASIN

SUBSHED #	Land Use Description	Area Acres	C	C A
	Business: Industrial and Commercial (0.80-0.90)			
	Apartments and Townhomes (0.65-0.75)			
	Schools (0.50-0.60)			
	Residential - lots 10,000 sq. ft. (0.40-0.50)			
	- lots 12,000 sq. ft. (0.40-0.45)			
	- lots 17,000 sq. ft. (0.35-0.45)			
	- lots ½ acre or more (0.30-0.40)			
	Parks, Cemeteries and Unimproved Areas (0.20-0.35)			
	Paved and Roof Areas (0.90)	0.40	0.90	0.36
	Cultivated Areas (0.50-0.70)			
	Pasture (0.35-0.45)			
	Lawns (0.25-0.35)	0.30	0.30	0.09
	Forest (0.20-0.30)	0.49	0.25	0.12
	Steep Grass (2:1) (0.40-0.70)			
	Shoulder and Ditch Areas (0.35-0.50)			
	Totals =	**1.19 Acres**	**0.48**	**0.57**

Time of Concentration (Tc)

	Reach	Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Rational C		Tc (Minutes)
Overland Flow (E.E. Seelye - VDOT Modified)								
Soil / Surface Type/Land Cover		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Rational C		
Forest	A-B	200.00	268.50	256.00	0.063	0.25		14.11
Channel Flow		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Natural Channel	B-C	119.02	256.00	251.15	0.041	0.050	5.78	0.34
			Area =	12.00		Wetted P =	12.70	
Pipe Flow		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Assumed Information	C-D	64.88	251.15	250.76	0.006	0.013	4.61	0.23
Pipe Diameter (in) =		18	Area =	1.77		Wetted P =	4.71	
							Total Tc (Minutes) =	**14.69**

		2-Year	**5-Year**	**10-Year**	**25-Year**	**50-Year**	**100-Year**
Rainfall Intensity	Inches / Hour.	**3.51**	**4.12**	**4.68**	**5.32**	**5.79**	**6.22**
Aosorption Coefficient / Ground Saturation Correction Coefficient	Cf	1.00	1.00	1.00	1.10	1.20	1.25
Peak Discharge	CFS.	**2.00**	**2.34**	**2.66**	**3.33**	**3.95**	**4.43**

LD-229
STORM SEWER DESIGN COMPUTATIONS

PROJECT: I-495 NEXT
LOCATION:
COUNTY: Vienna Tysons Corner

Designed by: JMON
Checked by: NVD

STORM FREQUENCY **2**

UNITS **ENGLISH**

PIPE NO.	FROM POINT REFERENCE	FROM POINT STA.	TO POINT REFERENCE	TO POINT STA.	DRAIN. AREA "A" Acre	RUNOFF COEFF. "C"	CA INCRE-MENT	CA ACCUM-ULATED	INLET TIME Minutes	RAIN FALL In/Hr	RUNOFF Lateral CFS	RUNOFF Total Q CFS	INVERT ELEVATIONS UPPER END	INVERT ELEVATIONS LOWER END	LENGTH of Pipe Ft.	SLOPE Ft./Ft.	SIZE (Dia. Or Span/Rise) In.	SHAPE	Number of Pipes	Capacity CFS	Friction Slope Ft./Ft.	NORMAL FLOW Depth of Flow, dn Ft.	NORMAL FLOW Area of Flow, An SqFt	NORMAL FLOW Hrn Ft.	NORMAL FLOW Vn Ft/Sec	NORMAL FLOW En Ft.	FLOW TIME INCRE-MENT Minutes	FLOW TIME ACCUMU-LATED Minutes	REMARKS
	(1)		(2)		(3)	(4)	(5)	(6)	(7)	(8)		(9)	(10)	(11)	(12)	(13)	(14)			(15)					(16)		(17)	(17)	(18)
EX1~EX2	EX1		EX2		-	-	-	-	-	-	-	2.00	246.14	239.20	99.30	0.06989	18	Circular	1	27.77	0.00040	0.27	0.22	0.17	9.13	1.57	0.18	5.18	

LD-229
STORM SEWER DESIGN COMPUTATIONS

PROJECT: I-495 NEXT
LOCATION:
COUNTY: Vienna Tysons Corner

Designed by: JMON
Checked by: NVD

STORM FREQUENCY **10**

UNITS **ENGLISH**

PIPE NO.	FROM POINT REFERENCE	FROM POINT STA.	TO POINT REFERENCE	TO POINT STA.	DRAIN. AREA "A" Acre	RUNOFF COEFF. "C"	CA INCRE-MENT	CA ACCUM-ULATED	INLET TIME Minutes	RAIN FALL In/Hr	RUNOFF Lateral CFS	RUNOFF Total Q CFS	INVERT ELEVATIONS UPPER END	INVERT ELEVATIONS LOWER END	LENGTH of Pipe Ft.	SLOPE Ft./Ft.	SIZE (Dia. Or Span/Rise) In.	SHAPE	Number of Pipes	Capacity CFS	Friction Slope Ft./Ft.	NORMAL FLOW Depth of Flow, dn Ft.	NORMAL FLOW Area of Flow, An SqFt	NORMAL FLOW Hrn Ft.	NORMAL FLOW Vn Ft/Sec	NORMAL FLOW En Ft.	FLOW TIME INCRE-MENT Minutes	FLOW TIME ACCUMU-LATED Minutes	REMARKS
	(1)		(2)		(3)	(4)	(5)	(6)	(7)	(8)		(9)	(10)	(11)	(12)	(13)	(14)			(15)					(16)		(17)	(17)	(18)
EX1~EX2	EX1		EX2		-	-	-	-	-	-	-	2.66	246.14	239.20	99.30	0.06989	18	Circular	1	27.77	0.00070	0.31	0.27	0.19	9.92	1.84	0.17	5.17	

Name of Project:	495-NEXT		Designed By: JMON
State:	VA	**County:** Fairfax County	Date: 03/01/22
Name of Culvert:	Post Development		Checked By: NVD
NOAA Station:	Vienna Tysons 44-8737		Date: 03/01/22
LOCATION:	PL23-OUT40 A-A		
			UNITS **ENGLISH**

RATIONAL METHOD - DATA:

DRAINAGE BASIN

SUBSHED #	Land Use Description	Area Acres	C	C A
	Business: Industrial and Commercial (0.80-0.90)			
	Apartments and Townhomes (0.65-0.75)			
	Schools (0.50-0.60)			
	Residential - lots 10,000 sq. ft. (0.40-0.50)			
	- lots 12,000 sq. ft. (0.40-0.45)			
	- lots 17,000 sq. ft. (0.35-0.45)			
	- lots ½ acre or more (0.30-0.40)			
	Parks, Cemeteries and Unimproved Areas (0.20-0.35)			
	Paved and Roof Areas (0.90)	0.40	0.90	0.36
	Cultivated Areas (0.50-0.70)			
	Pasture (0.35-0.45)			
	Lawns (0.25-0.35)	0.32	0.30	0.10
	Forest (0.20-0.30)	0.58	0.25	0.15
	Steep Grass (2:1) (0.40-0.70)			
	Shoulder and Ditch Areas (0.35-0.50)			
	Totals =	**1.30 Acres**	**0.46**	**0.60**

Time of Concentration (Tc)

		Reach	Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Rational C		Tc (Minutes)
Overland Flow (E.E. Seelye - VDOT Modified)									
	Soil / Surface Type/Land Cover		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Rational C		
	Forest	A-B	200.00	268.50	256.00	0.063	0.25		14.11
Channel Flow			Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Natural Channel		B-C	119.02	256.00	251.15	0.041	0.050	5.78	0.34
				Area =	12.00		Wetted P =	12.70	
Pipe Flow			Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Assumed Information		C-D	64.88	251.15	250.76	0.006	0.013	4.61	0.23
	Pipe Diameter (in) =		18	Area =	1.77		Wetted P =	4.71	
Pipe Flow			Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Assumed Information		D-E	99.30	250.76	239.00	0.118	0.013	20.46	0.08
	Pipe Diameter (in) =		18	Area =	1.77		Wetted P =	4.71	
Channel Flow			Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Natural Channel		E-F	50.33	239.00	228.60	0.207	0.045	14.45	0.06
				Area =	12.00		Wetted P =	12.70	
								Total Tc (Minutes) =	**14.82**

		2-Year	5-Year	10-Year	25-Year	50-Year	100-Year
Rainfall Intensity	Inches / Hour.	**3.50**	**4.10**	**4.66**	**5.30**	**5.76**	**6.20**
Aosorption Coefficient / Ground Saturation Correction Coefficient Cf		1.00	1.00	1.00	1.10	1.20	1.25
Peak Discharge	CFS.	**2.09**	**2.45**	**2.78**	**3.48**	**4.13**	**4.63**

PL23-OUT40 (A-A) Post - 2yr

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Channel Slope	0.091 ft/ft
Discharge	2.09 cfs

Section Definitions

Station (ft)	Elevation (ft)
0+00	232.00
0+00	231.00
0+01	230.00
0+01	229.00
0+04	228.62
0+11	233.00
0+19	234.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 232.00)	(0+19, 234.00)	0.045

Options	
Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results	
Normal Depth	0.4 ft
Roughness Coefficient	0.045
Elevation	229.02 ft
Elevation Range	228.6 to 234.0 ft
Flow Area	0.6 ft²
Wetted Perimeter	3.2 ft
Hydraulic Radius	0.2 ft
Top Width	3.00 ft
Normal Depth	0.4 ft
Critical Depth	0.4 ft
Critical Slope	0.051 ft/ft
Velocity	3.37 ft/s
Velocity Head	0.18 ft
Specific Energy	0.58 ft

PL23-OUT40 (A-A) Post - 2yr

Results	
Froude Number	1.306
Flow Type	Supercritical

GVF Input Data	
Downstream Depth	0.0 ft
Length	0.0 ft
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.0 ft
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	0.4 ft
Critical Depth	0.4 ft
Channel Slope	0.091 ft/ft
Critical Slope	0.051 ft/ft

PL23-OUT40 (A-A) Post - 10yr

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Channel Slope	0.091 ft/ft
Discharge	2.78 cfs

Section Definitions

Station (ft)	Elevation (ft)
0+00	232.00
0+00	231.00
0+01	230.00
0+01	229.00
0+04	228.62
0+11	233.00
0+19	234.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 232.00)	(0+19, 234.00)	0.045

Options	
Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results	
Normal Depth	0.4 ft
Roughness Coefficient	0.045
Elevation	229.06 ft
Elevation Range	228.6 to 234.0 ft
Flow Area	0.7 ft²
Wetted Perimeter	3.3 ft
Hydraulic Radius	0.2 ft
Top Width	3.09 ft
Normal Depth	0.4 ft
Critical Depth	0.5 ft
Critical Slope	0.049 ft/ft
Velocity	3.71 ft/s
Velocity Head	0.21 ft
Specific Energy	0.66 ft

PL23-OUT40 (A-A) Post - 10yr

Results	
Froude Number	1.330
Flow Type	Supercritical

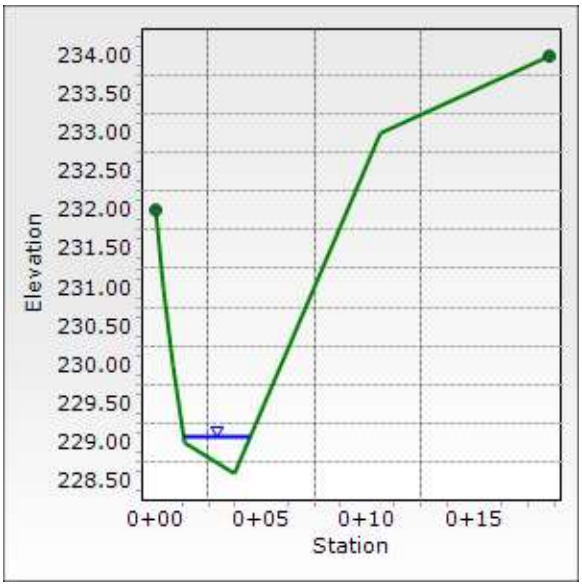
GVF Input Data	
Downstream Depth	0.0 ft
Length	0.0 ft
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.0 ft
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	0.4 ft
Critical Depth	0.5 ft
Channel Slope	0.091 ft/ft
Critical Slope	0.049 ft/ft

PL23-OUT40 (A-A) Post - 10yr

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Channel Slope	0.091 ft/ft
Normal Depth	0.4 ft
Discharge	2.78 cfs



Name of Project:	495-NEXT		Designed By: JMON
State:	VA	**County:** Fairfax County	Date: 03/01/22
Name of Culvert:	Post Development		Checked By: NVD
NOAA Station:	Vienna Tysons 44-8737		Date: 03/01/22
LOCATION:	PL23-OUT40 B-B		
			UNITS **ENGLISH**

RATIONAL METHOD - DATA:

DRAINAGE BASIN

SUBSHED #	Land Use Description	Area Acres	C	C A
	Business: Industrial and Commercial (0.80-0.90)			
	Apartments and Townhomes (0.65-0.75)			
	Schools (0.50-0.60)			
	Residential - lots 10,000 sq. ft. (0.40-0.50)			
	- lots 12,000 sq. ft. (0.40-0.45)			
	- lots 17,000 sq. ft. (0.35-0.45)			
	- lots ½ acre or more (0.30-0.40)			
	Parks, Cemeteries and Unimproved Areas (0.20-0.35)			
	Paved and Roof Areas (0.90)	0.40	0.90	0.36
	Cultivated Areas (0.50-0.70)			
	Pasture (0.35-0.45)			
	Lawns (0.25-0.35)	0.34	0.30	0.10
	Forest (0.20-0.30)	0.91	0.25	0.23
	Steep Grass (2:1) (0.40-0.70)			
	Shoulder and Ditch Areas (0.35-0.50)			
	Totals =	**1.65 Acres**	**0.42**	**0.69**

Time of Concentration (Tc)

	Reach	Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Rational C		Tc (Minutes)
Overland Flow (E.E. Seelye - VDOT Modified)								
Soil / Surface Type/Land Cover		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Rational C		
Forest	A-B	200.00	268.50	256.00	0.063	0.25		14.11
Channel Flow		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Natural Channel	B-C	119.02	256.00	251.15	0.041	0.050	5.78	0.34
			Area =	12.00		Wetted P =	12.70	
Pipe Flow		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Assumed Information	C-D	64.88	251.15	250.76	0.006	0.013	4.61	0.23
Pipe Diameter (in) =		18	Area =	1.77		Wetted P =	4.71	
Pipe Flow		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Assumed Information	D-E	99.30	250.76	239.00	0.118	0.013	20.46	0.08
Pipe Diameter (in) =		18	Area =	1.77		Wetted P =	4.71	
Channel Flow		Flow Distance Ft.	Upper Elev. Ft.	Lower Elev. Ft.	Slope Ft./Ft	Mannings 'n'	Velocity FPS	
Natural Channel	E-F	106.26	239.00	228.60	0.098	0.045	9.95	0.18
			Area =	12.00		Wetted P =	12.70	
							Total Tc (Minutes) =	**14.94**

		2-Year	5-Year	10-Year	25-Year	50-Year	100-Year
Rainfall Intensity	Inches / Hour.	**3.49**	**4.09**	**4.64**	**5.28**	**5.74**	**6.18**
Aosorption Coefficient / Ground Saturation Correction Coefficient Cf		1.00	1.00	1.00	1.10	1.20	1.25
Peak Discharge	CFS.	**2.39**	**2.81**	**3.19**	**3.99**	**4.73**	**5.31**

PL23-OUT40 (B-B) Post - 2yr

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Channel Slope	0.029 ft/ft
Discharge	2.39 cfs

Section Definitions

Station (ft)	Elevation (ft)
0+00	229.00
0+02	228.00
0+04	227.00
0+05	226.47
0+07	226.50
0+08	227.00
0+10	228.00
0+15	229.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 229.00)	(0+15, 229.00)	0.045

Options	
Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results	
Normal Depth	0.4 ft
Roughness Coefficient	0.045
Elevation	226.83 ft
Elevation Range	226.5 to 229.0 ft
Flow Area	1.0 ft²
Wetted Perimeter	3.7 ft
Hydraulic Radius	0.3 ft
Top Width	3.50 ft
Normal Depth	0.4 ft
Critical Depth	0.3 ft
Critical Slope	0.050 ft/ft
Velocity	2.37 ft/s
Velocity Head	0.09 ft

PL23-OUT40 (B-B) Post - 2yr

Results	
Specific Energy	0.44 ft
Froude Number	0.777
Flow Type	Subcritical

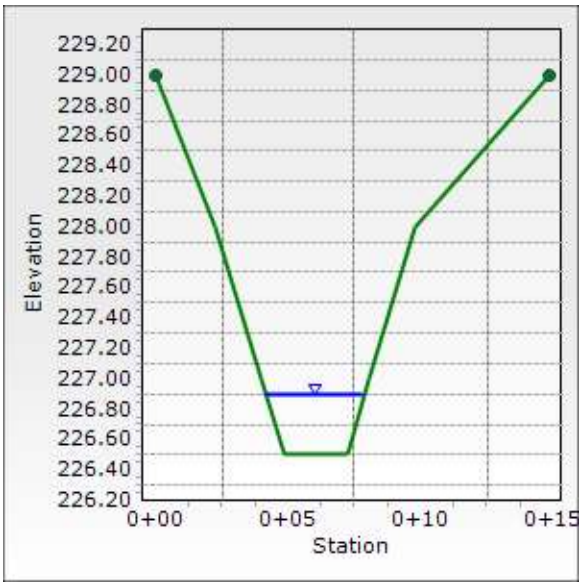
GVF Input Data	
Downstream Depth	0.0 ft
Length	0.0 ft
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.0 ft
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	0.4 ft
Critical Depth	0.3 ft
Channel Slope	0.029 ft/ft
Critical Slope	0.050 ft/ft

PL23-OUT40 (B-B) Post - 10yr

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Channel Slope	0.029 ft/ft
Normal Depth	0.4 ft
Discharge	3.19 cfs



PL23-OUT40 (B-B) Post - 10yr

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Channel Slope	0.029 ft/ft
Discharge	3.19 cfs

Section Definitions

Station (ft)	Elevation (ft)
0+00	229.00
0+02	228.00
0+04	227.00
0+05	226.47
0+07	226.50
0+08	227.00
0+10	228.00
0+15	229.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 229.00)	(0+15, 229.00)	0.045

Options	
Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results	
Normal Depth	0.4 ft
Roughness Coefficient	0.045
Elevation	226.89 ft
Elevation Range	226.5 to 229.0 ft
Flow Area	1.2 ft²
Wetted Perimeter	3.9 ft
Hydraulic Radius	0.3 ft
Top Width	3.69 ft
Normal Depth	0.4 ft
Critical Depth	0.4 ft
Critical Slope	0.048 ft/ft
Velocity	2.60 ft/s
Velocity Head	0.10 ft

PL23-OUT40 (B-B) Post - 10yr

Results	
Specific Energy	0.52 ft
Froude Number	0.793
Flow Type	Subcritical

GVF Input Data	
Downstream Depth	0.0 ft
Length	0.0 ft
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.0 ft
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	0.4 ft
Critical Depth	0.4 ft
Channel Slope	0.029 ft/ft
Critical Slope	0.048 ft/ft