PHASE II CHESAPEAKE BAY TMDL

ACTION PLAN PERMIT NUMBER

VAR040053

Submitted to DEQ:

November 2019

CITY OF WINCHESTER, VIRGINIA - PHASE II CHESAPEAKE BAY TOTAL MAXIMUM DAILY LOAD (TMDL) ACTION PLAN – JULY 1, 2018 – JUNE 30, 2023

INTRODUCTION

The City of Winchester (Winchester) developed this second phase Chesapeake Bay TMDL Action Plan (Action Plan) pursuant to the Special Condition for the Chesapeake Bay TMDL (Part II.A) located in the City's Municipal Separate Storm Sewer System (MS4) Permit. To assist with the development of the Action Plan, the City utilized the Reissued MS4 General Permit for 2018-2023. Furthermore, the City used in-house aerial imagery, the Virginia Geographic Information Network (VGIN), and Virginia Environmental Geographic Information Systems (VEGIS), and coupled the imagery with Winchester GIS data, to meet the technical requirements of the Action Plan.

The Action Plan is driven by the Chesapeake Bay TMDL which was approved by the US Environmental Protection Agency (EPA) in December of 2010. Nitrogen, total phosphorous, and sediment are the Pollutants of Concern (POC) identified in the TMDL as requiring pollutant reductions in the Chesapeake Bay Basin area, which includes Winchester. Three permit cycles have been adopted to address the pollutant reductions required by an MS4 in Virginia. A 5% POC load reduction was met by the end of the first permit cycle on June 30, 2018. An additional 35% POC load reduction is required by the end of the second permit cycle on June 30, 2023, followed by an additional 60% reduction in the third permit cycle. For the purposes of this Action Plan, the primary focus will be on Permit Cycle 2 and the associated 35% reduction requirements, but the loadings and reductions have been provided for the previous 5% and future 60% cycles as well.

This Action Plan details the methodology and results used to develop the required plan components. Detailed sections are provided within the report for the following tasks:

- ***New or Modified Legal Authorities*** - (Addresses Part II.A.11a of the MS4 Permit)
- ***Load and Cumulative Reduction Calculations*** – (Addresses Section I.C.2.a(4) and Section I.C.2.a(5) of the MS4 Permit)
- ***Total Reductions Achieved as of July 1, 2018*** – (Addresses Part II.A.11c of the MS4 Permit)
- ***List of BMPs Implemented Prior to July 1, 2018*** – (Addresses Part II.A.11d of the MS4 Permit)
- ***List of BMPs to be Implemented for the Second Permit Cycle*** – (Addresses Part II.A.11e of the MS4 Permit)
- **Public Comment Process** – (Addresses Part II.A.11f of the MS4 Permit)

NEW OR MODIFIED LEGAL AUTHORITIES

The jurisdictional area of Winchester lies completely within a 2010 U.S. Census designated urbanized area. As such, the size and extent of the City's MS4 was evaluated based on the City limits. Winchester's MS4 regulated land includes all lands owned and operated by the City, as well as all conveyances and drainage areas served by the City's MS4.

The Virginia Department of Environmental Quality (DEQ) issued a VSMP General Permit for small Municipal Separate Storm Sewer Systems (MS4s) to Winchester (Permit Registration Number: VAR040053) on October 29, 2018. A new permit registration statement will be submitted by August 3, 2023 along with this action plan to continue using the General Permit. In accordance with the General Permit, Winchester is responsible for developing, implementing and maintaining an MS4 Program that guides design, construction, maintenance, and management of all lands within its jurisdictional area.

The City, in preparing its revised MS4 Program Plan updated in accordance with New MS4 General Permit (Effective 11/1/2018 – 10/31/2023), along with its most recent MS4 Annual Report submitted to DEQ on September 30th, 2019, evaluated its ability to comply with the Special Condition for the Chesapeake Bay TMDL (Part II.A) in the MS4 Permit. As a result of this evaluation, no changes have been made to the following list of the City's relevant existing legal authorities and policies from the first Chesapeake Bay Action Plan:

- City of Winchester's Water Protection Ordinance
- City of Winchester's MS4 Program Plan
- City of Winchester's Public Services Standards Manual

LOAD AND CUMULATIVE REDUCTION CALCULATIONS

The process of determining Winchester's MS4 regulated land use acreage as of June 30, 2009 can be found in Winchester's First Chesapeake Bay TMDL Action Plan on the City's Stormwater website. The acreages associated with the regulated pervious and impervious areas from the First Action Plan data were input into Table 3b from the current MS4 General Permit titled "Calculation Sheet for Estimating Existing Source Loads for the Potomac River Basin". Table 3b was then used to derive an estimate of the annual POC loads discharged from Winchester's existing sources as of June 30, 2009. The estimated total POC Loadings for nitrogen, phosphorous, and total suspended solids (TSS) were calculated by multiplying the acreages for each land cover (subsource), by the 2009 Edge of Stream (EOS) loading rate for the corresponding pollutant.

Table 1: Permit Table 3b – Calculation Sheet for Estimating Existing Source Loads and Reduction Requirements for the Potomac River Basin.

Table 3b: Calculation Sheet for Estimating Existing Source Loads and Reduction Requirements for the Potomac River Basin								
Pollutant	Subsource	Loading Rate (lbs./ac/yr.)	Existing developed lands as of 6/30/09 served by the MS4 within the 2010 CUA (acres)	Loading (lbs./ac/yr.)	MS4 required Chesapeake Bay total L2 loading rate reduction	Percentage of L2 required reduction on by 6/30/2023	40% cumulative reduction required by 6/30/2023 (lbs./yr.)	Sum of 40% cumulative reduction (lbs./yr.)
Nitrogen	Regulated Urban Impervious	16.86	2,359.21	39,776.35	9%	40%	1,431.95	2,120.49
	Regulated Urban Pervious	10.07	2,848.97	28,689.15	6%	40%	688.54	
Phosphorus	Regulated Urban Impervious	1.62	2,359.21	3,821.97	16%	40%	244.61	278.48
	Regulated Urban Pervious	0.41	2,848.97	1,168.08	7.25%	40%	33.87	
Total Suspended Solids	Regulated Urban Impervious	1,171.32	2,359.21	2,763,394.54	20%	40%	221,071.56	238,601.29
	Regulated Urban Pervious	175.8	2,848.97	500,849.27	8.75%	40%	17,529.72	

The calculations shown in Table 1 illustrate the total 40% Cumulative Reduction required for Nitrogen, Phosphorus, and TSS are **2,120.49 lbs./yr**, **278.48 lbs./yr**, and **238,601.29 lbs./yr** respectively.

TOTAL REDUCTIONS ACHIEVED AS OF JULY 1, 2018

The next component of the Action Plan was to calculate the total 5% pollutant load reductions achieved as of July 1, 2018. For the 5% pollutant reduction, the City is claiming 8.856 lbs. of Total Nitrogen Credit each for 2 homes that have met the septic connection to sanitary sewer conditions. In addition, any excess credits that reached beyond the required 5% reduction requirements will be credited towards meeting the cumulative 40% pollutant loads reduction requirement. The resultant 5% achieved reductions for Winchester are shown in Table 2 below.

Table 2: Calculation Sheet for Determining Total Reduction Achieved as of July 1, 2018.

Pollutant	Subsource	5% Total Reductions Required First Permit Cycle (lbs./yr.)	Reduction Achieved: Street Sweeping Crediting (lbs./yr.)	Reduction Achieved: Septic Connection to Sanitary (lbs./yr.)	Reduction Achieved: BMPs	Reduction Achieved: Nutrient Credit Exchange	Sum of 5% reduction Achieved (lbs./yr.)	Remaining Credits to be Applied for the 40% Cumulative Reduction (lbs./yr.)
Nitrogen	Regulated Urban Impervious	188.74	206.73	17.712	N/A	49.768	274.21	0
	Regulated Urban Pervious	85.47						
Phosphorus	Regulated Urban Impervious	23.59	32.22	0	N/A	0	32.22	5.78
	Regulated Urban Pervious	2.85						
Total Suspended Solids	Regulated Urban Impervious	27,626.35	35,549.41	0	N/A	0	35,549.41	5729.35
	Regulated Urban Pervious	2,193.71						

The calculations shown in Table 2 illustrate the total 5% reduction achieved as of July 1, 2018 for Nitrogen, Phosphorus, and TSS. The 5% POC load reductions achieved are **274.21 lbs./yr.**, **32.22 lbs./yr.**, and **35,549.41 lbs./yr.** respectively. The cumulative excess credits to be applied to the 40% POC reduction goals generated from the street sweeping and stream restoration are shown in the last column of Table 2 for Nitrogen, Phosphorus, and TSS at **0 lbs./yr., 5.78 lbs./yr., and 5,729.35 lbs.yr.**, respectively.

Table 3: Overall City of Winchester 40% Cumulative Reduction Goals with Excess 5% POC Credits applied.

Table 3. City of Winchester 40% Overall Chesapeake Bay TMDL Reduction Goals						
Pollutant	Subsource	Loading Rate (lbs./ac./yr.)	Existing Developed Lands as of 6/30/09 served by the MS4 within the 2010 CUA (acres)	Sum of 40% cumulative reduction (lbs./yr.)	Credits from Total Reductions Achieved by July 1, 2018 to be Applied to the 40% Cumulative Reduction (lbs./yr.)	City of Winchester 40% Overall Reduction Goals (lbs./yr.)
Nitrogen	Regulated Urban Impervious	16.86	2,359.21	2,120.49	0	2,120.49
	Regulated Urban Pervious	10.07	2,848.97			
Phosphorus	Regulated Urban Impervious	1.62	2,359.21	278.48	5.78	272.70
	Regulated Urban Pervious	0.41	2,848.97			
Total Suspended Solids	Regulated Urban Impervious	1171.32	2,359.21	238,601.29	5729.35	232,871.94
	Regulated Urban Pervious	175.8	2,848.97			

Once the excess credits were applied to the 40% Cumulative Reduction Goal the City's Overall Reduction Goals for Nitrogen, Phosphorous, and TSS became **2,120.49 lbs./yr., 272.70 lbs./yr.**, and **232,871.94 lbs./yr**., respectively.

LIST OF BMPs TO BE IMPLEMENTED PRIOR TO JULY 1, 2018

For the City to receive credit towards the POC load reduction requirements from existing BMPs prior to July 1, 2018, Structural BMPs, BMP Retrofits, Stream Restoration, or Redevelopment Scenarios had to have been implemented. Although the City has implemented BMPs throughout the 2013 – 2018 Permit Cycle, those BMPs were implemented to offset development. The BMPs were not oversized to provide any additional credit beyond baseline development requirements, and thus no credit can be claimed to apply to any POC load reduction requirements from existing oversized BMPs. The City has implemented the following BMPs/ Practices prior to July 1, 2018 to achieve reductions associated with the Chesapeake Bay TMDL:

- **City Wide Street Sweeping Program**
  - Annual Nitrogen Reductions Achieved (lbs./yr.) = 206.73
  - Annual Phosphorous Reductions Achieved (lbs./yr.) = 32.22
  - Annual TSS Reductions Achieved (lbs./yr.) = 35,549.51

- **Sanitary Sewer Disconnect**
  - Annual Nitrogen Reductions Achieved (lbs./yr.) = 17.712
- **Nitrogen Credit Purchase**
  - Annual Nitrogen Reductions Achieved. = 49.768

Further documentation of the BMPs implemented prior to July 1, 2018 are presented in Appendix A.

LIST OF BMPs TO BE IMPLEMENTED FOR THE SECOND PERMIT CYCLE

The City of Winchester has projects occurring during the 2018 – 2023 MS4 Permit Cycle with BMPs that are qualified for nutrient credits. The Hope Drive Extension Project, North Cameron Street Drainage Improvements Projects, and Friendship Park and Fire Station Retrofit Project are the main projects that are anticipated to be utilized for nutrient credits. The Hope Drive Extension Project is a wet pond that is expected to achieve total nitrogen, total phosphorus, and total suspended solids reduction of **419.32 lbs., 132.44 lbs.**, and **152,795 lbs.**, respectively. In addition, the North Cameron Street Drainage Project is slated to have 4 BMPs that are expected to achieve total nitrogen, total phosphorus, and total suspended solids reduction of **239.33 lbs.**, **44.48 lbs.**, and **75,180.47 lbs.**, respectively. Lastly, the Friendship Park and Fire Station Retrofit Project will have an extended detention pond that will achieve total nitrogen, total phosphorus, and total suspended solids reduction of **70.97 lbs., 14.88 lbs.,** and **34,067.31 lbs.**, respectively. Table 4 illustrates the anticipated cumulative pollutant reduction credits that could be achieved through BMP implementation during the second permit cycle.

The data shown in Table 4 illustrates each BMP's percent removal efficiency and the reduction expected to be achieved for nitrogen, phosphorous, and sediment. The City of Winchester will address any deficit by purchasing Nitrogen Credits from the Opequon Water Reclamation Facility to achieve full compliance with the Second Permit Cycle (i.e. 40%) Requirements.

Table 4. Potential City of Winchester Projects to be utilized to meet cumulative POC reductions for the second permit cycle.

Potential Project Number	Project Name	Project Location	Type of BMP	Estimated Nitrogen reduction expected (lbs./yr.)	Estimated Phosphorous reduction expected (lbs./yr.)	Estimated TSS reduction expected (lbs./yr.)
1	Hope Drive Extension, Realignment and Safety Improvements	Hope Drive, Winchester, VA	Wet Pond #1	419.32	132.44	152,795
2	North Cameron Street Drainage Improvements	700 Fairmont Avenue, Winchester, VA	Detention Basin 1	Anticipated Design Level 1: 75.00	Anticipated Design Level 1: 15.73	Anticipated Design Level 1: 30,278.15
3	North Cameron Street Drainage Improvements	651 North Cameron Street, Winchester, VA	Detention Basin 2	Anticipated Design Level 1: 36.37	Anticipated Design Level 1: 7.63	Anticipated Design Level 1: 15,919.18
4	North Cameron Street Drainage Improvements	501-515 North Kent Street, Winchester, VA	Detention Basin 3 & 4	Anticipated Design Level 2: 127.96	Anticipated Design Level 2: 21.12	Anticipated Design Level 2: 28,983.14
5	Friendship Park and Fire Station Retrofit	N. Pleasant Valley Road, Winchester, VA	Extended Detention Pond	Anticipated Design Level 1: 70.97	Anticipated Design Level 1: 14.88	Anticipated Design Level 1: 34,067.31
6	Nitrogen Credit Purchase	N/A	Nitrogen Credit	1390.87	N/A	N/A
Total Reduction from BMP				2120.49	298.64	262,042.78
40% Overall Reduction Goal				2120.49	272.70	232,871.94
Total Required Reduction Remaining				0	-25.94	-29,170.84

PUBLIC COMMENT PROCESS

The City encourages the public's involvement and participation in the development and implementation of its MS4 Program. In keeping with this objective, the City posted this - 2nd Phase Chesapeake Bay TMDL Action Plan on its website https://www.winchesterva.gov/engineering/stormwater to solicit public comment on the plan. The 15-day public comment period was complete as of October 31, 2019 and all comments received were addressed.

CONCLUSION

The City developed this second permit term Chesapeake Bay TMDL Action Plan as required in the MS4 General Permit. This TMDL Action Plan concludes that the first permit term 5% pollutant reduction requirements have been met, and serves as a blueprint to reach the second permit term 40% cumulative reduction requirements by July 1, 2023. The City of Winchester reserves the right to modify this TMDL Action Plan as needed to maintain compliance with its Phase II MS4 Permit.

APPENDIX A – MEANS & METHODS DOCUMENTATION FOR THE FIRST PERMIT CYCLE

A.1 - UPDATED SEPTIC CONNECTION TO SANITARY SEWER

For the 2013 – 2018 MS4 Permit years with the 5% pollutant reduction, the City claimed credit for two homes that have met the conditions outlined in the email from DEQ titled "Chesapeake Bay TMDL Reductions: Septic Connection to Sanitary Sewer" sent on June 29, 2015.

Correspondence with DEQ stated that requirements for this crediting process were as follows: (1) The connections must be within the MS4 Service Area and, (2) the disconnections and corresponding connection to the sanitary sewer had to occur post 2006. Table A1 shows the home that has connected to the sanitary sewer, followed by Table A2 which shows the calculation methodology.

Table A1. Sanitary Connections post 2006

Septic Connection to Sanitary Sewer Homes	
Home	**Address**
#1	2316 Middle Road, Winchester VA 22601
#2	2721 Blue Ridge Terrace VA 22601

Table A2. Septic Connection to Sanitary Sewer Crediting Process

Chesapeake Bay TMDL Reductions: Septic Connection to Sanitary Sewer		
Septic Tank TN at Edge of Stream	**3.6**	**lbs. TN/year/person**
Winchester Census Data	**2.46**	**Average number of people per household for 2009-2013**
TN Credit	**8.856**	**lbs. TN Per Year per household**
Households with Septic Connection	**1**	**Home**
Total TN Reduction Credit Provided	**17.7**	**lbs. TN/year**

A.2 - NUTRIENT TRADING

The City of Winchester purchased 50 Class-A Nitrogen Credits on February 22, 2019 from the Opequon Water Reclamation Facility located at 3100 Berryville Pike, Winchester VA 22603. At the time of the purchase (2019), the Class-A Nitrogen Credit Purchase Price was $3.78 a share, for an overall cost of $189.00 to meet the 5% pollutants removal requirements. For the overall 40% pollutants removal requirements, credits will be purchased to address any deficit and achieve full compliance with the second permit cycle. The Credit Price schedule for subsequent years is shown in Figure A.3 taken from the Virginia Nutrient Credit Exchange Association 2018 Exchange Compliance Plan Annual Update. The following pages contain records of the nutrient credit purchase.

CREDIT PRICE SCHEDULE

Compliance Year	Reconciliation Year	Class A Credit Purchase Price ($/Credit)		Price Status (Firm or Estimate)
		Nitrogen	*Phosphorus*	
2011	2012	$2.00	$4.00	Firm
2012	2013	$2.00	$4.00	Firm
2013	2014	$2.15	$4.30	Firm
2014	2015	$2.65	$4.60	Firm
2015	2016	$3.05	$4.93	Firm
2016	2017	$3.50	$5.27	Firm
2017	2018	$3.75	$5.65	Firm
2018	2019	$3.78	$5.70	Firm
2019	2020	$3.82	$5.76	Firm
2020	2021	$3.86	$5.81	Firm
2021	2022	$3.87	$5.82	Firm
2022	2023	$3.94	$5.93	Firm

Figure A.3 Class-A Nutrient Credit Price Schedule

APPENDIX B – BMPS TO BE IMPLEMENTED TO MEET CUMULATIVE POC REDUCTIONS FOR THE SECOND PERMIT CYCLE (PART II.A.11.e)

APPENDIX B.1 – HOPE DRIVE EXTENSION PLAN

PROJECT MANAGER Perry Eisenach, P.E. - City of Winchester (540) 667-2085
SURVEYED BY, DATE Sidney Thomas, L.S. - Rinker Design Associates (703) 368-7373, October 2014
DESIGN BY John A. Giometti, P.E. - Rinker Design Associates (703) 334-0060
SUBSURFACE UTILITY BY, DATE Matthew Ransiem - Mid Atlantic Utility Locating (703) 378-0100, August 2014

FOR INDEX OF SHEETS SEE SHEET 1A

THIS PROJECT WAS DEVELOPED UTILIZING THE DEPARTMENT'S ENGINEERING DESIGN PACKAGE (GEOPAK).
GEOPAK Computer Identification No. 104266

COMMONWEALTH OF VIRGINIA

PLAN AND PROFILE OF PROPOSED
HOPE DRIVE EXTENSION
REALIGNMENT AND SAFETY IMPROVEMENT

DESIGNED BY:

Rinker Design Associates, P.C.
Engineering * Surveying * Land Planning * Transportation * Environmental Services
927 Maple Grove Drive, Suite 105, Fredericksburg, VA 22407 on the web @ www.rdadivil.com
Telephone: (540) 548-4470, Fax: (540) 548-4471
"Turning Challenges into Opportunities"

CITY OF WINCHESTER
HOPE DRIVE EXTENSION
REALIGNMENT AND SAFETY IMPROVEMENT

FHWA-534 DATA26003

STATE	FEDERAL AID PROJECT	STATE ROUTE	STATE PROJECT	SHEET NO.
VA.		-	RS14-138-R10 (SEE TABULATION BELOW FOR SECTION NUMBERS)	1

FUNCTIONAL CLASSIFICATION AND TRAFFIC DATA

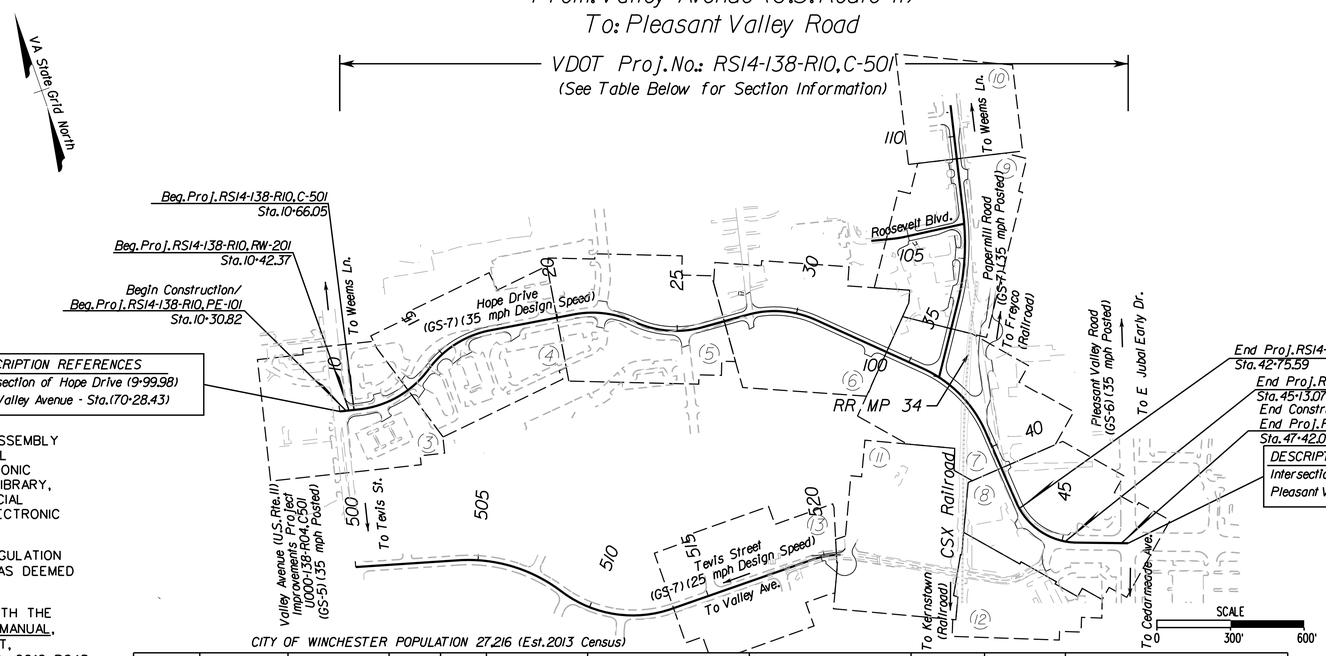
	HOPE DRIVE			PAPERMILL ROAD		TEVIS STREET	
From:	Valley Ave.	Wilson Blvd.	Papermill Rd.	Weems Ln.	Weems Ln.	Wilson Blvd.	Wilson Blvd.
To:	Wilson Blvd.	Papermill Rd.	Pleasant Valley Rd.	Pleasant Valley Rd.	Hope Dr.	Papermill Rd.	Cul-de-sac
FUNCTIONAL CLASSIFICATION	UNDIVIDED ROLLING URBAN COLLECTOR			UNDIVIDED ROLLING URBAN COLLECTOR		UNDIVIDED ROLLING URBAN COLLECTOR	
MIN. DESIGN SPEED	35 MPH			35 MPH		25 MPH	
ADT (2016)	3,400	N/A	N/A	7,000	N/A	7,800	N/A
ADT (2040)	13,690	11,270	11,270	N/A	9,050	N/A	3,000
DHV				677		1,159	
D (%) (design hour)	Not Available			51.9/48.1		50.5/49.5	
T (%) (design hour)	-%			1%		0%	
V (MPH)	*			*		*	
TC STD.	TC-5.11ULS			TC-5.11ULS		TC-5.11ULS	
GEOMETRIC STD.	GS-7			GS-7		GS-7	

*Note: See Plan and Profile Sheets for the Horizontal and Vertical curve design speeds.

CONSTRUCTION PLANS

CONVENTIONAL SIGNS

STATE LINE
COUNTY LINE
CITY,TOWN OR VILLAGE
RIGHT OF WAY LINE
FENCE LINE
UNFENCED PROPERTY LINE
FENCED PROPERTY LINE
WATER LINE
SANITARY SEWER LINE
GAS LINE
ELECTRIC UNDERGROUND CABLE
TRAVELED WAY
GUARD RAIL
RETAINING WALL
RAILROADS
BASE OR SURVEY LINE
LEVEE OR EMBANKMENT
BRIDGES
CULVERTS
DROP INLET
POWER POLES
TELEPHONE OR TELEGRAPH POLES
TELEPHONE OR TELEGRAPH LINES
HEDGE
TREES
HEAVY WOODS
GROUND ELEVATION
GRADE ELEVATION



CITY OF WINCHESTER POPULATION 27,216 (Est. 2013 Census)

TIER 2 PROJECT

THE COMPLETE ELECTRONIC PDF VERSION OF THE PLAN ASSEMBLY AS AWARDED, HAS BEEN SEALED AND SIGNED USING DIGITAL SIGNATURES AND THE OFFICIAL PLAN ASSEMBLY IN ELECTRONIC FORMAT IS STORED IN THE VDOT CENTRAL OFFICE PLAN LIBRARY, INCLUDING ALL SUBSEQUENT REVISIONS, WILL BE THE OFFICIAL CONSTRUCTION PLANS. FOR INFORMATION RELATIVE TO ELECTRONIC FILES AND LAYERED PLANS, SEE THE GENERAL NOTES.

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

THIS PROJECT IS TO BE CONSTRUCTED IN ACCORDANCE WITH THE CITY OF WINCHESTER, PUBLIC SERVICES DEPT. STANDARDS MANUAL, THE TECHNICAL SPECIFICATIONS, INCLUDED IN THE CONTRACT, THE DEPARTMENT'S 2016 ROAD AND BRIDGE SPECIFICATIONS, 2016 ROAD AND BRIDGE STANDARDS, 2009 MUTCD, 2011 VIRGINIA SUPPLEMENT TO THE MUTCD, 2011 VIRGINIA WORK AREA PROTECTION MANUAL AND AS AMENDED BY CONTRACT PROVISIONS AND THE COMPLETE ELECTRONIC PDF VERSION OF THE PLAN ASSEMBLY.

ALL CURVES ARE TO BE SUPERELEVATED, TRANSITIONED AND WIDENED IN ACCORDANCE WITH STANDARD TC-5.11ULS, EXCEPT WHERE OTHERWISE NOTED.

THE ORIGINAL APPROVED TITLE SHEET(S), INCLUDING ORIGINAL SIGNATURES, ARE FILED IN THE VDOT CENTRAL OFFICE PLAN LIBRARY. ANY MISUSE OF ELECTRONIC FILES, INCLUDING SCANNED SIGNATURES, IS ILLEGAL AND ENFORCED TO THE FULL EXTENT OF THE LAW.

STATE PROJECT NO.	SECTION	FEDERAL AID PROJECT NO.	TYPE CODE	UPC NO.	EQUALITIES	LENGTH INCLUDING BRIDGE(S)		LENGTH EXCLUDING BRIDGE(S)		BRIDGE PROJECT NO.	TYPE PROJECT	DESCRIPTION
					FEET	FEET	MILES	FEET	MILES			
RS14-138-R10	PE-101		PENG	104266	none	3,711.21	0.703	3,711.21	0.703	none	Prelim. Eng.	From 0.01 mi. east of Valley Avenue
												To 0.01 mi. west of Pleasant Valley Road
	RW-201		ROWA	104266	none	3,233.22	0.612	3,233.22	0.612	none	Right of Way	From 0.01 mi. east of Valley Avenue
												To 0.09 mi. west of Pleasant Valley Road
	C-501		1000	104266	none	3,447.02	0.653	3,447.02	0.653	none	Construction	From 0.01 mi. east of Valley Avenue
												To 0.05 mi. west of Pleasant Valley Road

Project Lengths are based on Hope Drive Construction Baseline.

REVISED

LOCALLY ADMINISTERED PROJECTS

CITY OF WINCHESTER
NAME OF LOCALITY

PERRY EISENACH, PE
RECOMMENDED FOR APPROVAL FOR RIGHT OF WAY ACQUISITION

DATE	TITLE OF POSITION
01/19/2018	PUBLIC SERVICES DIRECTOR

PERRY EISENACH, PE
RECOMMENDED FOR APPROVAL FOR CONSTRUCTION

DATE	TITLE OF POSITION
	PUBLIC SERVICES DIRECTOR

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SWM Facility #1 Plan View A-A'

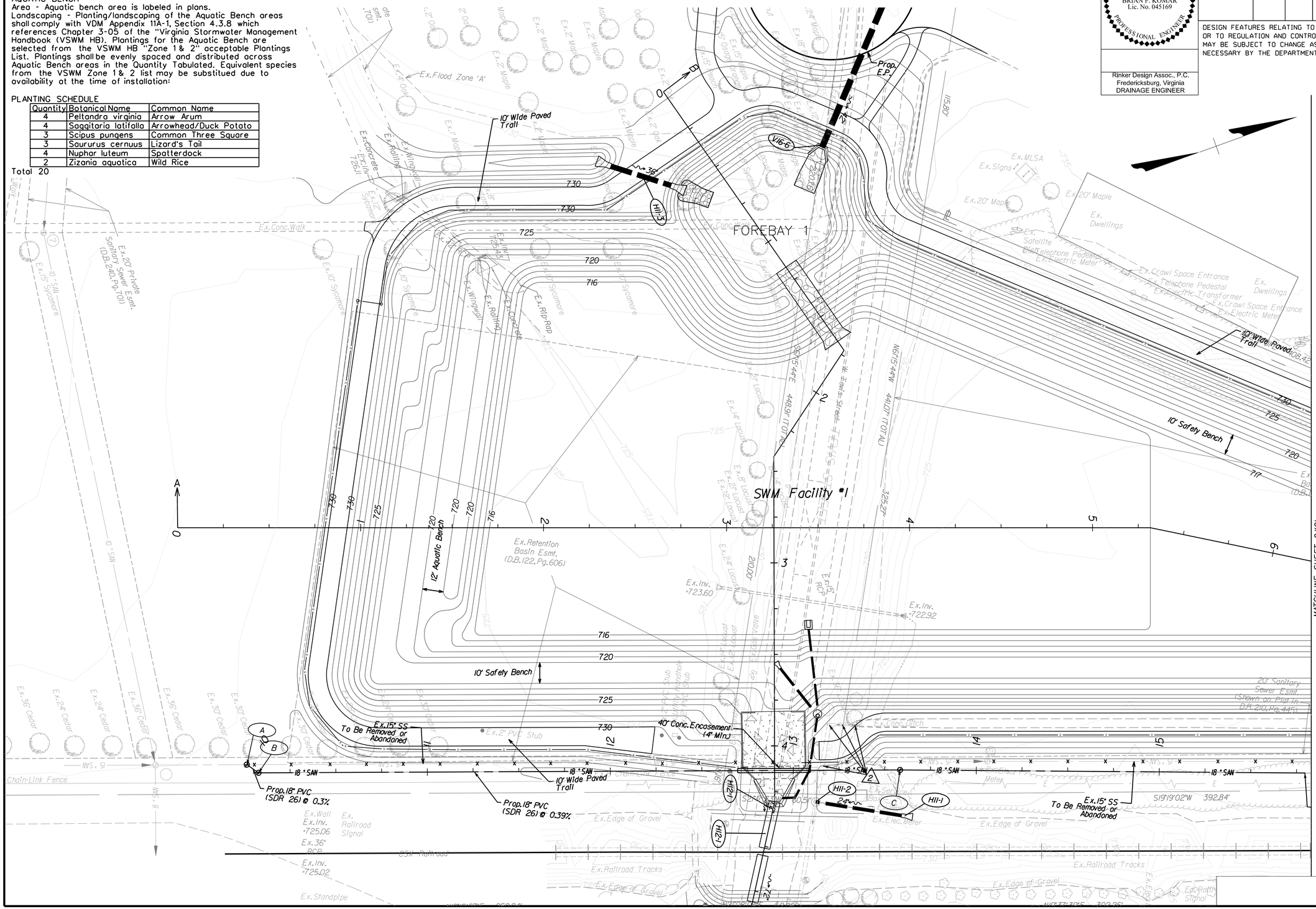
PROJECT MANAGER Perry Eisenach, P.E. - City of Winchester (540) 667-2085
SURVEYED BY, DATE Sidney Thomas, L.S. - Rinker Design Associates (703) 368-7373, October 2014
DESIGN BY John A. Glometti, P.E. - Rinker Design Associates (703) 334-0060
SUBSURFACE UTILITY BY, DATE Matthew Bansiem - Mid Atlantic Utility Locating (703) 378-0100, August 2014

AQUATIC BENCH
Area - Aquatic bench area is labeled in plans.
Landscaping - Planting/landscaping of the Aquatic Bench areas shall comply with VDM Appendix 11A-1, Section 4.3.8 which references Chapter 3-05 of the "Virginia Stormwater Management Handbook (VSWM HB). Plantings for the Aquatic Bench are selected from the VSWM HB "Zone 1 & 2" acceptable Plantings List. Plantings shall be evenly spaced and distributed across Aquatic Bench areas in the Quantity Tabulated. Equivalent species from the VSWM Zone 1 & 2 list may be substitued due to availability at the time of installation:

PLANTING SCHEDULE

Quantity	Botanical Name	Common Name
4	Peltandra virginia	Arrow Arum
4	Sagaitaria latifolia	Arrowhead/Duck Potato
3	Scipus pungens	Common Three Square
3	Saururus cernuus	Lizard's Tail
4	Nuphar luteum	Spatterdock
2	Zizania aquatica	Wild Rice

Total 20



COMMONWEALTH OF VIRGINIA
BRIAN P. KOMAR
Lic. No. 045169
PROFESSIONAL ENGINEER

Rinker Design Assoc., P.C.
Fredericksburg, Virginia
DRAINAGE ENGINEER

REVISED	STATE	STATE ROUTE	STATE PROJECT	SHEET NO.
	VA.	-	RS14-138-R10 R-201, C-501	2J

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

PROJECT	SHEET NO.
RS14-138-R10	2J

Rinker Design Associates, P.C.
Civil Engineering - Surveying - Environmental
Transportation - Land Development
Right-of-Way Services
Office Locations
Fredericksburg, Va. 22401 540-373-3000 Fax: (540) 373-0444
Sterling, Va. 20164 703-450-9000 Fax: (703) 450-9001
Richmond, Va. 23219 804-343-1215 Fax: (804) 343-1217
Roanoke, Va. 24018 540-772-4928 Fax: (540) 772-4929
Charlottesville, Va. 22903 434-293-3719 Fax: (434) 293-8859
Winchester, Va. 22601 540-667-2085 Fax: (540) 667-2086
1011 Hayes Street, Suite 100 Nashville, Tennessee 37203 Phone: (615) 244-8591 Fax: (615) 244-8271
www.rinkerdesign.com

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DESIGN BY John A. Giometti, P.E. - Rinker Design Associates (703) 334-0060
SUBSURFACE UTILITY BY, DATE Matthew Bansiem - Mid Atlantic Utility Locating (703) 378-0100, August 2014

SWM Facility #1 Cross Section View A-A'

COMMONWEALTH OF VIRGINIA
BRIAN P. KOMAR
Lic. No. 045169
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DRAINAGE ENGINEER

REVISED	STATE	STATE ROUTE	STATE PROJECT	SHEET NO.
	VA.	-	RS14-138-R10 R-201, C-501	2J(1)

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

SCALE
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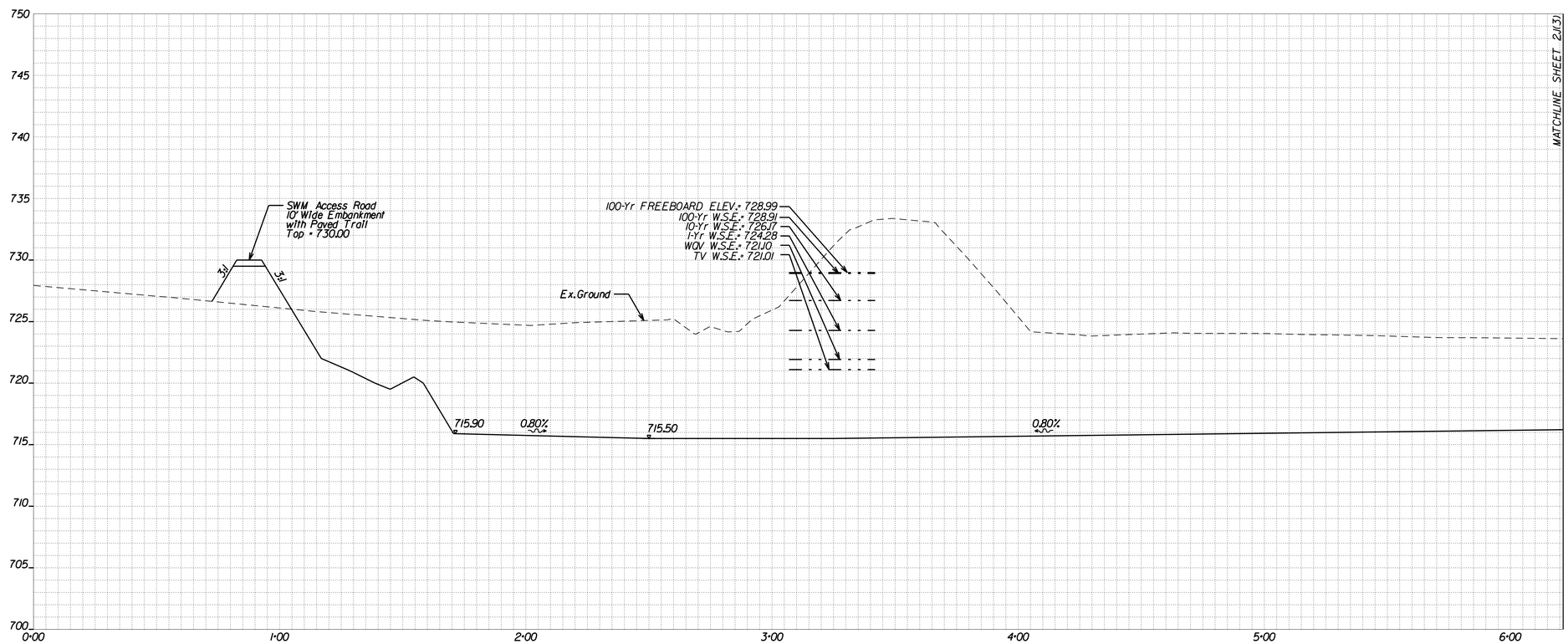
H: 1"=25'
0 25' 50'



PROJECT	SHEET NO.
RS14-138-R10	2J(1)

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SWM Facility #1 Plan View A-A'

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	VA.	-	RS14-138-R10 R-201, C-501	2J(2)

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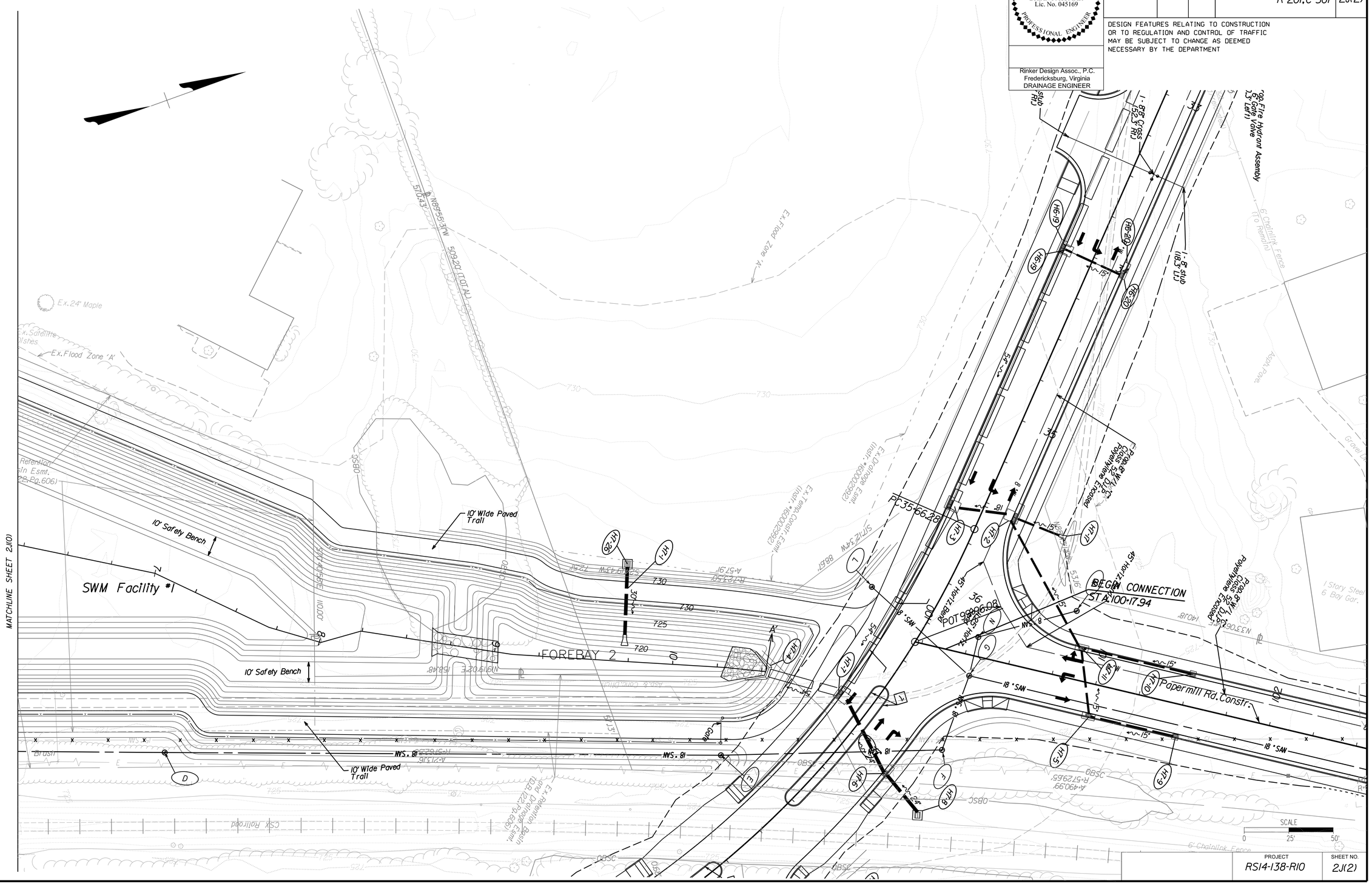

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RS14-138-R10	2J(2)

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SWM Facility #1 Cross Section View A-A'

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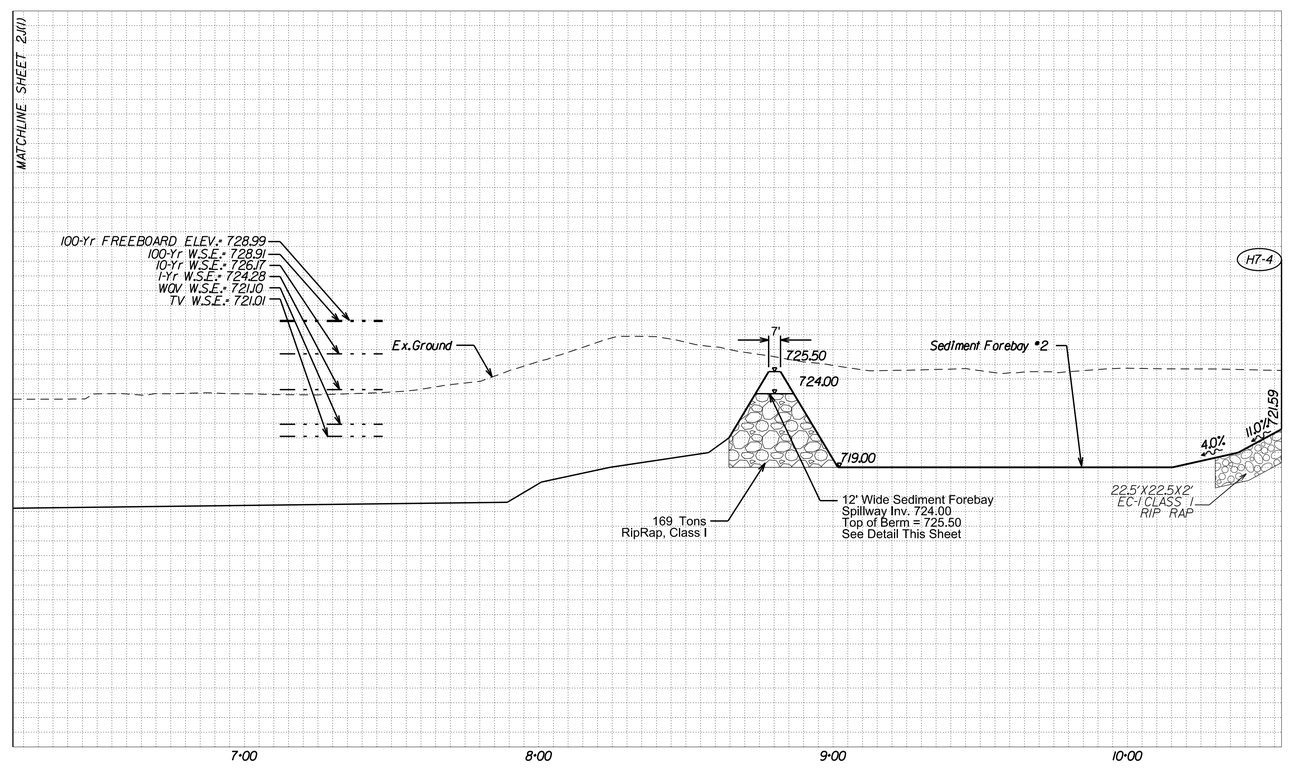
	VA.	-	RS14-138-R10 R-201, C-501	2J(3)

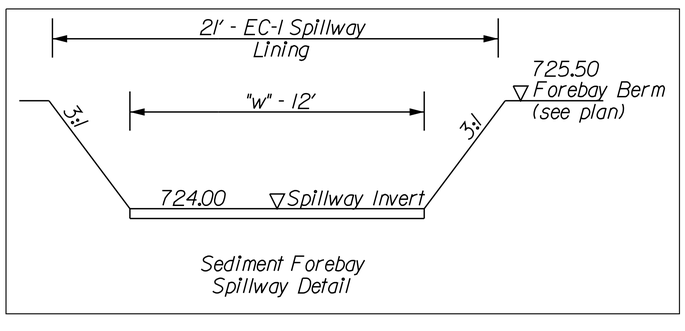
DESIGN FEATURES RELATING TO CONSTRUCTION OR TO REGULATION AND CONTROL OF TRAFFIC MAY BE SUBJECT TO CHANGE AS DEEMED NECESSARY BY THE DEPARTMENT

SCALE
V: 1"=5'
H: 1"=25'
0 25' 50'

SWM #1 A-A' CROSS SECTION



Sediment Forebay #2
(Not to Scale)



Sediment Forebay
Spillway Detail

PROJECT	SHEET NO.
RS14-138-R10	2J(3)

PROJECT MANAGER Perry Eisenach, P.E. - City of Winchester (540).667-2085
SURVEYED BY, DATE Sidney Thomas, L.S. - Rinker Design Associates (703).368-7373, October 2014
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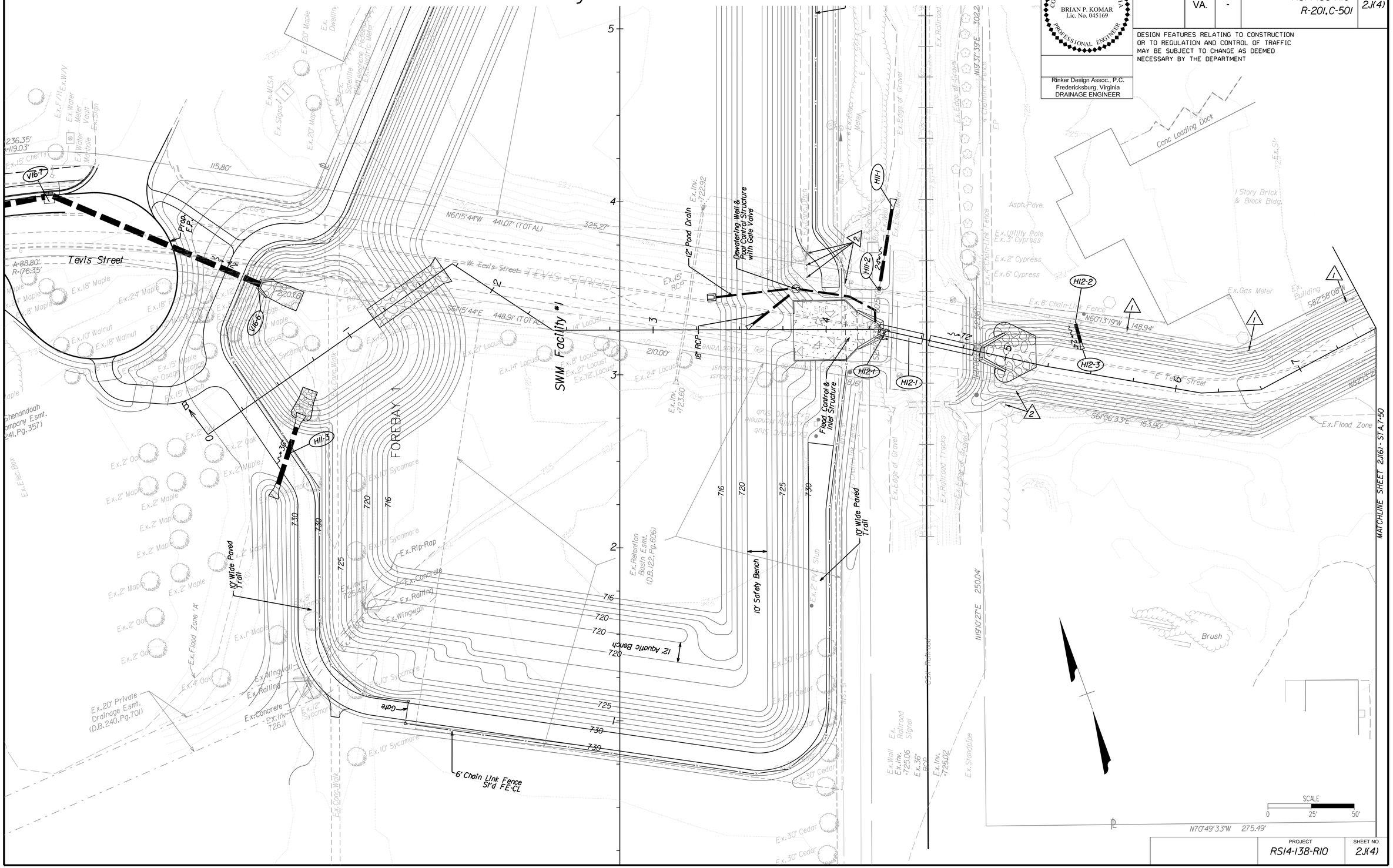
SUBSURFACE UTILITY BY, DATE Matthew Bansiem - Mid Atlantic Utility Locating (703) 378-0100, August 2014

SWM Facility #1 Plan View B-B'



MATCHLINE SHEET 2J(6) - STA.7+50

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REVISED	STATE	STATE ROUTE	STATE PROJECT	SHEET NO.
	VA.	-	RS14-138-R10 R-201, C-501	2J(4)

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

PROJECT	SHEET NO.
RS14-138-R10	2J(4)

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SUBSURFACE UTILITY BY, DATE Matthew Bansiem - Mid Atlantic Utility Locating (703) 378-0100, August 2014

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SWM Facility #1 Cross Section View B-B'

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REVISED	STATE	STATE ROUTE	STATE PROJECT	SHEET NO.
	VA.	-	RS14-138-R10 R-201, C-501	2J(5)

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

SCALE
V: 1"=5'
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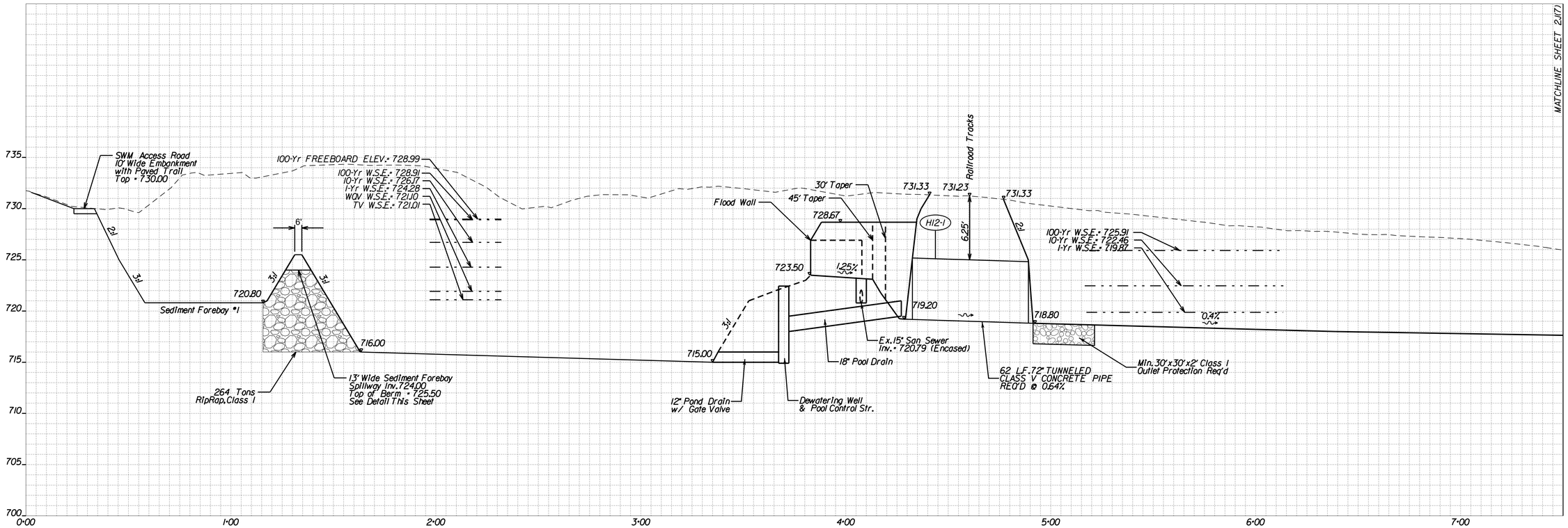
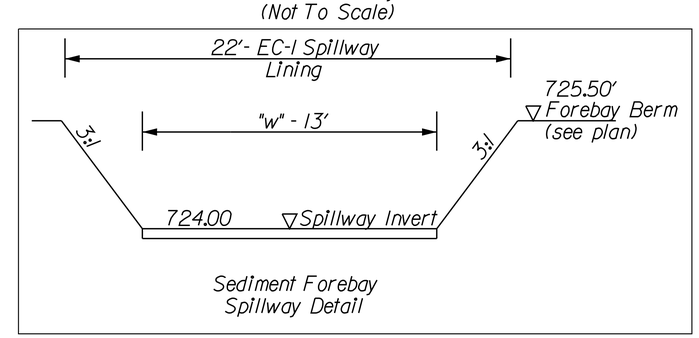
0 25' 50'



Sediment Forebay #1
(Not To Scale)



Sediment Forebay
Spillway Detail

PROJECT	SHEET NO.
RS14-138-R10	2J(5)

PROJECT MANAGER Perry Eisenach, P.E. - City of Winchester (540) 667-2085
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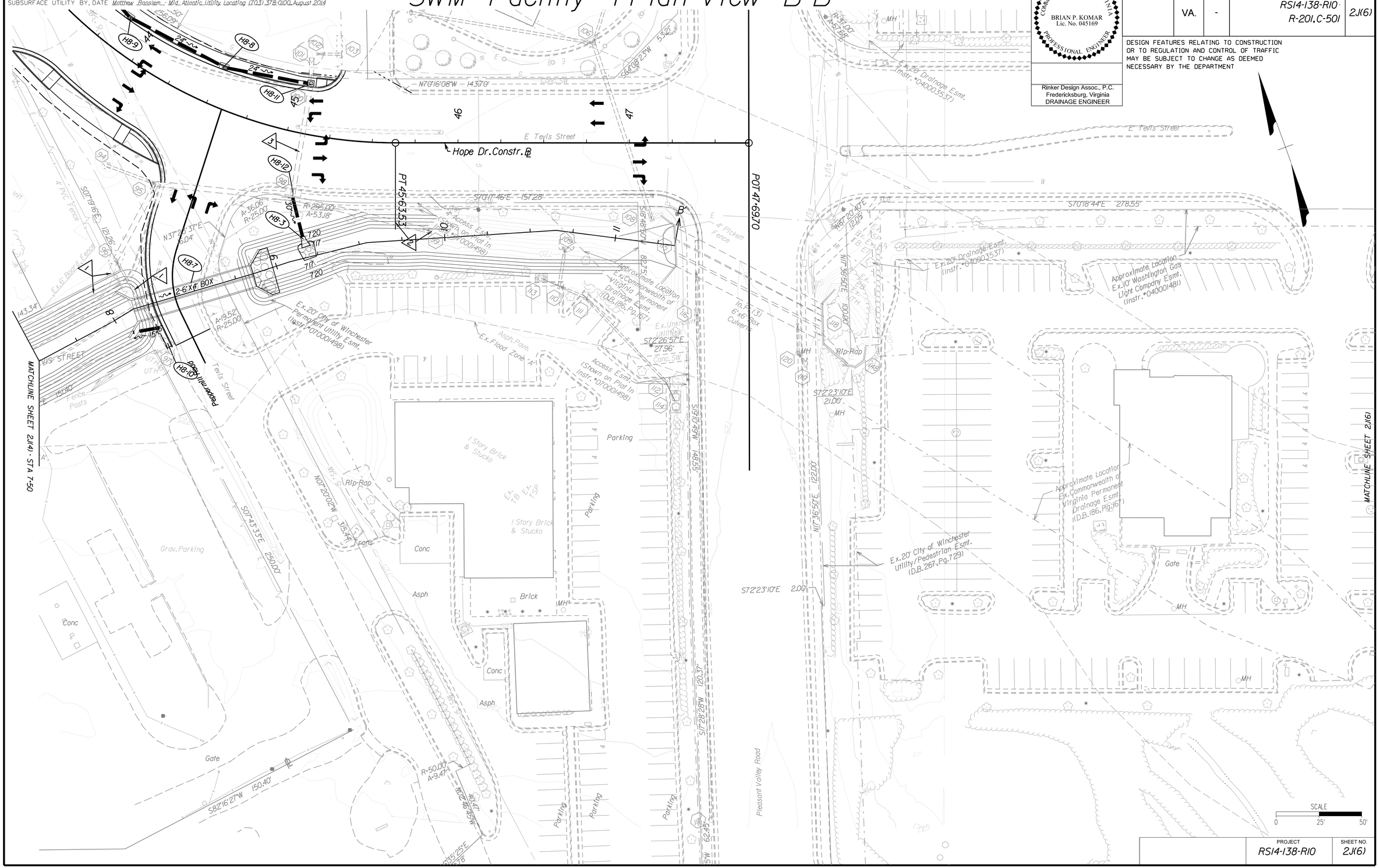
DESIGN BY John A. Glometti, P.E. - Rinker Design Associates (703) 334-0060
SUBSURFACE UTILITY BY, DATE Matthew Bansiem - Mid Atlantic Utility Locating (703) 378-0100, August 2014

SWM Facility #1 Plan View B-B'



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REVISED	STATE	STATE ROUTE	STATE PROJECT	SHEET NO.
	VA.	-	RS14-138-R10 R-201, C-501	2J(6)

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

PROJECT	SHEET NO.
RS14-138-R10	2J(6)

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SWM Facility #1 Cross Section View B-B'

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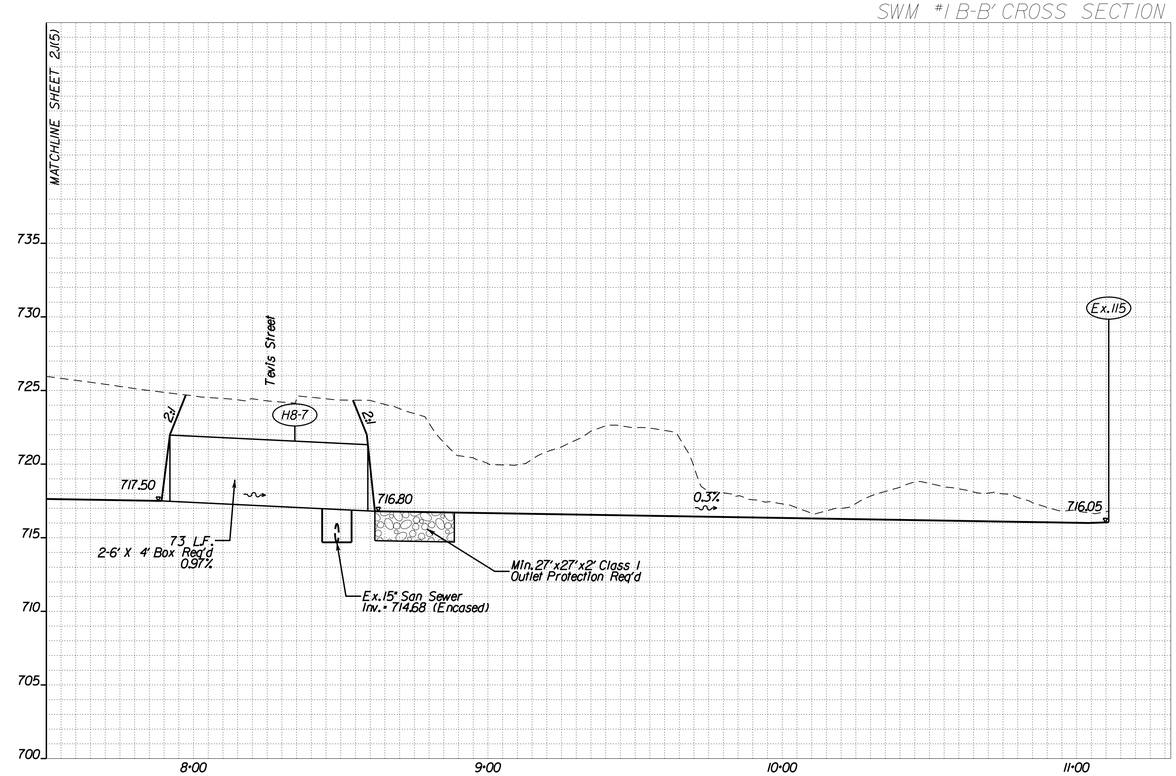
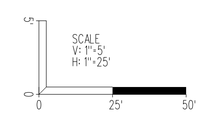
REVISED	STATE	STATE ROUTE	STATE PROJECT	SHEET NO.
	VA.	-	RS14-138-R10 R-201, C-501	2J17

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

SWM #1 B-B' CROSS SECTION





Hope Drive Extension, Realignment and Safety Improvement
UPC 14027
Project# RS14-138-R10

CITY OF WINCHESTER

Drainage Computations
&
Outfall Analysis

Rinker Design Assoc., P.C.
Fredericksburg, Virginia
Hydraulic Engineer

III. Stormwater Management & Best Management Practice Narrative

Stormwater Management

This project proposes the extension of Hope Drive from its current terminus at Wilson Boulevard. A new at grad railroad crossing will be created with the extension, and sections of Papermill Road and Tevis Street will be realigned to tie into the extension of Hope Drive. The existing at grade railroad crossing on both Papermill Road and Tevis Street will be eliminated. Portions of existing Hope Drive will also be realigned to improve safety. One SWM/BMP (WQN/WQL) facility has been designed.

This project discharges to one common outfall, a triple 6'x6' box culvert under Pleasant Valley road. The total drainage area to this point is 345.41 acres, with 16.71 acres of this located within the project limits. Development will increase the impervious area within the project limits from 3.84 acres to 6.00 acres. As this increase will raise the post development flow rate, a Wet Pond has been proposed to meet Channel Protection and Flood Protection Criteria. This pond will also serve to meet Water Quality requirements.

This pond also provides additional storage/treatment volume for the improvements to Valley Road proposed under a separate plan.

Drainage Area:

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

Drainage Area	Total Area	RCN	Tc
EX SWM AREA	4.40	80.5	18.8
EX UNCONTROLLED TO J	36.23	83.6	38.28
EX SWM V16-6	95.71	82.8	134.93
EX SWM H7-4	123.57	86.7	100.58
EX H11-3	63.35	81.2	133.45
EX UNCONTROLLED TO H	18.13	88.7	6.31
EX UNCONTROLLED TO G	17.89	92.1	36.87
EX UNCONTROLLED TO E	251.73	88.7	33.12
EX UNCONTROLLED TO C	28.90	90.0	25.44
PROP SWM AREA	10.45	83.7	17.68
PROP CULVERT H8-7	35.57	84.3	38.28
PROP UNC. BELOW H8-7	18.24	88.6	5.88
PROP SWM V16-6	96.78	82.8	72.58
PROP SWM H7-4	123.04	87.3	72.83
PROP H11-3	61.33	80.9	131.57
POST UNCONTROLLED TO G	17.89	92.1	36.87
POST UNCONTROLLED TO E	251.73	88.7	33.12
POST UNCONTROLLED TO C	28.90	90.0	25.44

Limits of Study:

The location of the outfall is shown in the included outfall drainage map. The point of analysis is at the limits of disturbance, downstream of the existing culvert. As the channel downstream is a natural channel, the requirements for natural channel will be used in this design.

Easement Requirements:

Easements will be required for Storm Water Management.

SWM #1 Design:

SWM#1 has been designed as a Wet Pond, Level 1 as described in Chapter 11, Appendix 11A Section 12.3.

The drainage area to the pond was established as follows:

Tv =(1)(Rv)(Area)	561,576.39
Rv =	0.53
Post Dev SWM Impervious	4.18
Post Dev V16-6 Impervious	35.58
Post Dev H11-3 Impervious	18.37
Post Dev H7-7 Impervious	68.87
Total Impervious to SWM	127.01
Post Dev SWM Turf	6.28
Post Dev V16-6 Turf	54.55
Post Dev H11-3 Turf	42.08
Post Dev H7-7 Turf	49.67
Total Turf to SWM	152.57
Post Dev SWM forest	0.00
Post Dev V16-6 forest	6.64
Post Dev H11-3 forest	0.88
Post Dev H7-7 forest	4.50
Total forest to SWM	12.02
Post Dev SWM Area	10.45
Post Dev V16-6 Area	96.78
Post Dev H11-3 Area	61.33
Post Dev H7-7 Area	123.04
Total Post Dev Area to SWM	291.60

Water Quality (Runoff Reduction)

The proposed SWM facility is designed to provide water quality and water quantity for the area located upstream of the facility. The proposed facility provides water quality for both the Hope Drive Improvements and Valley Avenue project per the Runoff Reduction Method to determine the amount of Treatment Volume (Tv) and how much lb/yr of phosphorous that the proposed facility can provide, a step back approach was performed with the Runoff Reduction Calculations.

Assumptions were made for the drainage areas located upstream of the proposed SWM facility. The drainage area upstream of the proposed pond has previously been developed as residential and commercial uses. As water quality credit cannot be taken for areas already treated, a total of the volume provided was generated as follows:

Existing Stormwater Management Facilities Located Upstream of SWM #1							
Location		BMP Type	Outfall	Area Treated Map	Total Impervious	Water Quality Volume Required	Notes
612 Lake Drive	Rolling Hills Estate	Detention Pond (0108)	V16-6	49.76	10.26	37251.70	2 x WQV
702 Kennedy Drive		SWM Pond (0107)	V16-6				
2659 Valley Avenue	Popeyes	Underground	V16-6	0.90	0.57	1034.07	1 x WQV
320 Hope Drive	Madison Center	Underground/Rain Garden	H7-7	2.21	1.68	6080.27	2 x WQV
321 Hope Drive	Hope Drive Site Plan	SWM Pond (0066)	H7-7	2.48	0.91	1642.83	
2725 Valley Avenue	Enterprise	Infiltration Gallery	V16-6	1.47	1.12	2024.67	1 x WQV
2610 Hockman Ave @ Tevis	Limestone Court	SWM Pond (0077)	H7-7	13.69	4.14	7519.92	1 x WQV
2610 Hockman Ave @ Townhomes	Limestone Court	SWM Pond (0077)	H7-7	15.40	4.61	8363.17	1 x WQV
2654 Valley Ave	Valley Insurance	SWM Pond (0134)	H11-3	31.07	11.00	39944.59	2 x WQV
415 Russelcroft Road	Stonecroft Village	SWM Pond (0119)	H11-3				
2584 Valley Avenue	Food Lion	SWM (0133)	H7-7	5.12	4.04	7324.94	1 x WQV
					Total	111,186.15	

This treatment volume was then subtracted from the total treatment volume required for this drainage area to arrive at a new required treatment volume of 450,390 CF. This adjusted Tv was then used in the Runoff Reduction Method, to determine how much lb/yr of phosphorous removal could be provided with the proposed SWM. A summary table has been provided below:

Water Quality (Runoff Reduction Summary)	
Total Area to Buffalo Lick Outfall	345.41 ac.
Total Drainage Area to SWM Facility	291.60 ac.
Total Site Area - Hope Drive Project	16.71 ac.
Total Site Area - Valley Avenue Project	3.78 ac.
Required Water Quality Volume Based on Total Drainage Area to SWM Facility	0 cf
Required Treatment Volume Based on Total Drainage Area to SWM Facility	561576 cf
Total Treatment Volume Provided in Existing Upstream Stormwater Management Facilities	111186 cf
Total Adjusted Treatment Volume Required Based on Existing SWM Facilities Located Upstream of SWM	450390 cf
Total Phosphorous Load Reduction Required - Hope Drive Project (lb/yr)	6.64
Total Phosphorous Load Reduction Required - Valley Avenue Project (lb/yr)	2.03
Total Allowable Phosphorous Reduction per Runoff Reduction Method (Step Back Method) for Prop. SWM Facility	141.11
Total Phosphorous Reduction Remaining after Hope Drive and Valley Avenue (lb/yr)	132.44
Total Nitrogen Reduction Required Hope Drive Project (lb/yr)	39.22
Total Nitrogen Reduction Required Valley Avenue Project (lb/yr)	147.14
Total Allowable Nitrogen Reduction per Runoff Reduction Method (Step Back Method) for Prop. SWM Facility (lb/yr)	605.68
Total Nitrogen Reduction Remaining after Hope Drive and Valley Avenue (lb/yr)	419.32

The water quality orifice was then set at a 12” diameter and designed to drawdown a conservative volume of 460,974 cf. No water quality credit was taken for the additional volume. The pond was then routed utilizing Pondpack to arrive at the following elevations and discharges. It should be noted that these routings do not account for any detention occurring in the upstream facilities.

SWM #1 Outfall									
SWM	1 Year WSEL	10 Year WSEL	100 Year WSEL	Facility Equiped with Emergency Spillway	Elevation of Emergency Spillway	100 Year Freeboard Elevation	Top of Dam	Freeboard Provided	Freeboard Required
SWM #1	724.28	726.17	728.91	Y	728.50	728.99	730.00	1.01	1'

Outfall SWM #1			
SWM #1	Peak Flow Rate (Total)		
	1 Year	10 Year	100 Year
SWM #1	65.38	226.75	405.41

Outfall Discharge:

Utilizing Pondpack, the discharge from the pond was then combined with the other uncontrolled areas to arrive at final post development flow rates as follows:

Outfall Flow Rate Information			
Drainage Area	**Peak Flow Rate 10-Year**	**Peak Flow Rate 1-Year**	
	10 Year	1 Year	1 Year Hyd. Volume
EX	245.84 cfs	99.16 cfs	1,273,065 cf
PROP	245.61 cfs	71.25 cfs	1,069,030 cf
Net Change	**-0.23 cfs**		

Energy Balance Equation:

Onsite areas were used for the Energy Balance Equation as it eliminates any Improvement Factor from being applied to areas not within our limits of disturbance. Point of Analysis for 1-Year peak flow is located at the existing triple 6’x’6 box culvert at Pleasant Valley Road. This is annotated as Cross Section H in the Pond Pack calculations.

Outfall						
q_{pre}	99.16	cfs	Energy Balance Equation :		$q_{post} \leq q_{pre}(\frac{RV_{pre}}{RV_{post}})(IF)$	
Vol_{pre}	1,273,065.00	cf				
q_{post}	71.25	cfs				
Vol_{post}	1,069,030.00	cf		71.25	≤	94.47
IF	0.8					

Channel Protection:

Under Section 11.4.2.1.3a of the VDOT Drainage Manual, areas draining to a natural stormwater conveyance channel shall satisfy the channel protection criteria by providing compliance with the energy balance equation. As the equation has been shown satisfied above, no further calculations are necessary.

Flood Protection:

The peak flow rate was calculated for the ten-year 24-hour storm in the pre and post development conditions. The resulting values were 245.84 cfs and 246.61 cfs, respectively. Under Section 11.4.2.2.2b, releasing a post development rate less than pre-development rate satisfies the flood protection criteria. As this reduction (0.23 cfs) has been provided, no additional downstream analysis is required.

Outfall Analysis

Virginia Standard MS19 states as follows *"Properties and waterways downstream from development sites shall be protected from sediment deposition, erosion and damage due to increases in volume, velocity and peak flow rate of stormwater runoff for the stated frequency storm of 24-hour duration"*

Under subsection N of this requirement

n. Compliance with the water quantity minimum standards set out in 9VAC25-870-66 of the Virginia Stormwater Management Program (VSMP) Regulation shall be deemed to satisfy the requirements of this subdivision 19.

As Channel Protection and Flood Protection have been demonstrated in accordance with this code section, it is our opinion that this outfall is adequate.

Chesapeake Bay Watershed TMDL Summary

The City of Winchester operates a MS4 that is regulated under the federal Clean Water Act and the Virginia State Water Control Law. Under these statutes and their associated regulations, the City is required to develop, implement and maintain a MS4 Program. The City developed a Chesapeake Bay TMDL Action Plan. The focus of the Action Plan is driven by the Chesapeake Bay TMDL which was approved by the US Environmental Protection Agency (EPA) in December of 2010. Nitrogen, Total Phosphorous, and Sediment are the Pollutants of Concern (POC) driving the need for required pollutant reductions in the Chesapeake Bay Basin area.

Removal Efficiency Calculations were performed for Total Phosphorous, Total Nitrogen and Total Suspended Solids based on the 2009 EOS (Edge of Stream) Loading Rates, which are provided in Table 2b. "Calculation Sheet for Estimating Source Loads for the Potomac River

Basin) – Based on Chesapeake Bay Program Watershed Model Phase 5.3.2 located in the Guidance Memo No. 15-2005, dated May 18, 2015 from the Commonwealth of Virginia Department of Environmental Quality, Water Division.

2009 Edge of Stream (EOS) Loading Rates

Potomac River Basin		
Subsource	Pollutant	2009 EOS Loading Rate (lbs/acre/yr)
Regulated Urban Impervious	Nitrogen	16.86
Regulated Urban Pervious		10.07
Regulated Urban Impervious	Phosphorous	1.62
Regulated Urban Pervious		0.41
Regulated Urban Impervious	TSS	1171.32
Regulated Urban Pervious		175.8

Based on the total allowable Impervious and Pervious area to be treated by the proposed BMP designed as part of the Hope Drive Project, and the Chesapeake Bay Program allowable removal rates for TP, TN and TSS and the EOS for the Potomac River Basin, Removal Efficiencies for the proposed SWM Facility were computed.

Total Areas to Pond Based on allowed removal		
Total Impervious	104	acres
Total Pervious	133	acres

Chesapeake Bay Program - Wet Pond Efficiency	
Nitrogen	30%
Phosphorous	50%
TSS	65%

Phosphorous Removal:

(Acres Impervious * EOS Impervious Loading Rate * BMP Efficiency) + (Acres Pervious * EOS Pervious Loading Rate * BMP Efficiency)

Phosphorous Loading Summary		
Phosphorous Impervious Loading	168.48	lb/yr
Phosphorous Pervious Loading	54.53	lb/yr
Removal Efficiency Calculation		
Impervious :	84.24	lb/yr
Pervious:	27.27	lb/yr
Total Phosphorous removal for allowable drainage area:	111.51	lb/yr

Nitrogen Removal:

(Acres Impervious * EOS Impervious Loading Rate * BMP Efficiency) + (Acres Pervious * EOS Pervious Loading Rate * BMP Efficiency)

Nitrogen Loading Summary		
Nitrogen Impervious Loading	1753.44	lb/yr
Nitrogen Pervious Loading	1339.31	lb/yr
Removal Efficiency Calculation		
Impervious :	526.03	lb/yr
Pervious:	401.79	lb/yr
Total Nitrogen removal:	927.83	lb/yr

Total Suspended Solids Removal:

(Acres Impervious * EOS Impervious Loading Rate * BMP Efficiency) + (Acres Pervious * EOS Pervious Loading Rate * BMP Efficiency)

Total Suspended Solids Loading Summary		
TSS Impervious Loading	121817.28	lb/yr
TSS Pervious Loading	23381.40	lb/yr
Removal Efficiency Calculation		
Impervious :	79181.23	lb/yr
Pervious:	15197.91	lb/yr
Total TSS removal for total drainage area:	94379.14	lb/yr

Hope Drive
8/28/2018

SWM/BMP WATER QUALITY TABULATIONS

Basin	Pond's Drainage Area		Imp. Area Treated	Req'd. Forebay Vol.	Req'd WQL Vol.	Req'd Forebay Vol	Total WQL Vol Req'd	Total WQL Vol Provided	Forebay Vol Provided	WQL Elevation	Type of Basin
	Total (ac)	Impervious (ac)	(ac)	(ac-ft)	(ac-ft)	(cubic feet)	(cubic feet)	(cubic feet)	(cubic feet)	(Feet)	
SWM 1 Forebay 1	158.11	53.94	53.94	0.450	2.248	19602	-	0	19607	-	Wet Pond Level I
SWM 1 Forebay 2	123.04	68.87	68.87	0.574	-	25003	-	0	27757	-	Wet Pond Level I
SWM 1 - Total	291.59	126.99	126.99	-	5.291	-	460,974	460,974	-	721.10	Wet Pond Level I

Hope Drive

WATER QUALITY ORIFICE CALCULATION

***Pond drain with gate valve**

WQL ORIFICE

WQL BASIN 1

Drawdown time =		30	hrs
WQL VOLUME		460974	cf
WQL WSE		721.10	ft
POND INVERT		715.00	ft
Max. h		6.10	ft
Q avg=	(Vol/t)	4.27	cfs
Qmax=	(Qavg *2)	8.54	cfs
A orifice=	{Qmax/C(2gh)^1/2}	0.72	ft
D orifice =		0.9562	ft
		11.47	**inch**

USE 12" ORIFICE

Sediment Forebay #1 Spillway

Q (2)	=	49.54	CFS
OVERLAND RELIEF WEIR INFORMATION			
FOREBAY BERM ELEVATION	=	725.5	FT
WEIR ELEVATION	=	724	FT
LENGTH OF WEIR	=	13	FT
WEIR COEFFICIENT	=	2.6	
$Q=CLh^{(3/2)}$	$h= (Q/CL)^{(2/3)}$		
h	=	1.29	FT
TOTAL WIDTH OF WEIR	=	22.00	FT

Sediment Forebay #2 Spillway

Q (2)	=	122.01	CFS
OVERLAND RELIEF WEIR INFORMATION			
FOREBAY BERM ELEVATION	=	725.5	FT
WEIR ELEVATION	=	724	FT
LENGTH OF WEIR	=	12	FT
WEIR COEFFICIENT	=	2.6	
$Q=CLh^{(3/2)}$	$h= (Q/CL)^{(2/3)}$		
h	=	2.49	FT
TOTAL WIDTH OF WEIR	=	21.00	FT

BASIN SWM 1 VOLUME

ELEV	AREA SF	AREA AC	FT ELEV DELTA	SF AVG AREA	CF VOL INCR	CF VOL ACCUM	AC-FT VOL ACCUM
715	-	-				0	0.0000
			0.50	14,034	4,677		
715.5	28,067	0.6443				4,677	0.1074
			0.40	39,294	15,497		
715.9	50,520	1.1598				20,175	0.4632
			0.10	53,327	5,330		
716	56,133	1.2886				25,504	0.5855
			0.90	59,608	53,611		
716.9	63,083	1.4482				79,116	1.8163
			0.10	68,738	6,865		
717	74,392	1.7078				85,981	1.9739
			1.00	76,695	76,675		
718	78,997	1.8135				162,657	3.7341
			1.00	83,738	83,684		
719	88,478	2.0312				246,341	5.6552
			1.00	92,502	92,464		
720	96,526	2.2159				338,804	7.7779
			1.00	100,527	100,490		
721	104,527	2.3996				439,294	10.0848
			1.00	111,091	111,015		
722	117,654	2.7010				550,309	12.6334
			1.00	120,549	120,525		
723	123,443	2.8339				670,834	15.4002
			1.00	126,341	126,317		
724	129,239	2.9669				797,151	18.3001
			1.00	132,267	132,242		
725	135,294	3.1059				929,393	21.3359
			1.00	146,436	146,280		
726	157,578	3.6175				1,075,673	24.6941
			1.00	160,294	160,270		
727	163,010	3.7422				1,235,943	28.3733
			1.00	165,718	165,694		
728	168,426	3.8665				1,401,637	32.1772
			1.00	171,083	171,059		
729	173,740	3.9885				1,572,696	36.1041
			1.00	176,478	176,453		
730	179,216	4.1142				1,749,149	40.1549

FOREBAY 1 VOLUME

ELEV	AREA SF	AREA AC	FT ELEV DELTA	SF AVG AREA	CF VOL INCR	CF VOL ACCUM	AC-FT VOL ACCUM
721	3,437	0.0789				0	0.0000
			1.00	3,780	3,774		
722	4,122	0.0946				3,774	0.0866
			1.00	4,493	4,487		
723	4,863	0.1116				8,261	0.1896
			1.00	5,262	5,256		
724	5,661	0.1300				13,517	0.3103
			1.00	6,096	6,090		
725	6,530	0.1499				19,607	0.4501

PROVIDED VOLUME =	19,607	CF
REQUIRED FOREBAY VOLUME =	19,602	CF

FOREBAY 2 VOLUME

ELEV	AREA SF	AREA AC	FT ELEV DELTA	SF AVG AREA	CF VOL INCR	CF VOL ACCUM	AC-FT VOL ACCUM
719	1,483	0.0340				0	0.0000
			1.00	1,987	1,965		
720	2,490	0.0572				1,965	0.0451
			1.00	2,992	2,977		
721	3,493	0.0802				4,942	0.1134
			1.00	4,006	3,995		
722	4,519	0.1037				8,936	0.2052
			1.00	5,078	5,067		
723	5,636	0.1294				14,003	0.3215
			1.00	6,254	6,243		
724	6,872	0.1578				20,246	0.4648
			1.00	7,521	7,510		
725	8,169	0.1875				27,757	0.6372

PROVIDED VOLUME =	27,757	CF
REQUIRED FOREBAY VOLUME =	25,003	CF

TOTAL BMP VOLUME

ELEV (FT)	STAGE (FT)	VOLUME BASIN (AC-FT)	VOLUME PRETREAT #1 (AC-FT)	VOLUME PRETREAT #2 (AC-FT)	TOTAL (BASIN + (AC-FT)	TOTAL (CF)
715	0	0.00	0.00		0.00	0
715.5	0.5	0.11	0.00		0.11	4677
715.9	0.9	0.46	0.00		0.46	20175
716	1	0.59	0.00		0.59	25504
716.9	1.9	1.82	0.00		1.82	79116
717	2	1.97	0.00		1.97	85981
718	3	3.73	0.00		3.73	162657
719	4	5.66	0.00	0.00	5.66	246341
720	5	7.78	0.05	0.05	7.87	342734
721	6	10.08	0.11	0.11	10.31	449178
722	7	12.63	0.29	0.21	13.13	571956
723	8	15.40	0.51	0.32	16.23	707101
724	9	18.30	0.31	0.46	19.08	830915
725	10	21.34	0.45	0.64	22.42	976757
726	11	24.69	0.00		24.69	1075673
727	12	28.37	0.00		28.37	1235943
728	13	32.18	0.00		32.18	1401637
729	14	36.10	0.00		36.10	1572696
730	15	40.15	0.00		40.15	1749149

REQUIRED Tv VOLUME =		561,576	CF	OR	12.89	AC-FT
ELEV1 =	722		VOLUME1 =		571,956	
ELEV2 =	723		VOLUME2 =		707,101	
DELTA1 VOLUME =		707,101	-	571,956	=	135,145
DELTA2 VOLUME =		707,101	-	561,576	=	145,525
	145,525	/	135,145	=	1.0768	
	1.0768	x	1.00	=	1.076801703	
BMP ELEVATION =		721.92	FEET			

REQUIRED WQV VOLUME =		460,974	CF	OR		10.58	AC-FT
ELEV1 =	721		VOLUME1 =			449,178	
ELEV2 =	722		VOLUME2 =			571,956	
DELTA1 VOLUME =		571,956	-		449,178	=	122,778
DELTA2 VOLUME =		571,956	-		460,974	=	110,982
	110,982	/	122,778		=	0.9039	
	0.9039	x	1.00		=	0.903925785	
BMP ELEVATION =		721.10	FEET				

**ADJUSTED REQUIRED Tv VOLUME =		450,390	CF	OR		10.34	AC-FT
ELEV1 =	721		VOLUME1 =			449,178	
ELEV2 =	722		VOLUME2 =			571,956	
DELTA1 VOLUME =		571,956	-		449,178	=	122,778
DELTA2 VOLUME =		571,956	-		450,390	=	121,566
	121,566	/	122,778		=	0.9901	
	0.9901	x	1.00		=	0.990125838	
BMP ELEVATION =		721.01	FEET				

* Total Water Quality Volume Provided in existing stormwater management facilities = 111,186.15

** Tv Volume Adjusted based on existing stormwater management facilities located upstream of SWM #1

Project Name:	
Date:	9/11/2018
Linear Development Project?	Yes

CLEAR ALL

data input cells
constant values
calculation cells
final results

Site Information

Post-Development Project (Treatment Volume and Loads)

Enter Total Disturbed Area *(acres)* → 16.71

Maximum reduction required:	*20%*
The site's net increase in impervious cover (acres) is:	*2.16*
Post-Development TP Load Reduction for Site (lb/yr):	*6.64*

Check:

BMP Design Specifications List:	2013 Draft Stds & Specs
Linear project?	Yes
Land cover areas entered correctly?	✓
Total disturbed area entered?	✓

Pre-ReDevelopment Land Cover (acres)

	A Soils	B Soils	C Soils	D Soils	Totals
Forest/Open Space (acres) -- undisturbed, protected forest/open space or reforested land	0.00	0.00	0.36	0.00	0.36
Managed Turf (acres) -- disturbed, graded for yards or other turf to be mowed/managed	0.00	0.00	12.51	0.00	12.51
Impervious Cover (acres)	0.00	0.00	3.84	0.00	3.84
					16.71

Post-Development Land Cover (acres)

	A Soils	B Soils	C Soils	D Soils	Totals
Forest/Open Space (acres) -- undisturbed, protected forest/open space or reforested land	0.00	0.00	0.08	0.00	0.08 *
Managed Turf (acres) -- disturbed, graded for yards or other turf to be mowed/managed	0.00	0.00	10.63	0.00	10.63
Impervious Cover (acres)	0.00	0.00	6.00	0.00	6.00
Area Check	**OK.**	**OK.**	**OK.**	**OK.**	16.71

** Forest/Open Space areas must be protected in accordance with the Virginia Runoff Reduction Method*

Constants

Annual Rainfall (inches)	43
Target Rainfall Event (inches)	1.00
Total Phosphorus (TP) EMC (mg/L)	0.26
Total Nitrogen (TN) EMC (mg/L)	1.86
Target TP Load (lb/acre/yr)	0.41
Pj (unitless correction factor)	0.90

Runoff Coefficients (Rv)

	A Soils	B Soils	C Soils	D Soils
Forest/Open Space	0.02	0.03	0.04	0.05
Managed Turf	0.15	0.20	0.22	0.25
Impervious Cover	0.95	0.95	0.95	0.95

LAND COVER SUMMARY -- PRE-REDEVELOPMENT

Land Cover Summary-Pre		
Pre-ReDevelopment	**Listed**	**Adjusted[1]**
Forest/Open Space Cover (acres)	0.36	0.08
Weighted Rv(forest)	0.04	0.04
% Forest	2%	1%
Managed Turf Cover (acres)	12.51	10.63
Weighted Rv(turf)	0.22	0.22
% Managed Turf	75%	73%
Impervious Cover (acres)	3.84	3.84
Rv(impervious)	0.95	0.95
% Impervious	23%	26%
Total Site Area (acres)	**16.71**	**14.55**
Site Rv	**0.38**	**0.41**

Treatment Volume and Nutrient Load

Pre-ReDevelopment Treatment Volume (acre-ft)	0.5346	0.4992
Pre-ReDevelopment Treatment Volume (cubic feet)	23,285	21,743
Pre-ReDevelopment TP Load (lb/yr)	**14.63**	**13.66**
Pre-ReDevelopment TP Load per acre (lb/acre/yr)	0.88	0.94
Baseline TP Load (lb/yr) (**0.41 lbs/acre/yr** applied to pre-redevelopment area excluding pervious land proposed for new impervious cover)		*5.97*

[1] *Adjusted Land Cover Summary:*
Pre ReDevelopment land cover minus pervious land cover (forest/open space or managed turf) acreage proposed for new impervious cover.

Adjusted total acreage is consistent with Post-ReDevelopment acreage (minus acreage of new impervious cover).

Column I shows load reduction requriement for new impervious cover (based on new development load limit, 0.41 lbs/acre/year).

LAND COVER SUMMARY -- POST DEVELOPMENT

Land Cover Summary-Post (Final)		*Land Cover Summary-Post*		*Land Cover Summary-Post*	
Post ReDev. & New Impervious		**Post-ReDevelopment**		**Post-Development New Impervious**	
Forest/Open Space Cover (acres)	0.08	Forest/Open Space Cover (acres)	0.08		
Weighted Rv(forest)	0.04	Weighted Rv(forest)	0.04		
% Forest	0%	% Forest	1%		
Managed Turf Cover (acres)	10.63	Managed Turf Cover (acres)	10.63		
Weighted Rv (turf)	0.22	Weighted Rv (turf)	0.22		
% Managed Turf	64%	% Managed Turf	73%		
Impervious Cover (acres)	6.00	ReDev. Impervious Cover (acres)	3.84	New Impervious Cover (acres)	2.16
Rv(impervious)	0.95	Rv(impervious)	0.95	Rv(impervious)	0.95
% Impervious	36%	% Impervious	26%		
Final Site Area (acres)	**16.71**	**Total ReDev. Site Area (acres)**	**14.55**		
Final Post Dev Site Rv	**0.48**	**ReDev Site Rv**	**0.41**		

Treatment Volume and Nutrient Load

Final Post-Development Treatment Volume (acre-ft)	0.6702	**Post-ReDevelopment Treatment Volume (acre-ft)**	0.4992	**Post-Development Treatment Volume (acre-ft)**	0.1710
Final Post-Development Treatment Volume (cubic feet)	29,192	**Post-ReDevelopment Treatment Volume (cubic feet)**	21,743	**Post-Development Treatment Volume (cubic feet)**	7,449
Final Post-Development TP Load (lb/yr)	**18.34**	**Post-ReDevelopment Load (TP) (lb/yr)***	**13.66**	**Post-Development TP Load (lb/yr)**	**4.68**
Final Post-Development TP Load per acre **(lb/acre/yr)**	1.10	Post-ReDevelopment TP Load per acre **(lb/acre/yr)**	0.94		
		Max. Reduction Required (Below Pre-ReDevelopment Load)	**20%**		
		TP Load Reduction Required for Redeveloped Area (lb/yr)	**2.73**	**TP Load Reduction Required for New Impervious Area (lb/yr)**	**3.79**

Post-Development Requirement for Site Area

TP Load Reduction Required (lb/yr)	**6.53**
Linear Project TP Load Reduction Required (lb/yr):	**6.64**

Nitrogen Loads (Informational Purposes Only)

Pre-ReDevelopment TN Load (lb/yr)	104.66
Final Post-Development TN Load (Post-ReDevelopment & New Impervious) (lb/yr)	131.21

DEQ Virginia Runoff Reduction Method Re-Development Compliance Spreadsheet - Version 3.0

BMP Design Specifications List: **2013 Draft Stds & Specs**

Site Summary - Linear Development Project***

Total Rainfall (in):	**43**
Total Disturbed Acreage:	**16.71**

Site Land Cover Summary

Pre-ReDevelopment Land Cover (acres)

	A soils	B Soils	C Soils	D Soils	Totals	% of Total
Forest/Open (acres)	0.00	0.00	0.36	0.00	0.36	2
Managed Turf (acres)	0.00	0.00	12.51	0.00	12.51	75
Impervious Cover (acres)	0.00	0.00	3.84	0.00	3.84	23
					16.71	100

Post-ReDevelopment Land Cover (acres)

	A soils	B Soils	C Soils	D Soils	Totals	% of Total	
Forest/Open (acres)	0.00	0.00	0.08	0.00	0.08	0	*
Managed Turf (acres)	0.00	0.00	10.63	0.00	10.63	64	
Impervious Cover (acres)	0.00	0.00	6.00	0.00	6.00	36	
					16.71	100	

*** Forest/Open Space areas must be protected in accordance with the Virginia Runoff Reduction Method**

Site Tv and Land Cover Nutrient Loads

	Final Post-Development (Post-ReDevelopment & New Impervious)	Post-ReDevelopment	Post-Development (New Impervious)	Adjusted Pre-ReDevelopment
Site Rv	0.48	0.41	0.95	0.41
Treatment Volume (ft^3)	29,192	21,743	7,449	21,743
TP Load (lb/yr)	18.34	13.66	4.68	13.66

Pre-ReDevelopment TP Load per acre (lb/acre/yr)	Final Post-Development TP Load per acre (lb/acre/yr)	Post-ReDevelopment TP Load per acre (lb/acre/yr)
0.94	**1.10**	**0.94**

Total TP Load Reduction Required (lb/yr)	**6.64**	N/A***	N/A***

******This is a linear development project***

	Final Post-Development Load (Post-ReDevelopment & New Impervious)	Pre-ReDevelopment
TN Load (lb/yr)	131.21	104.66

Site Compliance Summary - ***Linear Development Project

Maximum % Reduction Required Below Pre-ReDevelopment Load	20%

Total Runoff Volume Reduction (ft^3)	0	
Total TP Load Reduction Achieved (lb/yr)	9.16	
Total TN Load Reduction Achieved (lb/yr)	39.30	
Remaining Post Development TP Load (lb/yr)	9.18	
Remaining TP Load Reduction (lb/yr) Required	**0.00**	**** TARGET TP REDUCTION EXCEEDED BY 2.52 LB/YEAR ****

Drainage Area Summary

	D.A. A	D.A. B	D.A. C	D.A. D	D.A. E	Total
Forest/Open (acres)	0.08	0.00	0.00	0.00	0.00	0.08
Managed Turf (acres)	10.63	0.00	0.00	0.00	0.00	10.63
Impervious Cover (acres)	6.00	0.00	0.00	0.00	0.00	6.00
Total Area (acres)	**16.71**	**0.00**	**0.00**	**0.00**	**0.00**	**16.71**

Drainage Area Compliance Summary

	D.A. A	D.A. B	D.A. C	D.A. D	D.A. E	Total
TP Load Reduced (lb/yr)	9.16	0.00	0.00	0.00	0.00	9.16
TN Load Reduced (lb/yr)	39.30	0.00	0.00	0.00	0.00	39.30

Drainage Area A Summary

Land Cover Summary

	A Soils	B Soils	C Soils	D Soils	Total	% of Total
Forest/Open (acres)	0.00	0.00	0.08	0.00	0.08	0
Managed Turf (acres)	0.00	0.00	10.63	0.00	10.63	64
Impervious Cover (acres)	0.00	0.00	6.00	0.00	6.00	36
					16.71	

BMP Selections

Practice	Managed Turf Credit Area (acres)	Impervious Cover Credit Area (acres)	BMP Treatment Volume (ft^3)	TP Load from Upstream Practices (lbs)	Untreated TP Load to Practice (lbs)	TP Removed (lb/yr)	TP Remaining (lb/yr)	Downstream Treatment to be Employed
13.a. Wet Pond #1 (Spec #14)	**10.63**	**6**	**29,180.12**	**0.00**	**18.31**	**9.16**	**9.16**	

Total Impervious Cover Treated (acres)	6.00
Total Turf Area Treated (acres)	10.63
Total TP Load Reduction Achieved in D.A. (lb/yr)	9.16
Total TN Load Reduction Achieved in D.A. (lb/yr)	39.30

Runoff Volume and CN Calculations

	1-year storm	2-year storm	10-year storm
Target Rainfall Event (in)	2.94	3.58	5.53

Drainage Areas	RV & CN	Drainage Area A	Drainage Area B	Drainage Area C	Drainage Area D	Drainage Area E
CN		83	0	0	0	0
RR (ft^3)		0	0	0	0	0
1-year return period	RV wo RR (ws-in)	1.40	0.00	0.00	0.00	0.00
	RV w RR (ws-in)	1.40	0.00	0.00	0.00	0.00
	CN adjusted	83	0	0	0	0
2-year return period	RV wo RR (ws-in)	1.93	0.00	0.00	0.00	0.00
	RV w RR (ws-in)	1.93	0.00	0.00	0.00	0.00
	CN adjusted	83	0	0	0	0
10-year return period	RV wo RR (ws-in)	3.66	0.00	0.00	0.00	0.00
	RV w RR (ws-in)	3.66	0.00	0.00	0.00	0.00
	CN adjusted	83	0	0	0	0

Project Name:	Valley Avenue - Requirements Only
Date:	9/11/2018
Linear Development Project?	Yes

CLEAR ALL

data input cells
constant values
calculation cells
final results

Site Information

Post-Development Project (Treatment Volume and Loads)

Enter Total Disturbed Area *(acres)* → 3.78

Maximum reduction required:	*20%*
The site's net increase in impervious cover (acres) is:	*0.63*
Post-Development TP Load Reduction for Site (lb/yr):	*2.03*

Check:

BMP Design Specifications List:	2013 Draft Stds & Specs
Linear project?	Yes
Land cover areas entered correctly?	✓
Total disturbed area entered?	✓

Pre-ReDevelopment Land Cover (acres)

	A Soils	B Soils	C Soils	D Soils	Totals
Forest/Open Space (acres) -- undisturbed, protected forest/open space or reforested land			0.00		0.00
Managed Turf (acres) -- disturbed, graded for yards or other turf to be mowed/managed			1.96		1.96
Impervious Cover (acres)			1.82		1.82
					3.78

Post-Development Land Cover (acres)

	A Soils	B Soils	C Soils	D Soils	Totals
Forest/Open Space (acres) -- undisturbed, protected forest/open space or reforested land			0.00		0.00
Managed Turf (acres) -- disturbed, graded for yards or other turf to be mowed/managed			1.33		1.33
Impervious Cover (acres)			2.45		2.45
Area Check	**OK.**	**OK.**	**OK.**	**OK.**	3.78

Constants

Annual Rainfall (inches)	43
Target Rainfall Event (inches)	1.00
Total Phosphorus (TP) EMC (mg/L)	0.26
Total Nitrogen (TN) EMC (mg/L)	1.86
Target TP Load (lb/acre/yr)	0.41
Pj (unitless correction factor)	0.90

Runoff Coefficients (Rv)

	A Soils	B Soils	C Soils	D Soils
Forest/Open Space	0.02	0.03	0.04	0.05
Managed Turf	0.15	0.20	0.22	0.25
Impervious Cover	0.95	0.95	0.95	0.95

LAND COVER SUMMARY -- PRE-REDEVELOPMENT

Land Cover Summary-Pre

Pre-ReDevelopment	Listed	Adjusted[1]
Forest/Open Space Cover (acres)	0.00	0.00
Weighted Rv(forest)	0.00	0.00
% Forest	0%	0%
Managed Turf Cover (acres)	1.96	1.33
Weighted Rv(turf)	0.22	0.22
% Managed Turf	52%	42%
Impervious Cover (acres)	1.82	1.82
Rv(impervious)	0.95	0.95
% Impervious	48%	58%
Total Site Area (acres)	**3.78**	**3.15**
Site Rv	**0.57**	**0.64**

Treatment Volume and Nutrient Load

Pre-ReDevelopment Treatment Volume (acre-ft)	0.1800	0.1685
Pre-ReDevelopment Treatment Volume (cubic feet)	7,842	7,338
Pre-ReDevelopment TP Load (lb/yr)	**4.93**	**4.61**
Pre-ReDevelopment TP Load per acre (lb/acre/yr)	1.30	1.46
Baseline TP Load (lb/yr) (**0.41 lbs/acre/yr** applied to pre-redevelopment area excluding pervious land proposed for new impervious cover)		*1.29*

[1] *Adjusted Land Cover Summary:*
Pre ReDevelopment land cover minus pervious land cover (forest/open space or managed turf) acreage proposed for new impervious cover.

Adjusted total acreage is consistent with Post-ReDevelopment acreage (minus acreage of new impervious cover).

Column I shows load reduction requriement for new impervious cover (based on new development load limit, 0.41 lbs/acre/year).

LAND COVER SUMMARY -- POST DEVELOPMENT

Land Cover Summary-Post (Final)

Post ReDev. & New Impervious	
Forest/Open Space Cover (acres)	0.00
Weighted Rv(forest)	0.00
% Forest	0%
Managed Turf Cover (acres)	1.33
Weighted Rv (turf)	0.22
% Managed Turf	35%
Impervious Cover (acres)	2.45
Rv(impervious)	0.95
% Impervious	65%
Final Site Area (acres)	**3.78**
Final Post Dev Site Rv	**0.69**

Land Cover Summary-Post

Post-ReDevelopment	
Forest/Open Space Cover (acres)	0.00
Weighted Rv(forest)	0.00
% Forest	0%
Managed Turf Cover (acres)	1.33
Weighted Rv (turf)	0.22
% Managed Turf	42%
ReDev. Impervious Cover (acres)	1.82
Rv(impervious)	0.95
% Impervious	58%
Total ReDev. Site Area (acres)	**3.15**
ReDev Site Rv	**0.64**

Land Cover Summary-Post

Post-Development New Impervious	
New Impervious Cover (acres)	0.63
Rv(impervious)	0.95

Treatment Volume and Nutrient Load

Final Post-Development Treatment Volume (acre-ft)	0.2183	**Post-ReDevelopment Treatment Volume (acre-ft)**	0.1685	**Post-Development Treatment Volume (acre-ft)**	0.0499
Final Post-Development Treatment Volume (cubic feet)	9,511	**Post-ReDevelopment Treatment Volume (cubic feet)**	7,338	**Post-Development Treatment Volume (cubic feet)**	2,173
Final Post-Development TP Load (lb/yr)	**5.98**	**Post-ReDevelopment Load (TP) (lb/yr)***	**4.61**	**Post-Development TP Load (lb/yr)**	**1.37**
Final Post-Development TP Load per acre (lb/acre/yr)	1.58	Post-ReDevelopment TP Load per acre (lb/acre/yr)	1.46		
		Max. Reduction Required (Below Pre-ReDevelopment Load)	**20%**		
		TP Load Reduction Required for Redeveloped Area (lb/yr)	**0.92**	**TP Load Reduction Required for New Impervious Area (lb/yr)**	**1.11**

Post-Development Requirement for Site Area

TP Load Reduction Required (lb/yr)	**2.03**
Linear Project TP Load Reduction Required (lb/yr):	**2.03**

Nitrogen Loads (Informational Purposes Only)

Pre-ReDevelopment TN Load (lb/yr)	35.25
Final Post-Development TN Load (Post-ReDevelopment & New Impervious) (lb/yr)	42.75

DEQ Virginia Runoff Reduction Method Re-Development Compliance Spreadsheet - Version 3.0

BMP Design Specifications List: **2013 Draft Stds & Specs**

Site Summary - Linear Development Project***

Total Rainfall (in):	**43**
Total Disturbed Acreage:	**3.78**

Site Land Cover Summary

Pre-ReDevelopment Land Cover (acres)

	A soils	B Soils	C Soils	D Soils	Totals	% of Total
Forest/Open (acres)	0.00	0.00	0.00	0.00	0.00	0
Managed Turf (acres)	0.00	0.00	1.96	0.00	1.96	52
Impervious Cover (acres)	0.00	0.00	1.82	0.00	1.82	48
					3.78	100

Post-ReDevelopment Land Cover (acres)

	A soils	B Soils	C Soils	D Soils	Totals	% of Total
Forest/Open (acres)	0.00	0.00	0.00	0.00	0.00	0
Managed Turf (acres)	0.00	0.00	1.33	0.00	1.33	35
Impervious Cover (acres)	0.00	0.00	2.45	0.00	2.45	65
					3.78	100

Site Tv and Land Cover Nutrient Loads

	Final Post-Development (Post-ReDevelopment & New Impervious)	Post-ReDevelopment	Post-Development (New Impervious)	Adjusted Pre-ReDevelopment
Site Rv	0.69	0.64	0.95	0.64
Treatment Volume (ft^3)	9,511	7,338	2,173	7,338
TP Load (lb/yr)	5.98	4.61	1.37	4.61

Pre-ReDevelopment TP Load per acre (lb/acre/yr)	Final Post-Development TP Load per acre (lb/acre/yr)	Post-ReDevelopment TP Load per acre (lb/acre/yr)
1.46	**1.58**	**1.46**

Total TP Load Reduction Required (lb/yr)	**2.03**	N/A***	N/A***

******This is a linear development project***

	Final Post-Development Load (Post-ReDevelopment & New Impervious)	Pre-ReDevelopment
TN Load (lb/yr)	42.75	35.25

Site Compliance Summary - ***Linear Development Project

Maximum % Reduction Required Below Pre-ReDevelopment Load	20%

Total Runoff Volume Reduction (ft^3)	0	
Total TP Load Reduction Achieved (lb/yr)	2.98	
Total TN Load Reduction Achieved (lb/yr)	12.81	
Remaining Post Development TP Load (lb/yr)	2.99	
Remaining TP Load Reduction (lb/yr) Required	**0.00**	**** TARGET TP REDUCTION EXCEEDED BY 0.95 LB/YEAR ****

Drainage Area Summary

	D.A. A	D.A. B	D.A. C	D.A. D	D.A. E	Total
Forest/Open (acres)	0.00	0.00	0.00	0.00	0.00	0.00
Managed Turf (acres)	1.33	0.00	0.00	0.00	0.00	1.33
Impervious Cover (acres)	2.45	0.00	0.00	0.00	0.00	2.45
Total Area (acres)	**3.78**	**0.00**	**0.00**	**0.00**	**0.00**	**3.78**

Drainage Area Compliance Summary

	D.A. A	D.A. B	D.A. C	D.A. D	D.A. E	Total
TP Load Reduced (lb/yr)	2.98	0.00	0.00	0.00	0.00	2.98
TN Load Reduced (lb/yr)	12.81	0.00	0.00	0.00	0.00	12.81

Drainage Area A Summary

Land Cover Summary

	A Soils	B Soils	C Soils	D Soils	Total	% of Total
Forest/Open (acres)	0.00	0.00	0.00	0.00	0.00	0
Managed Turf (acres)	0.00	0.00	1.33	0.00	1.33	35
Impervious Cover (acres)	0.00	0.00	2.45	0.00	2.45	65
					3.78	

BMP Selections

Practice	Managed Turf Credit Area (acres)	Impervious Cover Credit Area (acres)	BMP Treatment Volume (ft^3)	TP Load from Upstream Practices (lbs)	Untreated TP Load to Practice (lbs)	TP Removed (lb/yr)	TP Remaining (lb/yr)	Downstream Treatment to be Employed
13.a. Wet Pond #1 (Spec #14)	**1.33**	**2.45**	**9,510.96**	**0.00**	**5.97**	**2.98**	**2.98**	

Total Impervious Cover Treated (acres)	2.45
Total Turf Area Treated (acres)	1.33
Total TP Load Reduction Achieved in D.A. (lb/yr)	2.98
Total TN Load Reduction Achieved in D.A. (lb/yr)	12.81

Runoff Volume and CN Calculations

	1-year storm	2-year storm	10-year storm
Target Rainfall Event (in)	2.38	2.86	4.16

Drainage Areas	RV & CN	Drainage Area A	Drainage Area B	Drainage Area C	Drainage Area D	Drainage Area E
CN		90	0	0	0	0
RR (ft^3)		0	0	0	0	0
1-year return period	RV wo RR (ws-in)	1.42	0.00	0.00	0.00	0.00
	RV w RR (ws-in)	1.42	0.00	0.00	0.00	0.00
	CN adjusted	90	0	0	0	0
2-year return period	RV wo RR (ws-in)	1.86	0.00	0.00	0.00	0.00
	RV w RR (ws-in)	1.86	0.00	0.00	0.00	0.00
	CN adjusted	90	0	0	0	0
10-year return period	RV wo RR (ws-in)	3.07	0.00	0.00	0.00	0.00
	RV w RR (ws-in)	3.07	0.00	0.00	0.00	0.00
	CN adjusted	90	0	0	0	0

Drainage Area A

CLEAR BMP AREAS

Drainage Area A Land Cover (acres)

	A Soils	B Soils	C Soils	D Soils	Totals	Land Cover Rv
Forest/Open Space (acres)	0.00	0.00	27.28	0.00	27.28	0.04
Managed Turf (acres)	0.00	0.00	166.36	0.00	166.36	0.22
Impervious Cover (acres)	0.00	0.00	151.77	0.00	151.77	0.95
				Total	345.41	

Total Phosphorus Available for Removal in D.A. A (lb/yr)	412.31
Post Development Treatment Volume in D.A. A (ft^3)	656,234

Stormwater Best Management Practices (RR = Runoff Reduction)

--Select from dropdown lists--

Practice	Runoff Reduction Credit (%)	Managed Turf Credit Area (acres)	Impervious Cover Credit Area (acres)	Volume from Upstream Practice (ft^3)	Runoff Reduction (ft^3)	Remaining Runoff Volume (ft^3)	Total BMP Treatment Volume (ft^3)	Phosphorus Removal Efficiency (%)	Phosphorus Load from Upstream Practices (lb)	Untreated Phosphorus Load to Practice (lb)	Phosphorus Removed By Practice (lb)	Remaining Phosphorus Load (lb)	Downstream Practice to be Employed
1. Vegetated Roof (RR)													
1.a. Vegetated Roof #1 (Spec #5)	45				0	0	0	0		0.00	0.00	0.00	
1.b. Vegetated Roof #2 (Spec #5)	60				0	0	0	0		0.00	0.00	0.00	
2. Rooftop Disconnection (RR)													
2.a. Simple Disconnection to A/B Soils (Spec #1)	50			0	0	0	0	0	0.00	0.00	0.00	0.00	
2.b. Simple Disconnection to C/D Soils (Spec #1)	25			0	0	0	0	0	0.00	0.00	0.00	0.00	
2.c. To Soil Amended Filter Path as per specifications (existing C/D soils) (Spec #4)	50			0	0	0	0	0	0.00	0.00	0.00	0.00	
2.d. To Dry Well or French Drain #1, Micro-Infilration #1 (Spec #8)	50			0	0	0	0	25	0.00	0.00	0.00	0.00	
2.e. To Dry Well or French Drain #2, Micro-Infiltration #2 (Spec #8)	90			0	0	0	0	25	0.00	0.00	0.00	0.00	
2.f. To Rain Garden #1, Micro-Bioretention #1 (Spec #9)	40			0	0	0	0	25	0.00	0.00	0.00	0.00	
2.g. To Rain Garden #2, Micro-Bioretention #2 (Spec #9)	80			0	0	0	0	50	0.00	0.00	0.00	0.00	
2.h. To Rainwater Harvesting (Spec #6)	0			0	0	0	0	0	0.00	0.00	0.00	0.00	
2.i. To Stormwater Planter, Urban Bioretention (Spec #9, Appendix A)	40			0	0	0	0	25	0.00	0.00	0.00	0.00	
3. Permeable Pavement (RR)													
3.a. Permeable Pavement #1 (Spec #7)	45			0	0	0	0	25	0.00	0.00	0.00	0.00	
3.b. Permeable Pavement #2 (Spec #7)	75				0	0	0	25		0.00	0.00	0.00	
4. Grass Channel (RR)													
4.a. Grass Channel A/B Soils (Spec #3)	20			0	0	0	0	15	0.00	0.00	0.00	0.00	
4.b. Grass Channel C/D Soils (Spec #3)	10			0	0	0	0	15	0.00	0.00	0.00	0.00	
4.c. Grass Channel with Compost Amended Soils as per specs (see Spec #4)	20			0	0	0	0	15	0.00	0.00	0.00	0.00	
5. Dry Swale (RR)													
5.a. Dry Swale #1 (Spec #10)	40			0	0	0	0	20	0.00	0.00	0.00	0.00	
5.b. Dry Swale #2 (Spec #10)	60			0	0	0	0	40	0.00	0.00	0.00	0.00	

Practice	Nitrogen Removal Efficiency (%)	Nitrogen Load from Upstream Practices (lbs)	Untreated Nitrogen Load to Practice (lbs)	Nitrogen Removed By Practice (lbs)	Remaining Nitrogen Load (lbs)
1. Vegetated Roof (RR)					
1.a. Vegetated Roof #1 (Spec #5)	0		0.00	0.00	0.00
1.b. Vegetated Roof #2 (Spec #5)	0		0.00	0.00	0.00
2. Rooftop Disconnection (RR)					
2.a. Simple Disconnection to A/B Soils (Spec #1)	0	0.00	0.00	0.00	0.00
2.b. Simple Disconnection to C/D Soils (Spec #1)	0	0.00	0.00	0.00	0.00
2.c. To Soil Amended Filter Path as per specifications (existing C/D soils) (Spec #4)	0	0.00	0.00	0.00	0.00
2.d. To Dry Well or French Drain #1, Micro-Infilration #1 (Spec #8)	15	0.00	0.00	0.00	0.00
2.e. To Dry Well or French Drain #2, Micro-Infiltration #2 (Spec #8)	15	0.00	0.00	0.00	0.00
2.f. To Rain Garden #1, Micro-Bioretention #1 (Spec #9)	40	0.00	0.00	0.00	0.00
2.g. To Rain Garden #2, Micro-Bioretention #2 (Spec #9)	60	0.00	0.00	0.00	0.00
2.h. To Rainwater Harvesting (Spec #6)	0	0.00	0.00	0.00	0.00
2.i. To Stormwater Planter, Urban Bioretention (Spec #9, Appendix A)	40	0.00	0.00	0.00	0.00
3. Permeable Pavement (RR)					
3.a. Permeable Pavement #1 (Spec #7)	25	0.00	0.00	0.00	0.00
3.b. Permeable Pavement #2 (Spec #7)	25		0.00	0.00	0.00
4. Grass Channel (RR)					
4.a. Grass Channel A/B Soils (Spec #3)	20	0.00	0.00	0.00	0.00
4.b. Grass Channel C/D Soils (Spec #3)	20	0.00	0.00	0.00	0.00
4.c. Grass Channel with Compost Amended Soils as per specs (see Spec #4)	20	0.00	0.00	0.00	0.00
5. Dry Swale (RR)					
5.a. Dry Swale #1 (Spec #10)	25	0.00	0.00	0.00	0.00
5.b. Dry Swale #2 (Spec #10)	35	0.00	0.00	0.00	0.00

6. Bioretention (RR)														**6. Bioretention (RR)**				
6.a. Bioretention #1 or Micro-Bioretention #1 or Urban Bioretention (Spec #9)	40			0	0	0	0	25	0.00	0.00	0.00	0.00		40	0.00	0.00	0.00	0.00
6.b. Bioretention #2 or Micro-Bioretention #2 (Spec #9)	80			0	0	0	0	50	0.00	0.00	0.00	0.00		60	0.00	0.00	0.00	0.00
7. Infiltration (RR)														**7. Infiltration (RR)**				
7.a. Infiltration #1 (Spec #8)	50			0	0	0	0	25	0.00	0.00	0.00	0.00		15	0.00	0.00	0.00	0.00
7.b. Infiltration #2 (Spec #8)	90			0	0	0	0	25	0.00	0.00	0.00	0.00		15	0.00	0.00	0.00	0.00
8. Extended Detention Pond (RR)														**8. Extended Detention Pond (RR)**				
8.a. ED #1 (Spec #15)	0			0	0	0	0	15	0.00	0.00	0.00	0.00		10	0.00	0.00	0.00	0.00
8.b. ED #2 (Spec #15)	15			0	0	0	0	15	0.00	0.00	0.00	0.00		10	0.00	0.00	0.00	0.00
9. Sheetflow to Filter/Open Space (RR)														**9. Sheetflow to Filter/Open Space (RR)**				
9.a. Sheetflow to Conservation Area, A/B Soils (Spec #2)	75			0	0	0	0	0	0.00	0.00	0.00	0.00		0	0.00	0.00	0.00	0.00
9.b. Sheetflow to Conservation Area, C/D Soils (Spec #2)	50			0	0	0	0	0	0.00	0.00	0.00	0.00		0	0.00	0.00	0.00	0.00
9.c. Sheetflow to Vegetated Filter Strip, A Soils or Compost Amended B/C/D Soils (Spec #2 & #4)	50			0	0	0	0	0	0.00	0.00	0.00	0.00		0	0.00	0.00	0.00	0.00

TOTAL IMPERVIOUS COVER TREATED (ac)	0.00	AREA CHECK: OK.
TOTAL MANAGED TURF AREA TREATED (ac)	0.00	AREA CHECK: OK.
TOTAL RUNOFF REDUCTION IN D.A. A (ft^3)	0	
TOTAL PHOSPHORUS AVAILABLE FOR REMOVAL IN D.A. A (lb/yr)	412.31	
TOTAL PHOSPHORUS REMOVED WITH RUNOFF REDUCTION PRACTICES IN D.A. A (lb/yr)	0.00	
TOTAL PHOSPHORUS REMAINING AFTER APPLYING RUNOFF REDUCTION PRACTICES IN D.A. A (lb/yr)	412.31	

SEE WATER QUALITY COMPLIANCE TAB FOR SITE COMPLIANCE CALCULATIONS

TOTAL RUNOFF REDUCTION IN D.A. A (ft^3)	0
NITROGEN REMOVED WITH RUNOFF REDUCTION PRACTICES IN D.A. A (lb/yr)	0.00

SEE WATER QUALITY COMPLIANCE TAB FOR SITE CALCULATIONS (Information Only)

10. Wet Swale (no RR)														**10. Wet Swale (Coastal Plain) (no RR)**				
10.a. Wet Swale #1 (Spec #11)	0			0	0	0	0	20	0.00	0.00	0.00	0.00		25	0.00	0.00	0.00	0.00
10.b. Wet Swale #2 (Spec #11)	0			0	0	0	0	40	0.00	0.00	0.00	0.00		35	0.00	0.00	0.00	0.00
11. Filtering Practices (no RR)														**11. Filtering Practices (no RR)**				
11.a.Filtering Practice #1 (Spec #12)	0			0	0	0	0	60	0.00	0.00	0.00	0.00		30	0.00	0.00	0.00	0.00
11.b. Filtering Practice #2 (Spec #12)	0			0	0	0	0	65	0.00	0.00	0.00	0.00		45	0.00	0.00	0.00	0.00
12. Constructed Wetland (no RR)														**12. Constructed Wetland (no RR)**				
12.a.Constructed Wetland #1 (Spec #13)	0			0	0	0	0	50	0.00	0.00	0.00	0.00		25	0.00	0.00	0.00	0.00
12.b. Constructed Wetland #2 (Spec #13)	0			0	0	0	0	75	0.00	0.00	0.00	0.00		55	0.00	0.00	0.00	0.00
13. Wet Ponds (no RR)														**13. Wet Ponds (no RR)**				
13.a. Wet Pond #1 (Spec #14)	0	114.00	104.00	0	0	449,684	449,684	50	0.00	282.22	141.11	141.11		30	0.00	2018.93	605.68	1413.25
13.b. Wet Pond #1 (Coastal Plain) (Spec #14)	0			0	0	0	0	45	0.00	0.00	0.00	0.00		20	0.00	0.00	0.00	0.00
13.c. Wet Pond #2 (Spec #14)	0			0	0	0	0	75	0.00	0.00	0.00	0.00		40	0.00	0.00	0.00	0.00
13.d. Wet Pond #2 (Coastal Plain) (Spec #14)	0			0	0	0	0	65	0.00	0.00	0.00	0.00		30	0.00	0.00	0.00	0.00
14. Manufactured Treatment Devices (no RR)														**14. Manufactured BMP (no RR)**				
14.a. Manufactured Treatment Device-Hydrodynamic	0			0	0	0	0	20	0.00	0.00	0.00	0.00		0	0.00	0.00	0.00	0.00
14.b. Manufactured Treatment Device-Filtering	0			0	0	0	0	20	0.00	0.00	0.00	0.00		0	0.00	0.00	0.00	0.00
14.c. Manufactured Treatment Device-Generic	0			0	0	0	0	20	0.00	0.00	0.00	0.00		0	0.00	0.00	0.00	0.00

TOTAL IMPERVIOUS COVER TREATED (ac)	104.00	AREA CHECK: OK.
TOTAL MANAGED TURF AREA TREATED (ac)	114.00	AREA CHECK: OK.
TOTAL PHOSPHORUS REMOVAL REQUIRED ON SITE (lb/yr)	86.92	

TOTAL PHOSPHORUS AVAILABLE FOR REMOVAL IN D.A. A (lb/yr)	412.31
TOTAL PHOSPHORUS REMOVED WITHOUT RUNOFF REDUCTION PRACTICES IN D.A. A (lb/yr)	141.11
TOTAL PHOSPHORUS REMOVED WITH RUNOFF REDUCTION PRACTICES IN D.A. A (lb/yr)	0.00
TOTAL PHOSPHORUS LOAD REDUCTION ACHIEVED IN D.A. A (lb/yr)	141.11
TOTAL PHOSPHORUS REMAINING AFTER APPLYING BMP LOAD REDUCTIONS IN D.A. A (lb/yr)	271.20

SEE WATER QUALITY COMPLIANCE TAB FOR SITE COMPLIANCE CALCULATIONS

NITROGEN REMOVED WITH RUNOFF REDUCTION PRACTICES IN D.A. A (lb/yr)	0.00
NITROGEN REMOVED WITHOUT RUNOFF REDUCTION PRACTICES IN D.A. A (lb/yr)	605.68
TOTAL NITROGEN REMOVED IN D.A. A (lb/yr)	605.68

BMP Selections

Practice	Managed Turf Credit Area (acres)	Impervious Cover Credit Area (acres)	BMP Treatment Volume (ft^3)	TP Load from Upstream Practices (lbs)	Untreated TP Load to Practice (lbs)	TP Removed (lb/yr)	TP Remaining (lb/yr)	Downstream Treatment to be Employed
13.a. Wet Pond #1 (Spec #14)	114	104	449,684.40	0.00	282.22	141.11	141.11	

Total Impervious Cover Treated (acres)	104.00
Total Turf Area Treated (acres)	114.00
Total TP Load Reduction Achieved in D.A. (lb/yr)	141.11
Total TN Load Reduction Achieved in D.A. (lb/yr)	605.68

APPENDIX B.2 – NORTH CAMERON STREET BASIN 1

N. CAMERON STREET - FLOOD CONTROL BASIN 1

30% PRELIMINARY DESIGN PLANS

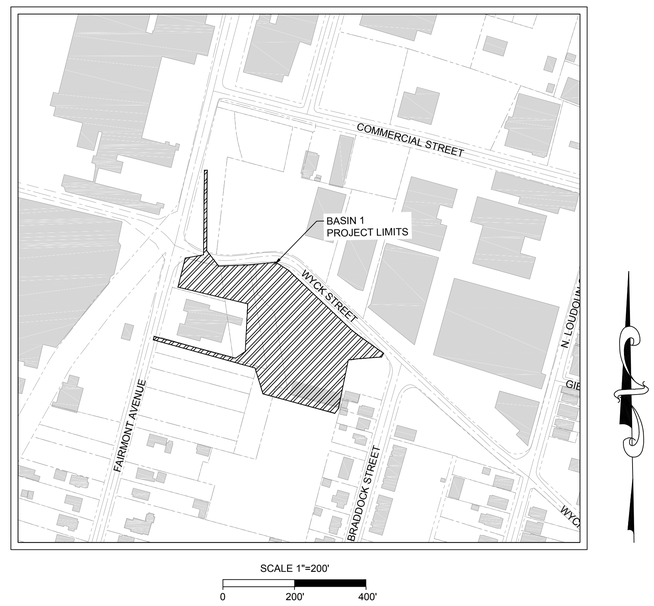
(NOT FOR CONSTRUCTION PURPOSES)

E S 701 FAIRMONT AVENUE
WINCHESTER, VA 22601

NOTICE REQUIRED

CONTRACTORS SHALL NOTIFY OPERATORS WHO MAINTAIN UNDERGROUND UTILITY LINES IN THE AREA OF PROPOSED EXCAVATION AND OR BLASTING AT LEAST TWO (2) WORKING DAYS, BUT NOT MORE THAN TEN (10) WORKING DAYS PRIOR TO COMMENCEMENT OF EXCAVATION OR DEMOLITION. NAMES AND TELEPHONE NUMBERS OF THE OPERATORS OF UNDERGROUND UTILITY LINES APPEAR BELOW. THESE NUMBERS SHALL ALSO BE USED TO SERVE IN AN EMERGENCY CONDITION.

EMERGENCY
Police/Fire/Rescue 911



PROJECT NARRATIVE

THIS PROJECT IS A CITY OF WINCHESTER STORMWATER DRAINAGE IMPROVEMENT PRELIMINARY DESIGN. THE PROJECT CONSISTS OF A DETENTION BASIN WITHIN THE NORTH CAMERON STREET DRAINAGE SHED. THE HYDROLOGIC PARAMETERS UTILIZED IN PLAN DEVELOPMENT WERE BASED ON LIMITED SITE SURVEY AND SUPPLEMENTAL GIS TOPOGRAPHY, ROADWAY DATA, AND EXISTING STORMWATER INFRASTRUCTURE DATA. THIS PLAN WAS DEVELOPED IN CONJUNCTION WITH THREE (3) OTHER PROPOSED DETENTION BASINS.

SITE STATISTICAL DATA

TAX MAP NUMBER: 153-01-B-25C
LATITUDE: 39° 11' 38" N LONGITUDE: 78° 9' 53" W
RECEIVING WATER: TOWN RUN (HUC: 02070004)

CURRENT OWNER: FAIRMONT AVENUE HOLDINGS LLC.

EST. FUTURE OWNER: CITY OF WINCHESTER, VIRGINIA

CITY OF WINCHESTER ENGINEERING DIVISION
WINCHESTER, VIRGINIA, 22601
ATTN: KELLY HENSHAW P.E. - CITY ENGINEER
PHONE: (540) 667-1815 EXT. 1481

ENGINEER: TIMMONS GROUP
20110 ASHBROOK PLACE, SUITE 100
ASHBURN, VIRGINIA 20147
PHONE: (703) 726-1342

Sheet List Table

Sheet Number	Sheet Title
C0.0	BASIN 1 - COVER SHEET
C1.0	BASIN 1 - EXISTING CONDITIONS
C2.0	BASIN 1 - DEMOLITION PLAN
C3.0	BASIN 1 - EROSION & SEDIMENT CONTROL PLAN - PHASE I
C3.1	BASIN 1 - EROSION & SEDIMENT CONTROL PLAN - PHASE II
C3.2	BASIN 1 - EROSION & SEDIMENT CONTROL NOTES & DETAILS
C3.3	BASIN 1 - EROSION & SEDIMENT CONTROL NOTES & DETAILS
C3.4	EROSION & SEDIMENT CONTROL NOTES & DETAILS
C4.0	BASIN 1 - PRELIMINARY GRADING AND LAYOUT PLAN
C5.0	BASIN 1 - SITE HYDROLOGY
C5.1	BASIN 1 - BASIN PROFILE

TOTAL NUMBER OF SHEETS: 11

30% DESIGN PLANS ARE NOT FOR CONSTRUCTION

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REVISION DESCRIPTION

DATE

DATE
01/18/2019

DRAWN BY
JAC

DESIGNED BY
JAC

CHECKED BY
JJD

SCALE
SEE PLAN

TIMMONS GROUP

NORTH CAMERON STREET DRAINAGE IMPROVEMENTS (30% PRELIMINARY DESIGN)
WINCHESTER, VIRGINIA
BASIN 1 - COVER SHEET

JOB NO.
36284.013

SHEET NO.
C0.0

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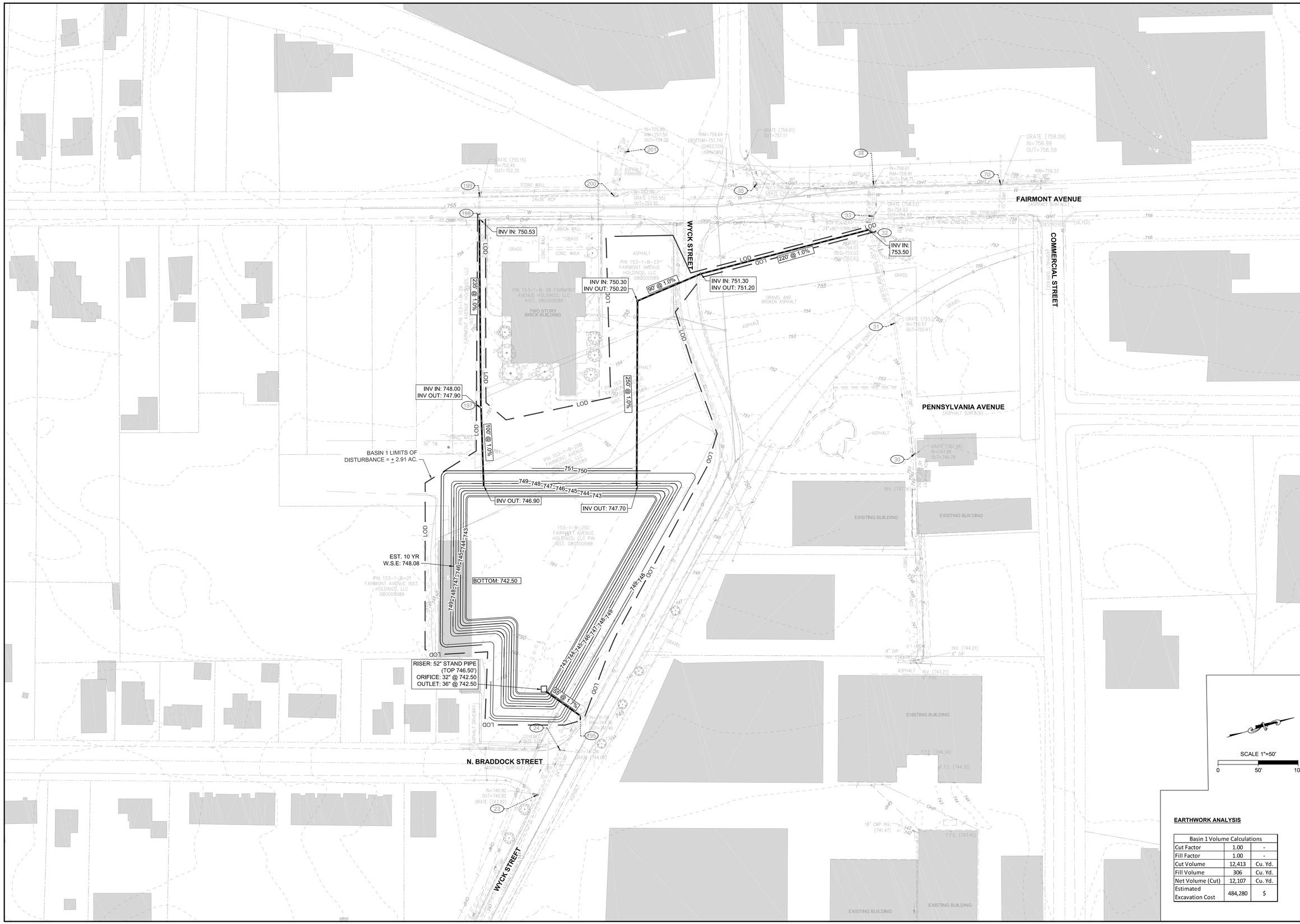

EARTHWORK ANALYSIS

Basin 1 Volume Calculations		
Cut Factor	1.00	-
Fill Factor	1.00	-
Cut Volume	12,413	Cu. Yd.
Fill Volume	306	Cu. Yd.
Net Volume (Cut)	12,107	Cu. Yd.
Estimated Excavation Cost	484,280	$

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NORTH CAMERON STREET DRAINAGE IMPROVEMENTS (30% PRELIMINARY DESIGN)

WINCHESTER, VIRGINIA

BASIN 1 - PRELIMINARY GRADING AND LAYOUT PLAN

JOB NO.
36284.013

SHEET NO.
C4.0

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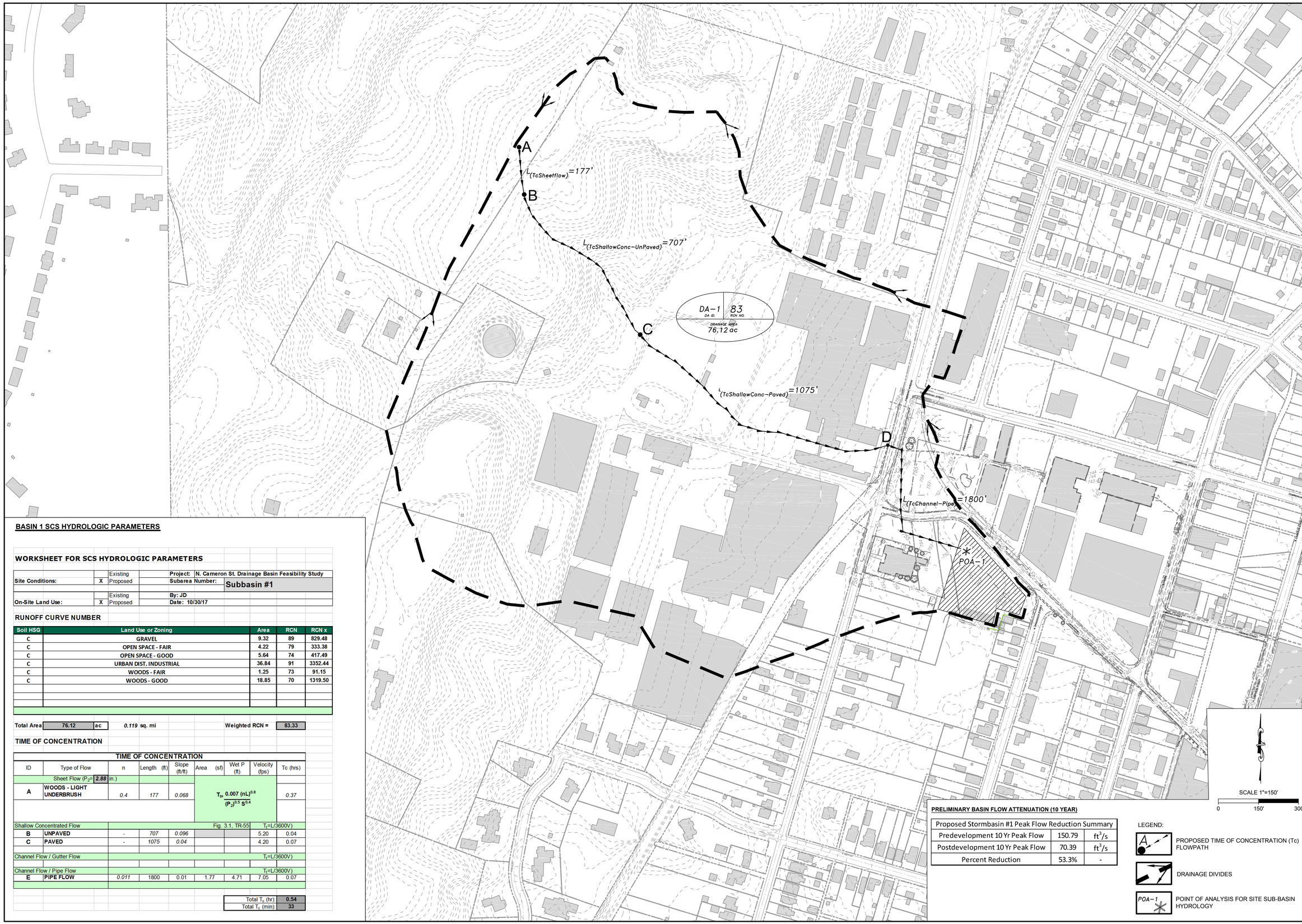

BASIN 1 SCS HYDROLOGIC PARAMETERS

WORKSHEET FOR SCS HYDROLOGIC PARAMETERS

Site Conditions:		Existing	Project:	N. Cameron St. Drainage Basin Feasibility Study
	X	Proposed	Subarea Number:	Subbasin #1
On-Site Land Use:		Existing	By: JD	
	X	Proposed	Date: 10/30/17	

RUNOFF CURVE NUMBER

Soil HSG	Land Use or Zoning	Area	RCN	RCN x
C	GRAVEL	9.32	89	829.48
C	OPEN SPACE - FAIR	4.22	79	333.38
C	OPEN SPACE - GOOD	5.64	74	417.49
C	URBAN DIST. INDUSTRIAL	36.84	91	3352.44
C	WOODS - FAIR	1.25	73	91.15
C	WOODS - GOOD	18.85	70	1319.50

Total Area 76.12 ac *0.119* sq. mi Weighted RCN = 83.33

TIME OF CONCENTRATION

TIME OF CONCENTRATION

ID	Type of Flow	n	Length (ft)	Slope (ft/ft)	Area (sf)	Wet P (ft)	Velocity (fps)	Tc (hrs)
Sheet Flow (P_2= 2.88 in.)								
A	WOODS - LIGHT UNDERBRUSH	0.4	177	0.068	$T_{tt} = \frac{0.007\,(nL)^{0.8}}{(P_2)^{0.5}\,S^{0.4}}$			0.37
Shallow Concentrated Flow						Fig. 3.1, TR-55	T_t=L/3600V)	
B	UNPAVED	-	707	0.096			5.20	0.04
C	PAVED	-	1075	0.04			4.20	0.07
Channel Flow / Gutter Flow							T_t=L/3600V)	
Channel Flow / Pipe Flow							T_t=L/3600V)	
E	PIPE FLOW	0.011	1800	0.01	1.77	4.71	7.05	0.07

Total T_c (hr):	0.54
Total T_c (min):	33

PRELIMINARY BASIN FLOW ATTENUATION (10 YEAR)

Proposed Stormbasin #1 Peak Flow Reduction Summary		
Predevelopment 10 Yr Peak Flow	150.79	ft^3/s
Postdevelopment 10 Yr Peak Flow	70.39	ft^3/s
Percent Reduction	53.3%	-

LEGEND:

- PROPOSED TIME OF CONCENTRATION (Tc) FLOWPATH
- DRAINAGE DIVIDES
- POA-1 POINT OF ANALYSIS FOR SITE SUB-BASIN HYDROLOGY

30% DESIGN PLANS ARE NOT FOR CONSTRUCTION

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REVISION DESCRIPTION	DATE

DATE	01/18/2019
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DESIGNED BY	JAC
CHECKED BY	JJD
SCALE	SEE PLAN

TIMMONS GROUP

NORTH CAMERON STREET DRAINAGE IMPROVEMENTS (30% PRELIMINARY DESIGN)

WINCHESTER, VIRGINIA

BASIN 1 - SITE HYDROLOGY

JOB NO. 36284.013

SHEET NO. C5.0

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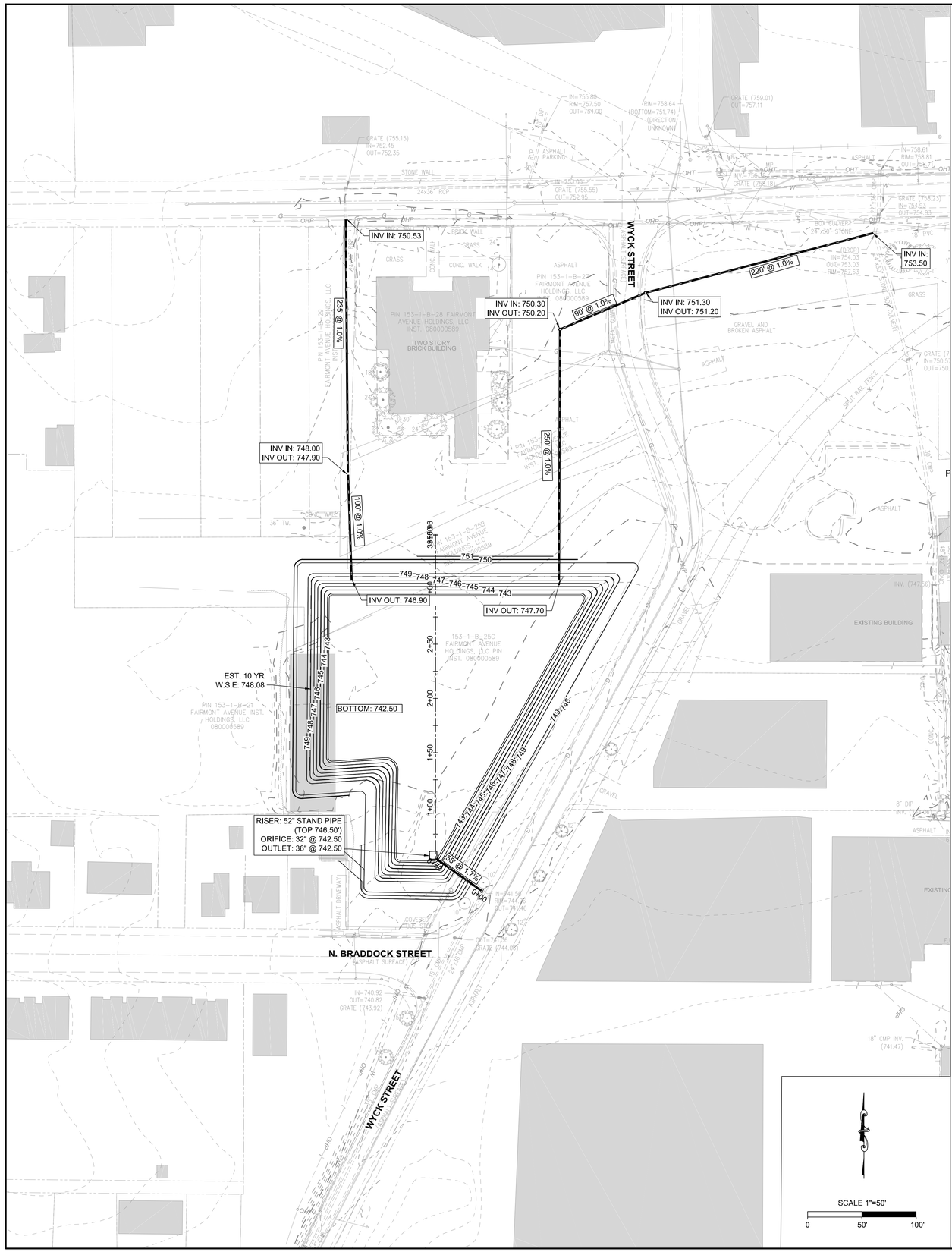
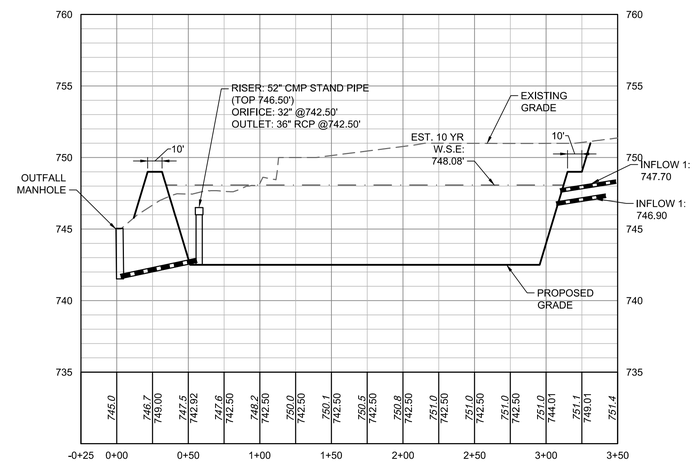
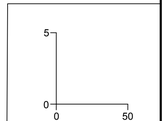




BASIN 1 LONGITUDINAL PROFILE

HORZ SCALE: 1"= 50'

VERT. SCALE: 1" = 5'



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REVISION DESCRIPTION	DATE

DATE: 01/18/2019

DRAWN BY: JAC

DESIGNED BY: JAC

CHECKED BY: JJD

SCALE: SEE PLAN

TIMMONS GROUP

NORTH CAMERON STREET DRAINAGE IMPROVEMENTS (30% PRELIMINARY DESIGN)

WINCHESTER, VIRGINIA

BASIN 1 - BASIN PROFILE

JOB NO. 36284.013

SHEET NO. C5.1

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North Cameron Street Basin 1 Nutrient Removal Calculations

Drainage Area A

Drainage Area A Land Cover (acres)

	A Soils	B Soils	C Soils	D Soils	Totals	Land Cover Rv
Forest/Open Space (acres)	0.00	0.00	20.10	0.00	20.10	0.04
Managed Turf (acres)	0.00	0.00	9.86	0.00	9.86	0.22
Impervious Cover (acres)	0.00	0.00	46.16	0.00	46.16	0.95
				Total	76.12	

CLEAR BMP AREAS

Total Phosphorus Available for Removal in D.A. A (lb/yr)	104.96
Post Development Treatment Volume in D.A. A (ft^3)	167,057

Stormwater Best Management Practices (RR = Runoff Reduction)

--Select from dropdown lists--

Practice	Runoff Reduction Credit (%)	Managed Turf Credit Area (acres)	Impervious Cover Credit Area (acres)	Volume from Upstream Practice (ft^3)	Runoff Reduction (ft^3)	Remaining Runoff Volume (ft^3)	Total BMP Treatment Volume (ft^3)	Phosphorus Removal Efficiency (%)	Phosphorus Load from Upstream Practices (lb)	Untreated Phosphorus Load to Practice (lb)	Phosphorus Removed By Practice (lb)	Remaining Phosphorus Load (lb)	Downstream Practice to be Employed
8. Extended Detention Pond (RR)													
8. a. ED #1 (Spec #15)	0	9.86	46.16	0	0	167,057	167,057	15	0.00	104.84	15.73	89.12	
8. b. ED #2 (Spec #15)	15			0	0	0	0	15	0.00	0.00	0.00	0.00	

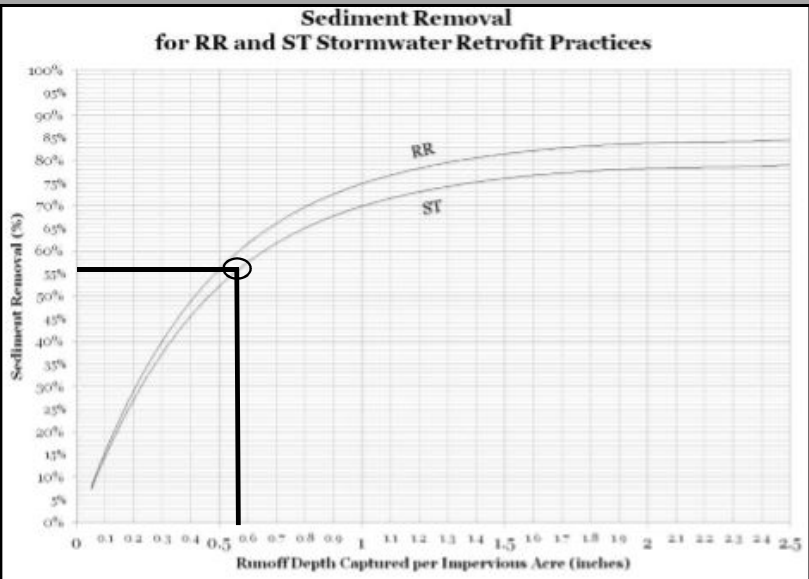
Nitrogen Removal Efficiency (%)	Nitrogen Load from Upstream Practices (lbs)	Untreated Nitrogen Load to Practice (lbs)	Nitrogen Removed By Practice (lbs)	Remaining Nitrogen Load (lbs)
8. Extended Detention Pond (RR)				
10	0.00	750.03	75.00	675.03
10	0.00	0.00	0.00	0.00

TOTAL IMPERVIOUS COVER TREATED (ac)	46.16	AREA CHECK: OK.
TOTAL MANAGED TURF AREA TREATED (ac)	9.86	AREA CHECK: OK.

TOTAL PHOSPHORUS REMOVAL REQUIRED ON SITE (lb/yr)	21.36
TOTAL PHOSPHORUS AVAILABLE FOR REMOVAL IN D.A. A (lb/yr)	104.96
TOTAL PHOSPHORUS REMOVED WITHOUT RUNOFF REDUCTION PRACTICES IN D.A. A (lb/yr)	0.00
TOTAL PHOSPHORUS REMOVED WITH RUNOFF REDUCTION PRACTICES IN D.A. A (lb/yr)	15.73
TOTAL PHOSPHORUS LOAD REDUCTION ACHIEVED IN D.A. A (lb/yr)	15.73
TOTAL PHOSPHORUS REMAINING AFTER APPLYING BMP LOAD REDUCTIONS IN D.A. A (lb/yr)	89.24

SEE WATER QUALITY COMPLIANCE TAB FOR SITE COMPLIANCE CALCULATIONS

NITROGEN REMOVED WITH RUNOFF REDUCTION PRACTICES IN D.A. A (lb/yr)	75.00
NITROGEN REMOVED WITHOUT RUNOFF REDUCTION PRACTICES IN D.A. A (lb/yr)	0.00
TOTAL NITROGEN REMOVED IN D.A. A (lb/yr)	75.00

Estimated Sediment Reductions Provided by a Level 1 - Extended Detention (ED) Basin 1 Retrofit		
1 Determination of TSS Available for Removal in Basin 1 (lbs./yr.)	**Regulated Impervious Acres Drainage to Basin 1 (ac.)**	46.16
	Total Suspended Solids (TSS) Source Loading per Acre of Regulated Impervious - Potomac River (lbs./ac./yr.)	1171.32
	TSS Available for Removal in Basin 1 Drainage Area (lbs.)	**54,068.13**
2 Estimation of Runoff Volume Provided by Basin 1 Retrofit (inches)	**Runoff Depth (in) = (RS)(12)/IA** **Where:** **RS = Runoff Storage Volume (acre-feet)** **IA = Impervious Area (acres)**	
	1-year WQ RS (acre-feet)	2.232
	IA (acres)	46.16
	Runoff Volume (RV) by Basin 1 (in.)	**0.58**
3 Estimation of Sediment Removal Efficiency of a Level 2 ED Pond Retrofit (%)	 **Figure 5. Retrofit Removal Adjustor Curve for Sediment**	**56%**
4 Estimation of Sediment Reductions Provided by a Level 1 - ED Basin 1 Retrofit (lbs.)	**TSS Available for Removal in Basin 1 Drainage Area (lbs.)**	54,068.13
	Sediment Removal Efficiency of Level 1 ED Basin 1 Retrofit	56%
	Total Estimated Sediment Removed by a Level 1 ED Basin 1 Retrofit (lbs.)	**30,278.15**

APPENDIX B.3 – NORTH CAMERON STREET BASIN 2

N. CAMERON STREET - FLOOD CONTROL BASIN 2
30% PRELIMINARY DESIGN PLANS
(NOT FOR CONSTRUCTION PURPOSES)

W S 651 N CAMERON STREET
WINCHESTER, VA 22601

NOTICE REQUIRED

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EMERGENCY
Police/Fire/Rescue 911

SCALE 1"=200'
0 200' 400'

PROJECT NARRATIVE

THIS PROJECT IS A CITY OF WINCHESTER STORMWATER DRAINAGE IMPROVEMENT PRELIMINARY DESIGN. THE PROJECT CONSISTS OF A DETENTION BASIN WITHIN THE NORTH CAMERON STREET DRAINAGE SHED. THE HYDROLOGIC PARAMETERS UTILIZED IN PLAN DEVELOPMENT WERE BASED ON LIMITED SITE SURVEY AND SUPPLEMENTAL GIS TOPOGRAPHY, ROADWAY DATA, AND EXISTING STORMWATER INFRASTRUCTURE DATA. THIS PLAN WAS DEVELOPED IN CONJUNCTION WITH THREE (3) OTHER PROPOSED DETENTION BASINS.

SITE STATISTICAL DATA

TAX MAP NUMBER: 154-01-B-11, 10, 9, 8-
LATITUDE: 39° 8' 0.96" W LONGITUDE: 77° 44'41.28" W
RECEIVING WATER: TOWN RUN (HUC- 02070004)

CURRENT OWNER: CSX RAIL TRANSPORTATION INC.

EST. FUTURE OWNER: CITY OF WINCHESTER, VIRGINIA

CITY OF WINCHESTER ENGINEERING DIVISION
WINCHESTER, VIRGINIA, 22601
ATTN: KELLY HENSHAW P.E. - CITY ENGINEER
PHONE: (540) 667-1815 EXT. 1481

ENGINEER: TIMMONS GROUP
20110 ASHBROOK PLACE, SUITE 100
ASHBURN, VIRGINIA 20147
PHONE: (703) 726-1342

Sheet List Table

Sheet Number	Sheet Title
C0.0	BASIN 2 - COVER SHEET
C1.0	BASIN 2 - EXISTING CONDITIONS
C2.0	BASIN 2 - DEMOLITION PLAN
C3.0	BASIN 2 - EROSION & SEDIMENT CONTROL PLAN - PHASE I
C3.1	BASIN 2 - EROSION & SEDIMENT CONTROL PLAN - PHASE II
C3.2	BASIN 2 - EROSION & SEDIMENT CONTROL NOTES & DETAILS
C3.3	BASIN 2 - EROSION & SEDIMENT CONTROL NOTES & DETAILS
C3.4	BASIN 2 - EROSION & SEDIMENT CONTROL NOTES & DETAILS
C4.0	BASIN 2 - PRELIMINARY GRADING AND LAYOUT PLAN
C5.0	BASIN 2 - SITE HYDROLOGY
C5.1	BASIN 2 - BASIN PROFILE

TOTAL NUMBER OF SHEETS: 11

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REVISION DESCRIPTION	DATE

DATE	01/18/2019
DRAWN BY	JAC
DESIGNED BY	JAC
CHECKED BY	JJD
SCALE	SEE PLAN

NORTH CAMERON STREET DRAINAGE IMPROVEMENTS (30% PRELIMINARY DESIGN)
WINCHESTER, VIRGINIA
BASIN 2 - COVER SHEET

JOB NO. 36284.013
SHEET NO. C0.0

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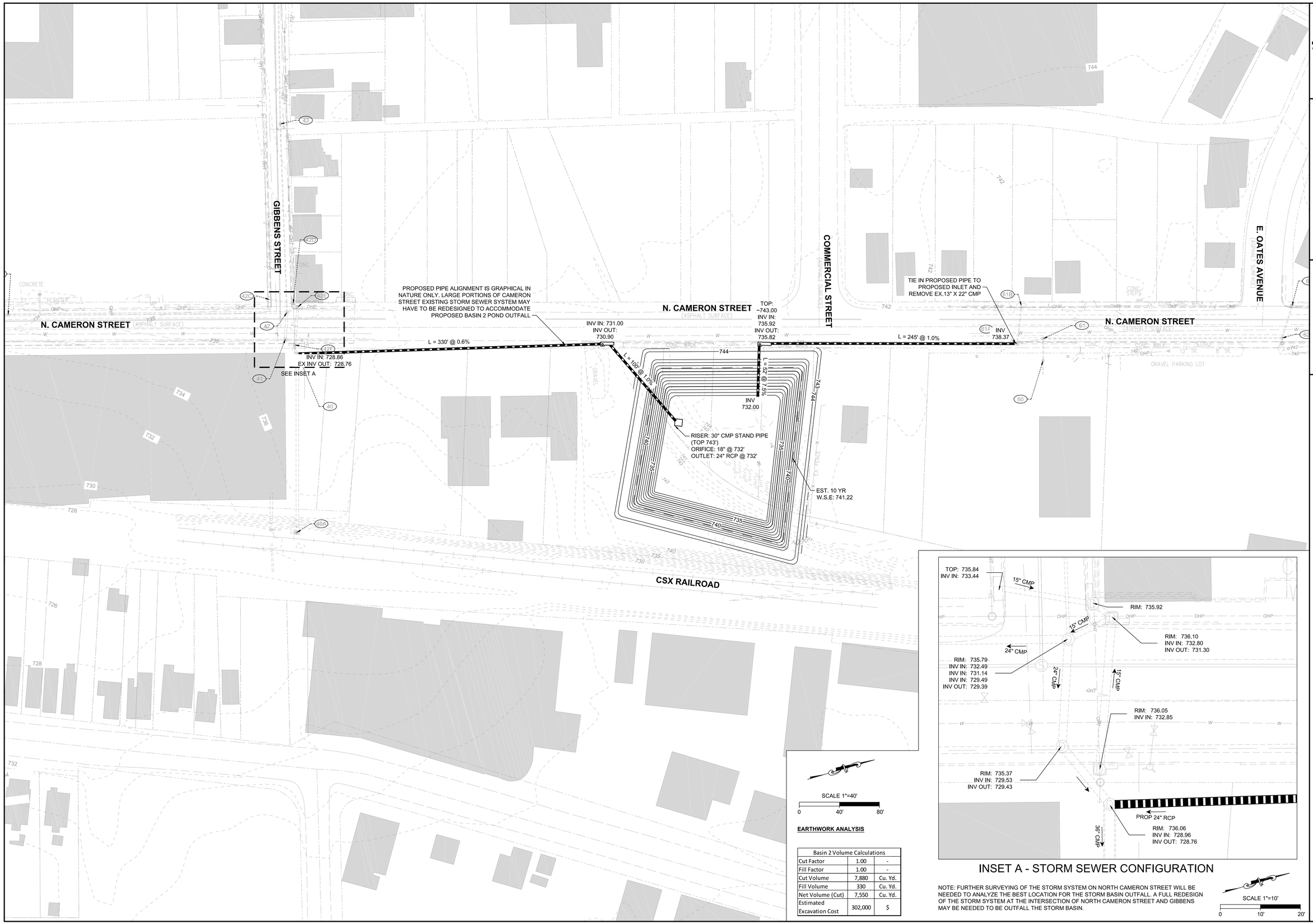

EARTHWORK ANALYSIS

Basin 2 Volume Calculations		
Cut Factor	1.00	-
Fill Factor	1.00	-
Cut Volume	7,880	Cu. Yd.
Fill Volume	330	Cu. Yd.
Net Volume (Cut)	7,550	Cu. Yd.
Estimated Excavation Cost	302,000	$

INSET A - STORM SEWER CONFIGURATION

NOTE: FURTHER SURVEYING OF THE STORM SYSTEM ON NORTH CAMERON STREET WILL BE NEEDED TO ANALYZE THE BEST LOCATION FOR THE STORM BASIN OUTFALL. A FULL REDESIGN OF THE STORM SYSTEM AT THE INTERSECTION OF NORTH CAMERON STREET AND GIBBENS MAY BE NEEDED TO BE OUTFALL THE STORM BASIN.

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REVISION DESCRIPTION	DATE

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DRAWN BY: JAC
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CHECKED BY: JJD
SCALE: SEE PLAN

TIMMONS GROUP

NORTH CAMERON STREET DRAINAGE IMPROVEMENTS (30% PRELIMINARY DESIGN)
WINCHESTER, VIRGINIA

BASIN 2 - PRELIMINARY GRADING AND LAYOUT PLAN

JOB NO. 36284.013
SHEET NO. C4.0

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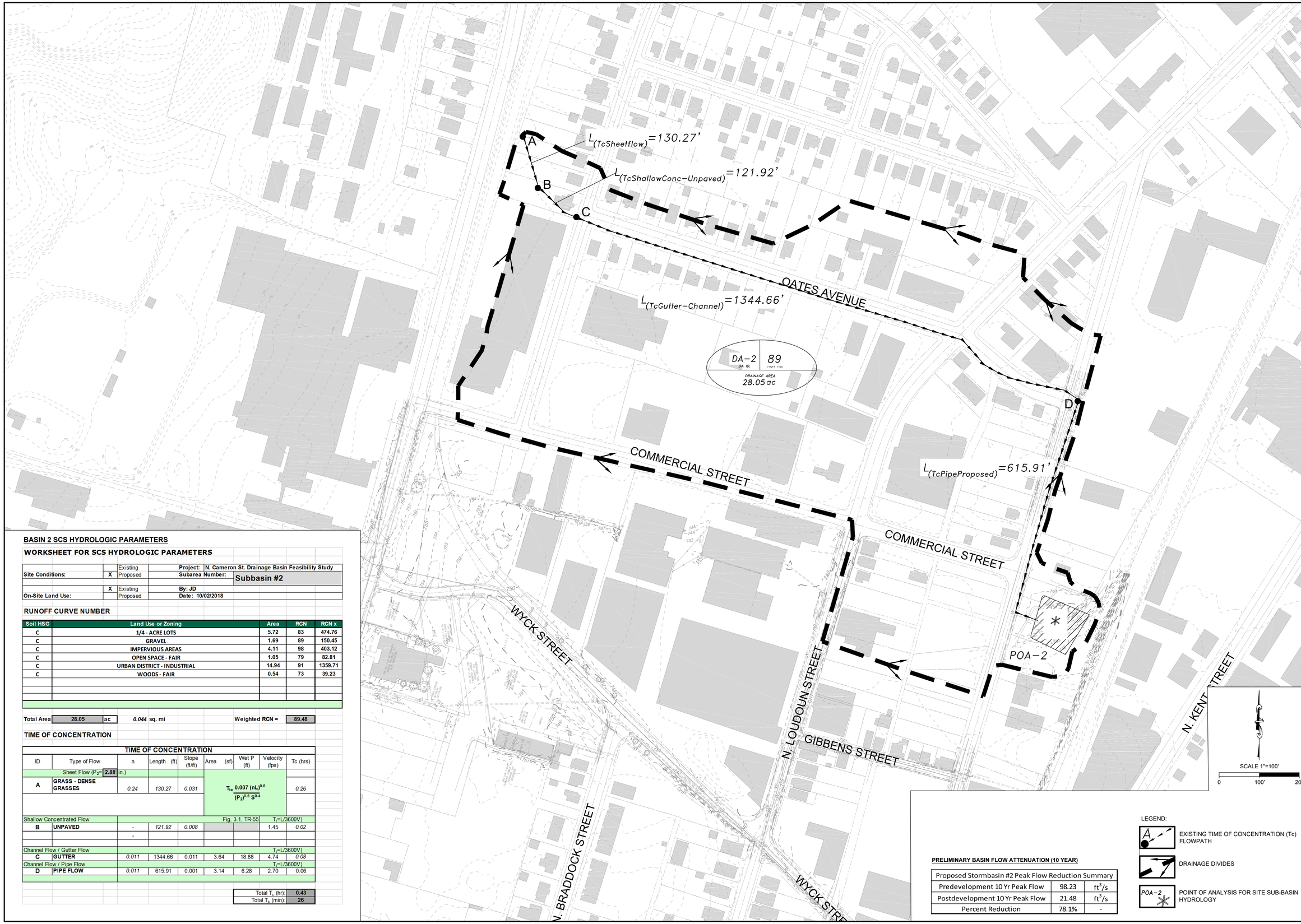

BASIN 2 SCS HYDROLOGIC PARAMETERS

WORKSHEET FOR SCS HYDROLOGIC PARAMETERS

Site Conditions:		Existing	Project:	N. Cameron St. Drainage Basin Feasibility Study
	X	Proposed	Subarea Number:	Subbasin #2
On-Site Land Use:	X	Existing	By: JD	
		Proposed	Date: 10/02/2018	

RUNOFF CURVE NUMBER

Soil HSG	Land Use or Zoning	Area	RCN	RCN x
C	1/4 - ACRE LOTS	5.72	83	474.76
C	GRAVEL	1.69	89	150.45
C	IMPERVIOUS AREAS	4.11	98	403.12
C	OPEN SPACE - FAIR	1.05	79	82.81
C	URBAN DISTRICT - INDUSTRIAL	14.94	91	1359.71
C	WOODS - FAIR	0.54	73	39.23

Total Area 28.05 ac *0.044* sq. mi Weighted RCN = 89.48

TIME OF CONCENTRATION

TIME OF CONCENTRATION								
ID	Type of Flow	n	Length (ft)	Slope (ft/ft)	Area (sf)	Wet P (ft)	Velocity (fps)	Tc (hrs)
Sheet Flow (P_2= 2.88 in.)								
A	GRASS - DENSE GRASSES	*0.24*	*130.27*	*0.031*	$T_{ti}= \frac{0.007\,(nL)^{0.8}}{(P_2)^{0.5}\,S^{0.4}}$			*0.26*
Shallow Concentrated Flow						Fig. 3.1, TR-55	T_t=L/3600V)	
B	UNPAVED	-	*121.92*	*0.008*			1.45	*0.02*
		-						
Channel Flow / Gutter Flow							T_t=L/3600V)	
C	GUTTER	*0.011*	1344.66	0.011	3.64	18.88	4.74	*0.08*
Channel Flow / Pipe Flow							T_t=L/3600V)	
D	PIPE FLOW	*0.011*	615.91	0.001	3.14	6.28	2.70	0.06

Total T_c (hr):	0.43
Total T_c (min):	26

PRELIMINARY BASIN FLOW ATTENUATION (10 YEAR)

Proposed Stormbasin #2 Peak Flow Reduction Summary		
Predevelopment 10 Yr Peak Flow	98.23	ft^3/s
Postdevelopment 10 Yr Peak Flow	21.48	ft^3/s
Percent Reduction	78.1%	-

LEGEND:

- EXISTING TIME OF CONCENTRATION (Tc) FLOWPATH
- DRAINAGE DIVIDES
- POA-2 POINT OF ANALYSIS FOR SITE SUB-BASIN HYDROLOGY

30% DESIGN PLANS ARE NOT FOR CONSTRUCTION

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REVISION DESCRIPTION	DATE

DATE 01/18/2019
DRAWN BY JAC
DESIGNED BY JAC
CHECKED BY JJD
SCALE SEE PLAN

TIMMONS GROUP

NORTH CAMERON STREET DRAINAGE IMPROVEMENTS (30% PRELIMINARY DESIGN)
WINCHESTER, VIRGINIA

BASIN 2 - SITE HYDROLOGY

JOB NO. 36284.013
SHEET NO. C5.0

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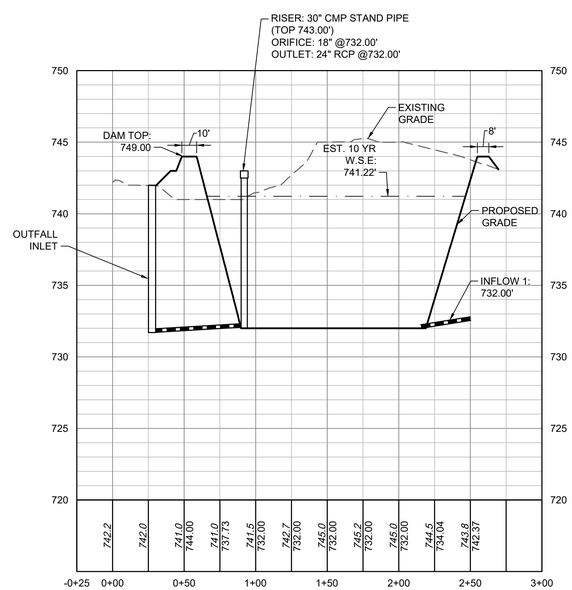

BASIN 2 LONGITUDINAL PROFILE

HORZ SCALE: 1"= 50'

VERT. SCALE: 1" = 5'

5

0

0

50

PROFILE SCALE

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TIMMONS GROUP

NORTH CAMERON STREET DRAINAGE IMPROVEMENTS (30% PRELIMINARY DESIGN)

WINCHESTER, VIRGINIA

BASIN 2 - BASIN PROFILE

JOB NO. 36284.013

SHEET NO. C5.1

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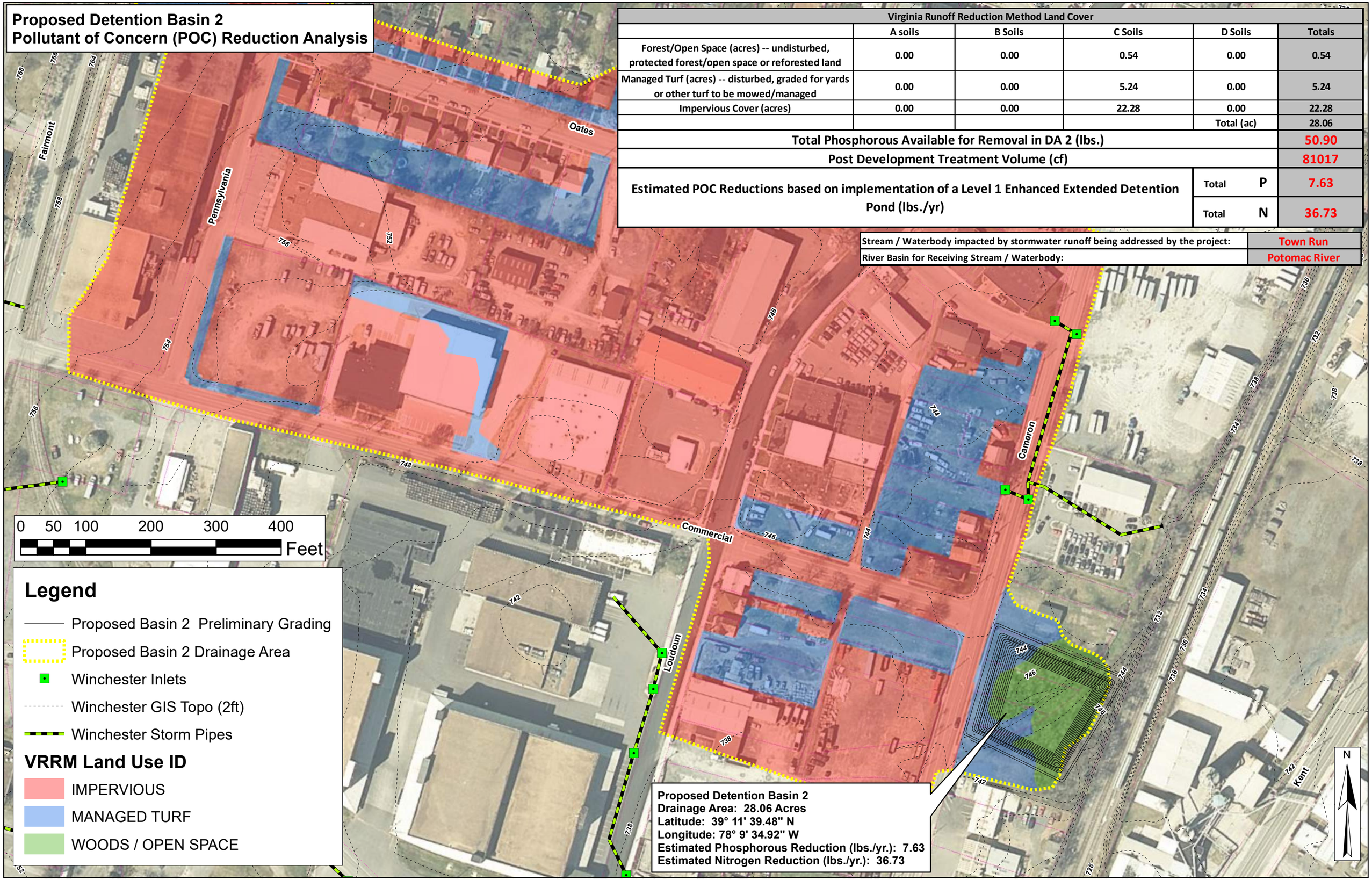
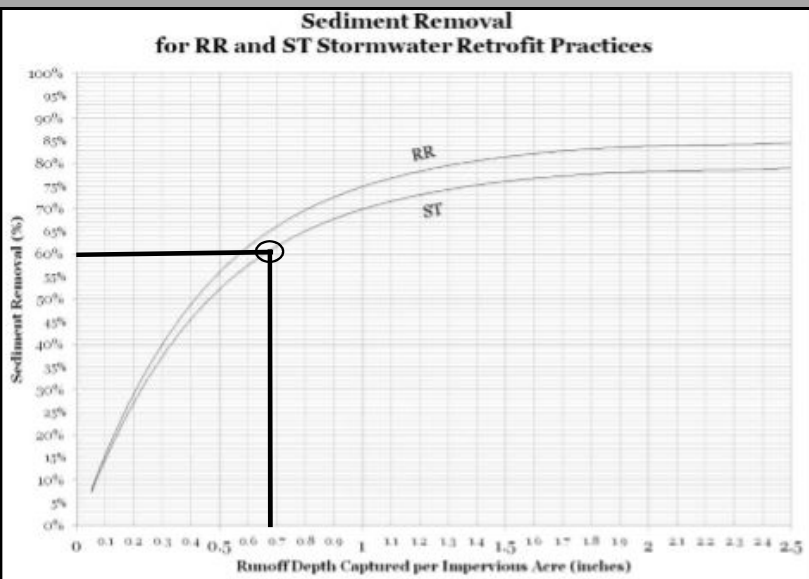
Proposed Detention Basin 2
Pollutant of Concern (POC) Reduction Analysis

Virginia Runoff Reduction Method Land Cover					
	A soils	B Soils	C Soils	D Soils	Totals
Forest/Open Space (acres) -- undisturbed, protected forest/open space or reforested land	0.00	0.00	0.54	0.00	0.54
Managed Turf (acres) -- disturbed, graded for yards or other turf to be mowed/managed	0.00	0.00	5.24	0.00	5.24
Impervious Cover (acres)	0.00	0.00	22.28	0.00	22.28
				Total (ac)	28.06
Total Phosphorous Available for Removal in DA 2 (lbs.)					50.90
Post Development Treatment Volume (cf)					81017
Estimated POC Reductions based on implementation of a Level 1 Enhanced Extended Detention Pond (lbs./yr)				Total P	7.63
				Total N	36.73

Stream / Waterbody impacted by stormwater runoff being addressed by the project:	Town Run
River Basin for Receiving Stream / Waterbody:	Potomac River



Estimated Sediment Reductions Provided by a Level 1 - Extended Detention (ED) Basin 2 Retrofit		
1 Determination of TSS Available for Removal in Basin 2 (lbs./yr.)	**Regulated Impervious Acres Drainage to Basin 2 (ac.)**	22.28
	Total Suspended Solids (TSS) Source Loading per Acre of Regulated Impervious - Potomac River (lbs./ac./yr.)	1171.32
	TSS Available for Removal in Basin 2 Drainage Area (lbs.)	**26,097.01**
2 Estimation of Runoff Volume Provided by Basin 2 Retrofit (inches)	**Runoff Depth (in) = (RS)(12)/IA** **Where:** **RS = Runoff Storage Volume (acre-feet)** **IA = Impervious Area (acres)**	
	1-year WQ RS (acre-feet)	1.267
	IA (acres)	22.28
	Runoff Volume (RV) by Basin 2 (in.)	**0.68**
3 Estimation of Sediment Removal Efficiency of a Level 2 ED Pond Retrofit (%)	 **Figure 5. Retrofit Removal Adjustor Curve for Sediment**	**61%**
4 Estimation of Sediment Reductions Provided by a Level 1 - ED Basin 2 Retrofit (lbs.)	**TSS Available for Removal in Basin 2 Drainage Area (lbs.)**	26,097.01
	Sediment Removal Efficiency of Level 1 ED Basin 2 Retrofit	61%
	Total Estimated Sediment Removed by a Level 1 ED Basin 2 Retrofit (lbs.)	**15,919.18**

APPENDIX B.4 – NORTH CAMERON STREET BASINS 3 AND 4

N. CAMERON STREET - FLOOD CONTROL BASIN 3

30% PRELIMINARY DESIGN PLANS

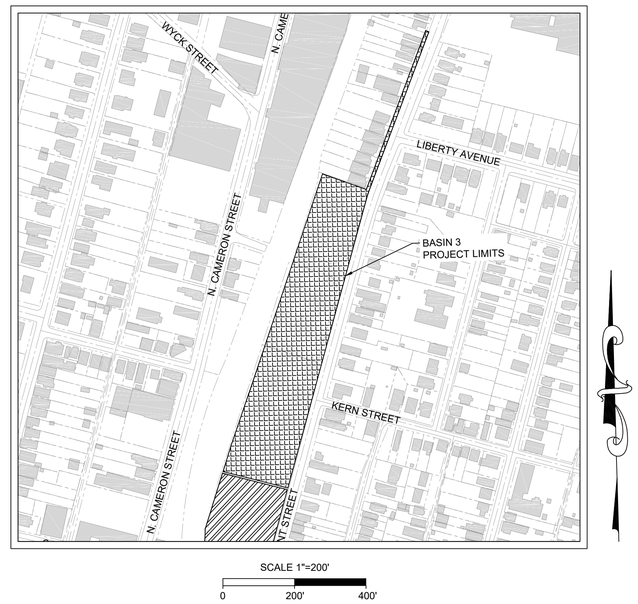
(NOT FOR CONSTRUCTION PURPOSES)

W S 501-515 NORTH KENT STREET
WINCHESTER, VA 22601

NOTICE REQUIRED

CONTRACTORS SHALL NOTIFY OPERATORS WHO MAINTAIN UNDERGROUND UTILITY LINES IN THE AREA OF PROPOSED EXCAVATION AND OR BLASTING AT LEAST TWO (2) WORKING DAYS, BUT NOT MORE THAN TEN (10) WORKING DAYS PRIOR TO COMMENCEMENT OF EXCAVATION OR DEMOLITION. NAMES AND TELEPHONE NUMBERS OF THE OPERATORS OF UNDERGROUND UTILITY LINES APPEAR BELOW. THESE NUMBERS SHALL ALSO BE USED TO SERVE IN AN EMERGENCY CONDITION.

EMERGENCY
Police/Fire/Rescue 911



PROJECT NARRATIVE

THIS PROJECT IS A CITY OF WINCHESTER STORMWATER DRAINAGE IMPROVEMENT PRELIMINARY DESIGN. THE PROJECT CONSISTS OF A DETENTION BASIN WITHIN THE NORTH CAMERON STREET DRAINAGE SHED. THE HYDROLOGIC PARAMETERS UTILIZED IN PLAN DEVELOPMENT WERE BASED ON LIMITED SITE SURVEY AND SUPPLEMENTAL GIS TOPOGRAPHY, ROADWAY DATA, AND EXISTING STORMWATER INFRASTRUCTURE DATA. THIS PLAN WAS DEVELOPED IN CONJUNCTION WITH THREE (3) OTHER PROPOSED DETENTION BASINS.

SITE STATISTICAL DATA

TAX MAP NUMBER: 173-01-W-2A-T
LATITUDE: 39° 11' 024" N LONGITUDE: 78° 15'36" W
RECEIVING WATER: TOWN RUN (HUC: 02070004)

CURRENT OWNER: CSX RAIL TRANSPORTATION INC.

EST. FUTURE OWNER: CITY OF WINCHESTER, VIRGINIA

CITY OF WINCHESTER ENGINEERING DIVISION
WINCHESTER, VIRGINIA, 22601
ATTN: KELLY HENSHAW P.E. - CITY ENGINEER
PHONE: (540) 667-1815 EXT. 1481

ENGINEER: TIMMONS GROUP
20110 ASHBROOK PLACE, SUITE 100
ASHBURN, VIRGINIA 20147
PHONE: (703) 726-1342

Sheet List Table

Sheet Number	Sheet Title
C0.0	BASIN 3 - COVER SHEET
C1.0	BASIN 3 - EXISTING CONDITIONS
C2.0	BASIN 3 - DEMOLITION PLAN
C3.0	BASIN 3 - EROSION & SEDIMENT CONTROL PLAN - PHASE I
C3.1	BASIN 3 - EROSION & SEDIMENT CONTROL PLAN - PHASE II
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C4.0	BASIN 3 - PRELIMINARY GRADING AND LAYOUT PLAN
C5.0	BASIN 3 - SITE HYDROLOGY
C5.1	BASIN 3 - BASIN PROFILE

TOTAL NUMBER OF SHEETS: 13

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NORTH CAMERON STREET DRAINAGE IMPROVEMENTS (30% PRELIMINARY DESIGN)
WINCHESTER, VIRGINIA
BASIN 3 - COVER SHEET

JOB NO.
36284.013

SHEET NO.
C0.0

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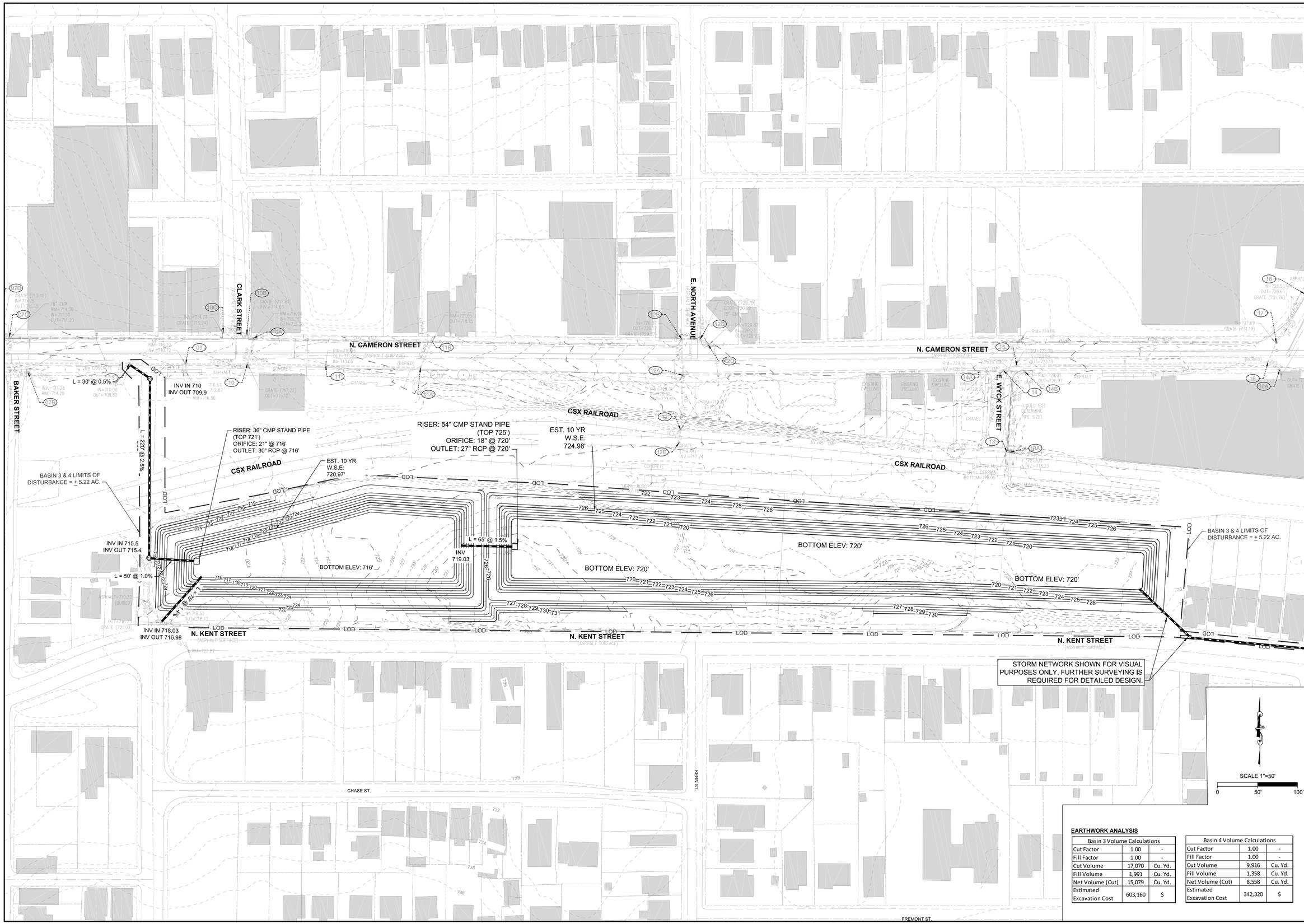

EARTHWORK ANALYSIS

Basin 3 Volume Calculations		
Cut Factor	1.00	-
Fill Factor	1.00	-
Cut Volume	17,070	Cu. Yd.
Fill Volume	1,991	Cu. Yd.
Net Volume (Cut)	15,079	Cu. Yd.
Estimated Excavation Cost	603,160	$

Basin 4 Volume Calculations		
Cut Factor	1.00	-
Fill Factor	1.00	-
Cut Volume	9,916	Cu. Yd.
Fill Volume	1,358	Cu. Yd.
Net Volume (Cut)	8,558	Cu. Yd.
Estimated Excavation Cost	342,320	$

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NORTH CAMERON STREET DRAINAGE IMPROVEMENTS (30% PRELIMINARY DESIGN)

WINCHESTER, VIRGINIA

BASIN 3 - PRELIMINARY GRADING AND LAYOUT PLAN

JOB NO. 36284.013

SHEET NO. C4.0

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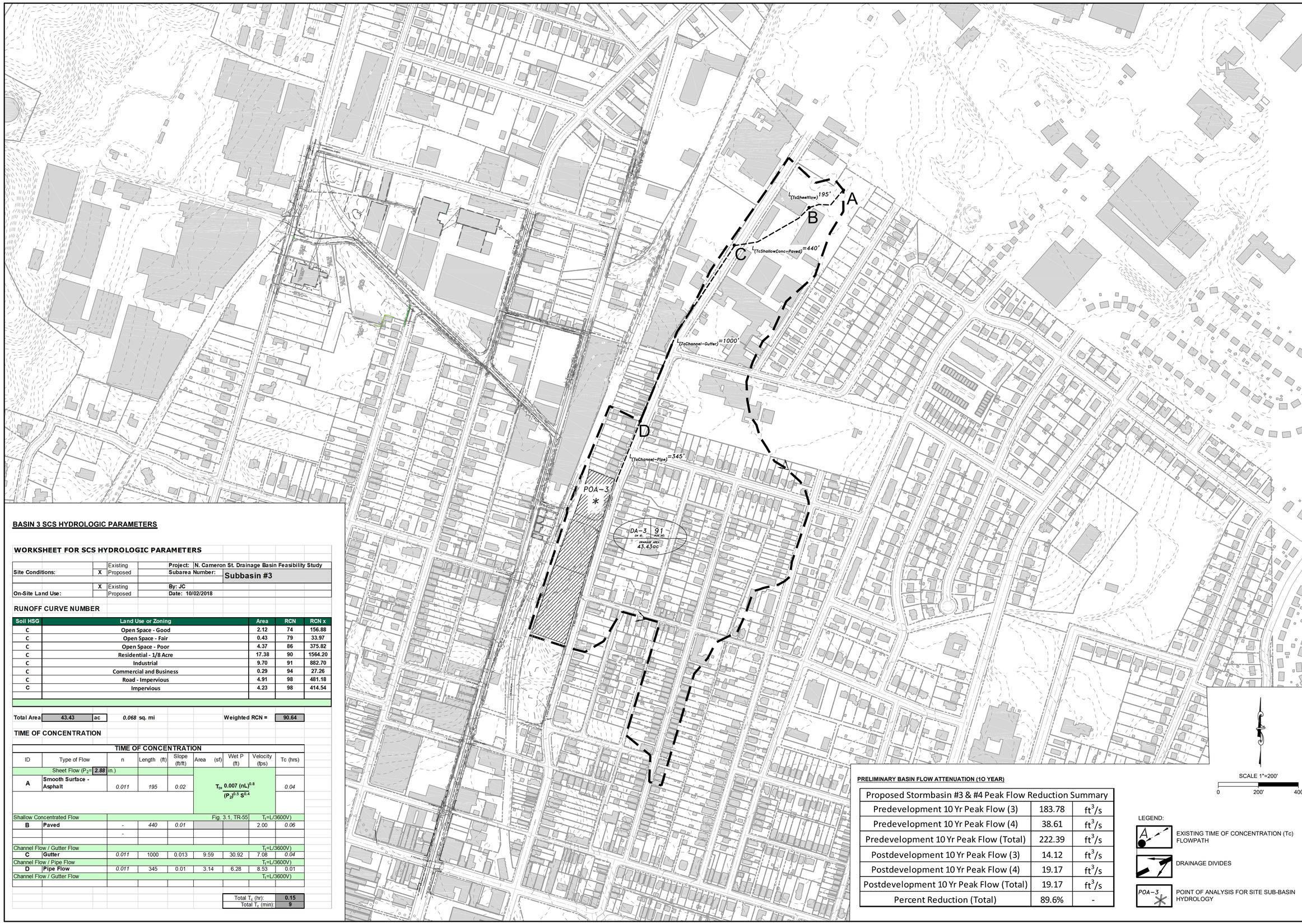

BASIN 3 SCS HYDROLOGIC PARAMETERS

WORKSHEET FOR SCS HYDROLOGIC PARAMETERS

Site Conditions:		Existing	Project:	N. Cameron St. Drainage Basin Feasibility Study
	X	Proposed	Subarea Number:	Subbasin #3
On-Site Land Use:	X	Existing	By: JC	
		Proposed	Date: 10/02/2018	

RUNOFF CURVE NUMBER

Soil HSG	Land Use or Zoning	Area	RCN	RCN x
C	Open Space - Good	2.12	74	156.88
C	Open Space - Fair	0.43	79	33.97
C	Open Space - Poor	4.37	86	375.82
C	Residential - 1/8 Acre	17.38	90	1564.20
C	Industrial	9.70	91	882.70
C	Commercial and Business	0.29	94	27.26
C	Road - Impervious	4.91	98	481.18
C	Impervious	4.23	98	414.54

Total Area 43.43 ac *0.068* sq. mi Weighted RCN = 90.64

TIME OF CONCENTRATION

TIME OF CONCENTRATION								
ID	Type of Flow	n	Length (ft)	Slope (ft/ft)	Area (sf)	Wet P (ft)	Velocity (fps)	Tc (hrs)
Sheet Flow (P_2= 2.88 in.)								
A	Smooth Surface - Asphalt	0.011	195	0.02	$T_{tt} = \frac{0.007\,(nL)^{0.8}}{(P_2)^{0.5}\,S^{0.4}}$			0.04
Shallow Concentrated Flow						Fig. 3.1, TR-55	T_t=L/3600V)	
B	Paved	-	440	0.01			2.00	0.06
		-						
Channel Flow / Gutter Flow							T_t=L/3600V)	
C	Gutter	0.011	1000	0.013	9.59	30.92	7.08	0.04
Channel Flow / Pipe Flow							T_t=L/3600V)	
D	Pipe Flow	0.011	345	0.01	3.14	6.28	8.53	0.01
Channel Flow / Gutter Flow							T_t=L/3600V)	

Total T_c (hr): 0.15
Total T_c (min): 9

PRELIMINARY BASIN FLOW ATTENUATION (10 YEAR)

Proposed Stormbasin #3 & #4 Peak Flow Reduction Summary		
Predevelopment 10 Yr Peak Flow (3)	183.78	ft^3/s
Predevelopment 10 Yr Peak Flow (4)	38.61	ft^3/s
Predevelopment 10 Yr Peak Flow (Total)	222.39	ft^3/s
Postdevelopment 10 Yr Peak Flow (3)	14.12	ft^3/s
Postdevelopment 10 Yr Peak Flow (4)	19.17	ft^3/s
Postdevelopment 10 Yr Peak Flow (Total)	19.17	ft^3/s
Percent Reduction (Total)	89.6%	-

LEGEND:

- EXISTING TIME OF CONCENTRATION (Tc) FLOWPATH
- DRAINAGE DIVIDES
- POA-3 — POINT OF ANALYSIS FOR SITE SUB-BASIN HYDROLOGY

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DESIGNED BY	JAC
CHECKED BY	JJD
SCALE	SEE PLAN

TIMMONS GROUP

NORTH CAMERON STREET DRAINAGE IMPROVEMENTS (30% PRELIMINARY DESIGN)
WINCHESTER, VIRGINIA
BASIN 3 - SITE HYDROLOGY

JOB NO. 36284.013
SHEET NO. C5.0

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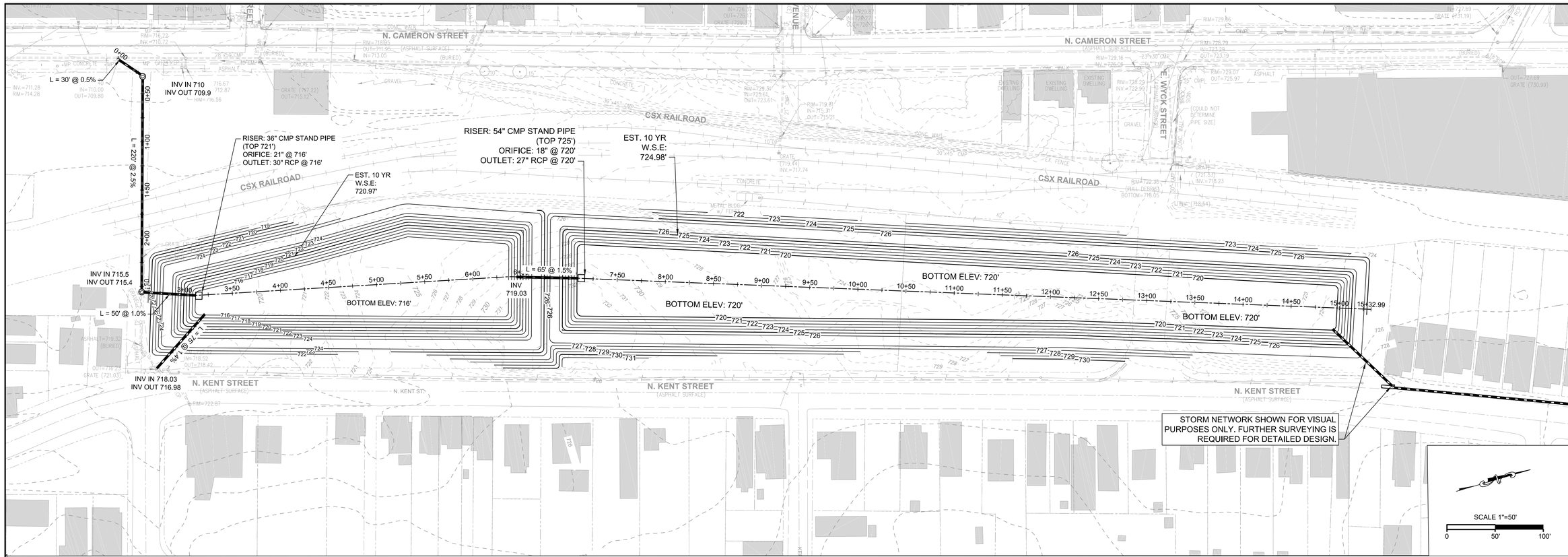
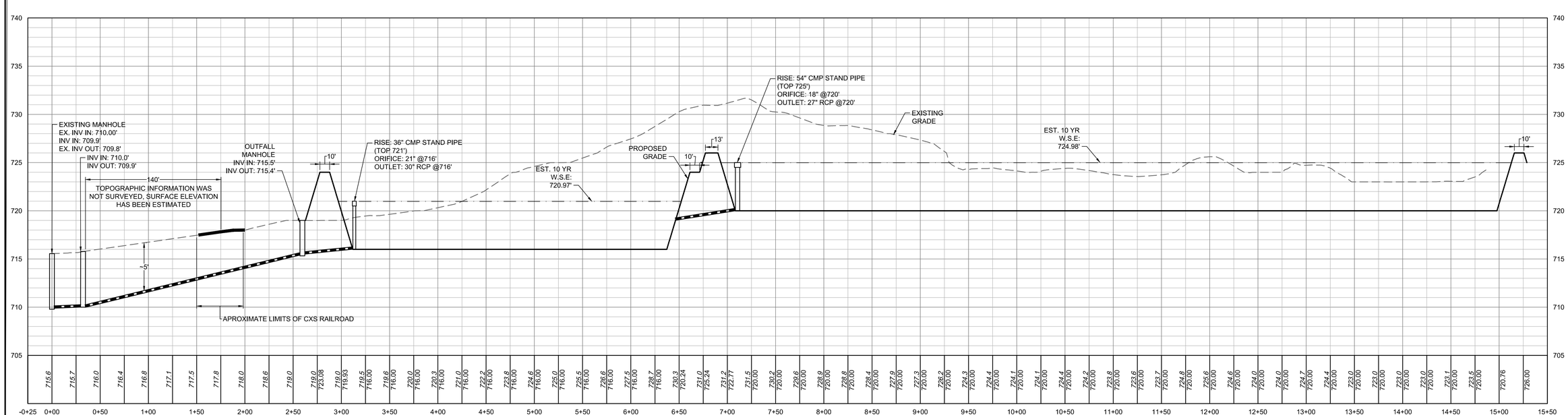
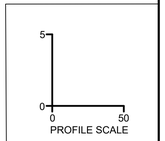




BASIN 3 & 4 LONGITUDINAL PROFILE
HORZ SCALE: 1"= 50'
VERT. SCALE: 1" = 5'



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WINCHESTER, VIRGINIA

BASIN 3 - BASIN PROFILE

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N. CAMERON STREET - FLOOD CONTROL BASIN 4

30% PRELIMINARY DESIGN PLANS

(NOT FOR CONSTRUCTION PURPOSES)

W S 501-515 NORTH KENT STREET
WINCHESTER, VA 22601

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EMERGENCY
Police/Fire/Rescue 911

SCALE 1"=200'
0 200' 400'

PROJECT NARRATIVE

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SITE STATISTICAL DATA

TAX MAP NUMBER: 173-01-W-2A

PARCEL NUMBER: ???

LATITUDE: 39° 11' 024" N LONGITUDE: 78° 15'36" W

RECEIVING WATER: TOWN RUN (HUC: 02070004)

CURRENT OWNER: CSX RAIL TRANSPORTATION INC.

EST. FUTURE OWNER: CITY OF WINCHESTER, VIRGINIA

CITY OF WINCHESTER ENGINEERING DIVISION
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ATTN: KELLY HENSHAW P.E. - CITY ENGINEER
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ENGINEER: TIMMONS GROUP
20110 ASHBROOK PLACE, SUITE 100
ASHBURN, VIRGINIA 20147
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C5.1	BASIN 4 - BASIN PROFILE

TOTAL NUMBER OF SHEETS: 13

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NORTH CAMERON STREET DRAINAGE IMPROVEMENTS (30% PRELIMINARY DESIGN)
WINCHESTER, VIRGINIA
BASIN 4 - COVER SHEET

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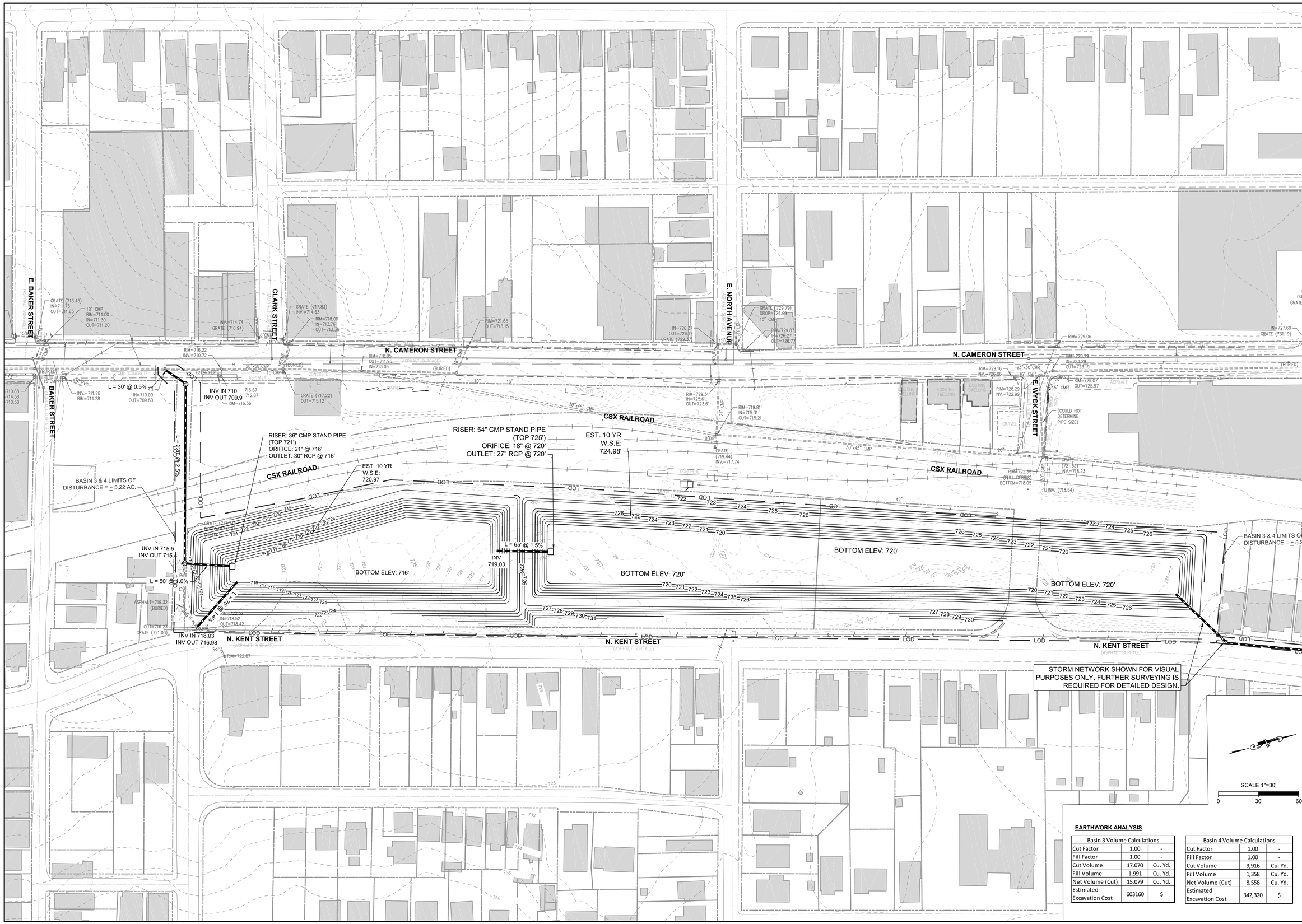

EARTHWORK ANALYSIS

Basin 3 Volume Calculations		
Cut Factor	1.00	-
Fill Factor	1.00	-
Cut Volume	17,070	Cu. Yd.
Fill Volume	1,991	Cu. Yd.
Net Volume (Cut)	15,079	Cu. Yd.
Estimated Excavation Cost	603160	$

Basin 4 Volume Calculations		
Cut Factor	1.00	-
Fill Factor	1.00	-
Cut Volume	9,916	Cu. Yd.
Fill Volume	1,358	Cu. Yd.
Net Volume (Cut)	8,558	Cu. Yd.
Estimated Excavation Cost	342,320	$

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WINCHESTER, VIRGINIA

BASIN 4 - PRELIMINARY GRADING AND LAYOUT PLAN

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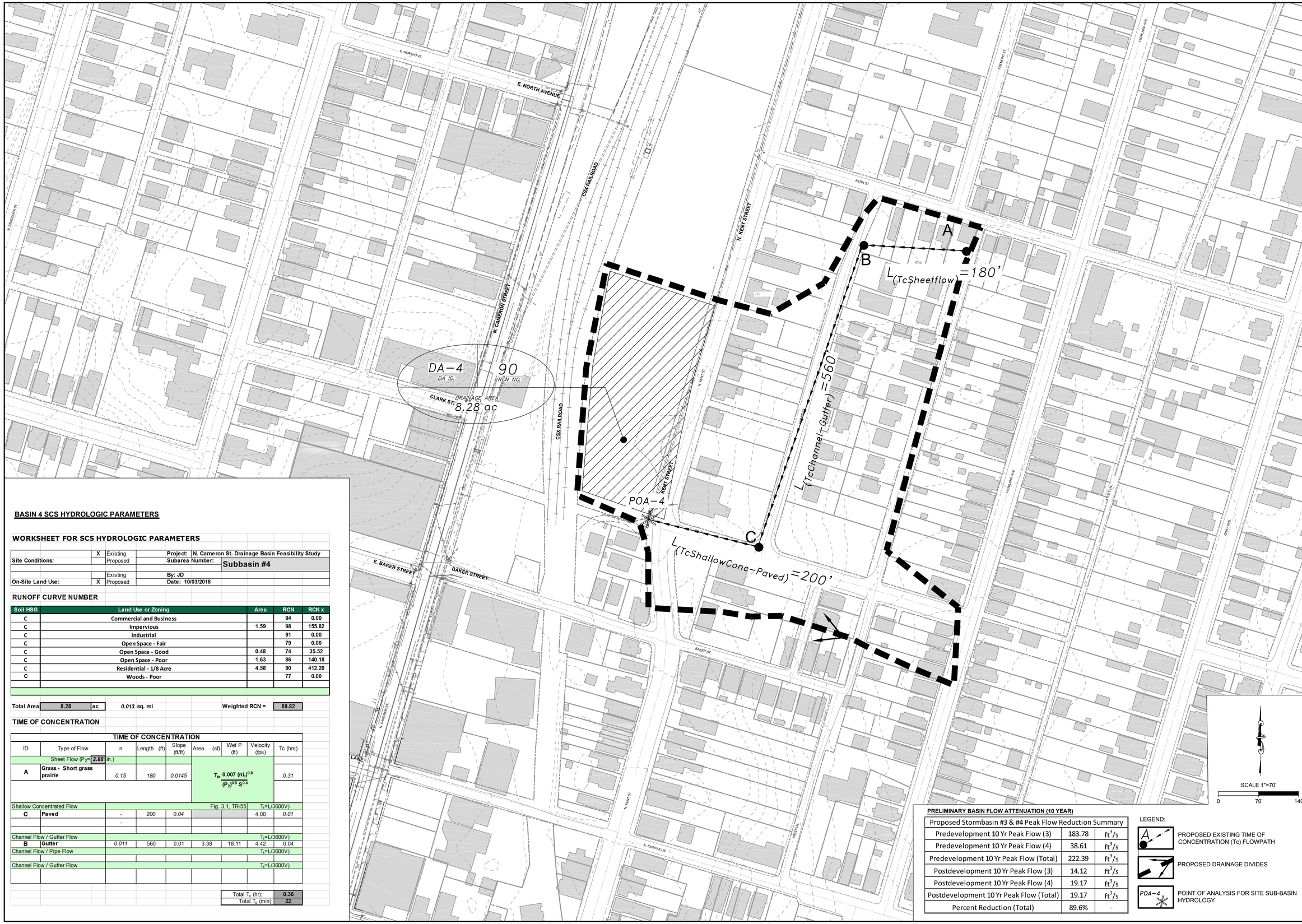

BASIN 4 SCS HYDROLOGIC PARAMETERS

WORKSHEET FOR SCS HYDROLOGIC PARAMETERS

Site Conditions:	X	Existing	Project:	N. Cameron St. Drainage Basin Feasibility Study
		Proposed	Subarea Number:	Subbasin #4
On-Site Land Use:		Existing	By: JD	
	X	Proposed	Date: 10/03/2018	

RUNOFF CURVE NUMBER

Soil HSG	Land Use or Zoning	Area	RCN	RCN x
C	Commercial and Business		94	0.00
C	Impervious	1.59	98	155.82
C	Industrial		91	0.00
C	Open Space - Fair		79	0.00
C	Open Space - Good	0.48	74	35.52
C	Open Space - Poor	1.63	86	140.18
C	Residential - 1/8 Acre	4.58	90	412.20
C	Woods - Poor		77	0.00

Total Area 8.28 ac *0.013* sq. mi Weighted RCN = 89.82

TIME OF CONCENTRATION

TIME OF CONCENTRATION								
ID	Type of Flow	n	Length (ft)	Slope (ft/ft)	Area (sf)	Wet P (ft)	Velocity (fps)	Tc (hrs)
Sheet Flow (P_2= 2.88 in.)								
A	Grass - Short grass prairie	*0.15*	*180*	*0.0145*	$T_{Tc} = \frac{0.007\,(nL)^{0.8}}{(P_2)^{0.5}\,S^{0.4}}$			*0.31*
Shallow Concentrated Flow						Fig. 3.1, TR-55		T_t=L/3600V)
C	Paved	-	*200*	*0.04*			4.00	*0.01*
		-						
Channel Flow / Gutter Flow								T_t=L/3600V)
B	Gutter	*0.011*	560	0.01	3.38	18.11	4.42	0.04
Channel Flow / Pipe Flow								T_t=L/3600V)
Channel Flow / Gutter Flow								T_t=L/3600V)

Total T_c (hr):	0.36
Total T_c (min):	22

PRELIMINARY BASIN FLOW ATTENUATION (10 YEAR)

Proposed Stormbasin #3 & #4 Peak Flow Reduction Summary		
Predevelopment 10 Yr Peak Flow (3)	183.78	ft^3/s
Predevelopment 10 Yr Peak Flow (4)	38.61	ft^3/s
Predevelopment 10 Yr Peak Flow (Total)	222.39	ft^3/s
Postdevelopment 10 Yr Peak Flow (3)	14.12	ft^3/s
Postdevelopment 10 Yr Peak Flow (4)	19.17	ft^3/s
Postdevelopment 10 Yr Peak Flow (Total)	19.17	ft^3/s
Percent Reduction (Total)	89.6%	-

LEGEND:

- PROPOSED EXISTING TIME OF CONCENTRATION (Tc) FLOWPATH
- PROPOSED DRAINAGE DIVIDES
- POA-4 — POINT OF ANALYSIS FOR SITE SUB-BASIN HYDROLOGY

30% DESIGN PLANS ARE NOT FOR CONSTRUCTION

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TIMMONS GROUP • (DESIGN)

NORTH CAMERON STREET DRAINAGE IMPROVEMENTS (30% PRELIMINARY DESIGN)

WINCHESTER, VIRGINIA

BASIN 4 - SITE HYDROLOGY

JOB NO. 36284.013

SHEET NO. C5.0

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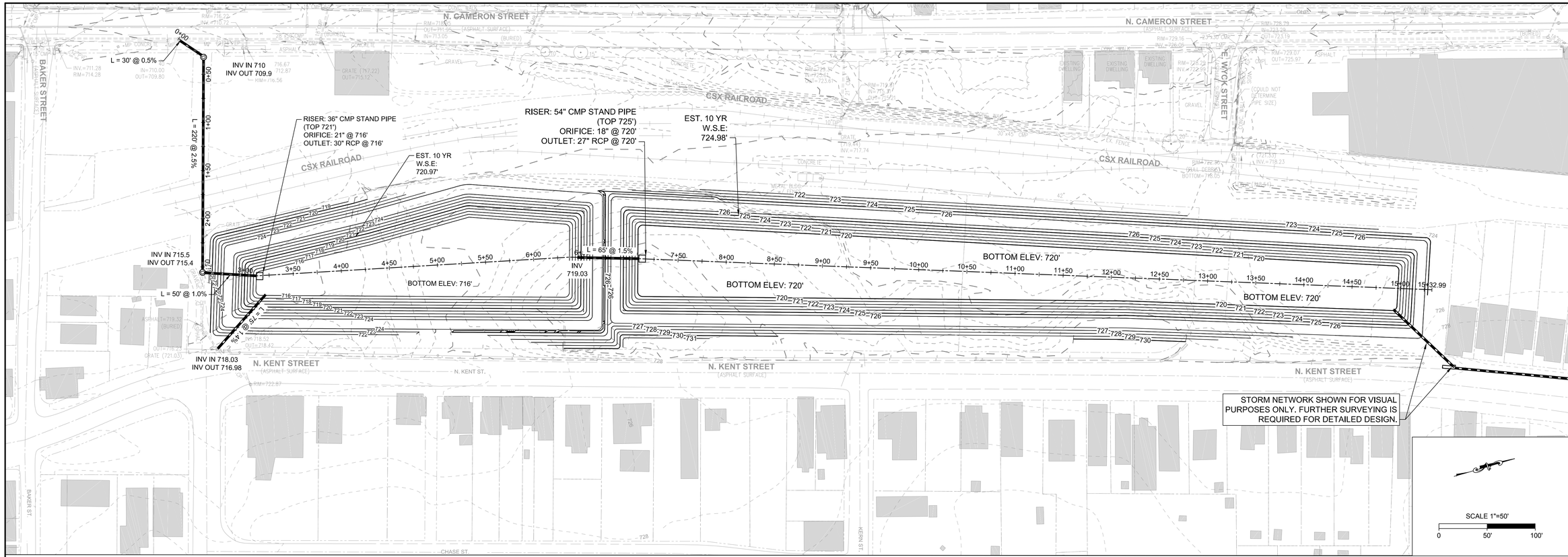

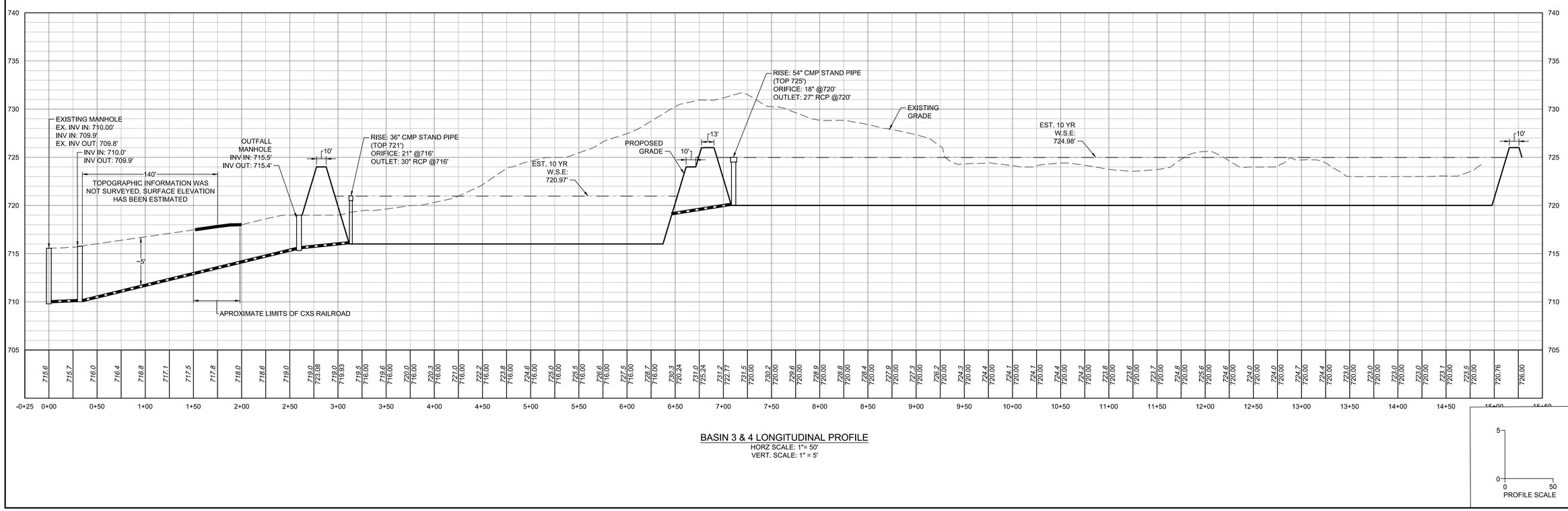

BASIN 3 & 4 LONGITUDINAL PROFILE
HORZ SCALE: 1"= 50'
VERT. SCALE: 1" = 5'

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TIMMONS GROUP

NORTH CAMERON STREET DRAINAGE IMPROVEMENTS (30% PRELIMINARY DESIGN)
WINCHESTER, VIRGINIA

BASIN 4 - BASIN PROFILE

JOB NO. 36284.013

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Proposed Detention Basin 3 & 4 (Combined) Pollutant of Concern (POC) Reduction Analysis

Virginia Runoff Reduction Method Land Cover					
	A soils	B Soils	C Soils	D Soils	Totals
Forest/Open Space (acres) -- undisturbed, protected forest/open space or reforested land	0.00	0.00	2.55	0.00	2.55
Managed Turf (acres) -- disturbed, graded for yards or other turf to be mowed/managed	0.00	0.00	18.30	0.00	18.30
Impervious Cover (acres)	0.00	0.00	30.93	0.00	30.93
				Total (ac)	51.78
Total Phosphorous Available for Removal in Combined DA 3 and 4 (lbs.)					76.20
Post Development Treatment Volume (cf)					121276
Estimated POC Reductions based on implementation of a Level 2 Enhanced Extended Detention Pond (lbs./yr)				Total P	21.12
				Total N	127.96

Stream / Waterbody impacted by stormwater runoff being addressed by the project:	Town Run
River Basin for Receiving Stream / Waterbody:	Potomac River

Proposed Detention Basin 3 & 4 (Combined)
Drainage Area: 51.78 Acres
Latitude: 39° 11' 27.6" N
Longitude: 78° 9' 37.44" W
Estimated Phosphorous Reduction (lbs./yr.): 21.12
Estimated Nitrogen Reduction (lbs./yr.): 127.96

0 50100 200 300 400 Feet

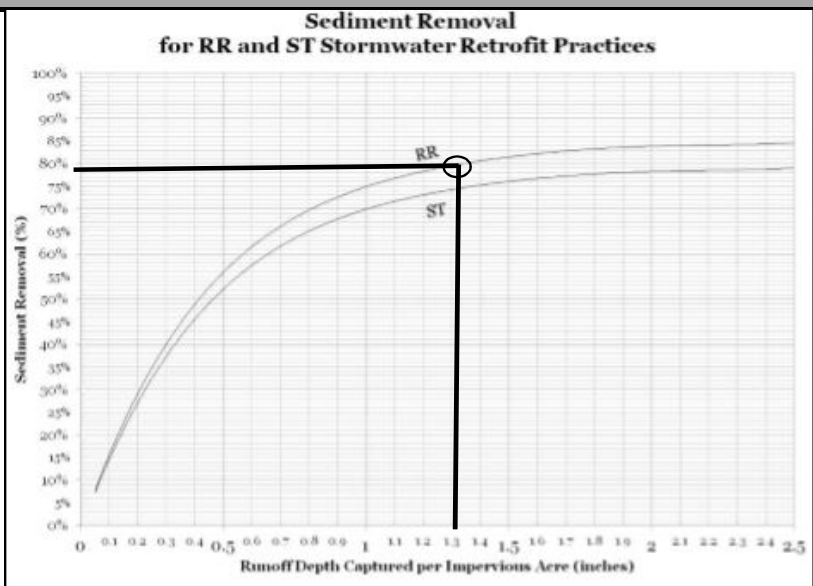
Legend

- Proposed Basin 3 & 4 Combined Preliminary Grading
- Proposed Basin 3 & 4 Combined Drainage Area
- Winchester Manholes
- Winchester Inlets
- Winchester GIS Topo (2ft)
- Winchester Storm Pipes

VRRM Land Use ID

- IMPERVIOUS
- MANAGED TURF
- WOODS

N

Estimated Sediment Reductions Provided by a Level 2- Extended Detention (ED) Basin 3 & 4 Retrofit		
1 Determination of TSS Available for Removal in Basin 3 & 4 (lbs./yr.)	**Regulated Impervious Acres Drainage to Basin 3 & 4 (ac.)**	30.93
	Total Suspended Solids (TSS) Source Loading per Acre of Regulated Impervious - Potomac River (lbs./ac./yr.)	1171.32
	TSS Available for Removal in Basin 3 & 4 Drainage Area (lbs.)	**36,228.93**
2 Estimation of Runoff Volume Provided by Basin 3 & 4 Retrofit (inches)	**Runoff Depth (in) = (RS)(12)/IA** **Where:** **RS = Runoff Storage Volume (acre-feet)** **IA = Impervious Area (acres)**	
	1-year WQ RS (acre-feet)	3.404
	IA (acres)	30.93
	Runoff Volume (RV) by Basin 3 & 4 (in.)	**1.32**
3 Estimation of Sediment Removal Efficiency of a Level 2 ED Pond Retrofit (%)	 **Figure 5. Retrofit Removal Adjustor Curve for Sediment**	**80%**
4 Estimation of Sediment Reductions Provided by a Level 1 - ED Basin 3 & 4 Retrofit (lbs.)	**TSS Available for Removal in Basin 3 & 4 Drainage Area (lbs.)**	36,228.93
	Sediment Removal Efficiency of Level 1 ED Basin 3 & 4 Retrofit	80%
	Total Estimated Sediment Removed by a Level 1 ED Basin 3 & 4 Retrofit (lbs.)	**28,983.14**

APPENDIX B.5 – FRIENDSHIP PARK AND FIRE STATION POND RETROFIT

Virginia Runoff Reduction Method Land Cover					
	A soils	B Soils	C Soils*	D Soils	Totals
Forest/Open Space (acres) -- undisturbed, protected forest/open space or reforested land	0.00	0.00	0.00	0.00	0.00
Managed Turf (acres) -- disturbed, graded for yards or other turf to be mowed/managed	0.00	0.00	48.96	0.00	48.96
Impervious Cover (acres)	0.00	0.00	34.50	0.00	34.50
				Total (ac)	83.46
Total Phosphorous Available for Removal in DA 1 (lbs)					99.32
Post Development Treatment Volume (cf)					158073

** Note: All soils assumed to be HSG C due to lack of mapped soils information for the City of Winchester*

Pollutant of Concern Removal		Design Level 1 Estimated Cost = $253,700.00	Design Level 2 Estimated Cost = $405,700.00
Total P	Total Phosphorous (P) Removal (lbs./yr)	14.88	27.53
	Cost per pound (P) removed ($/lb.)	$17,049.73	$14,736.65
Total N	Total Nitrogen (N) Removal (lbs./yr)	70.97	166.78
	Cost per pound (N) removed ($/lb.)	$3,574.75	$2,432.55
Total TSS	Estimated Total Suspended Solids (TSS) Removal (lbs./yr)	34067.31	36420.16
	Cost per pound (TSS) removed ($/lb.)	$7.45	$11.14

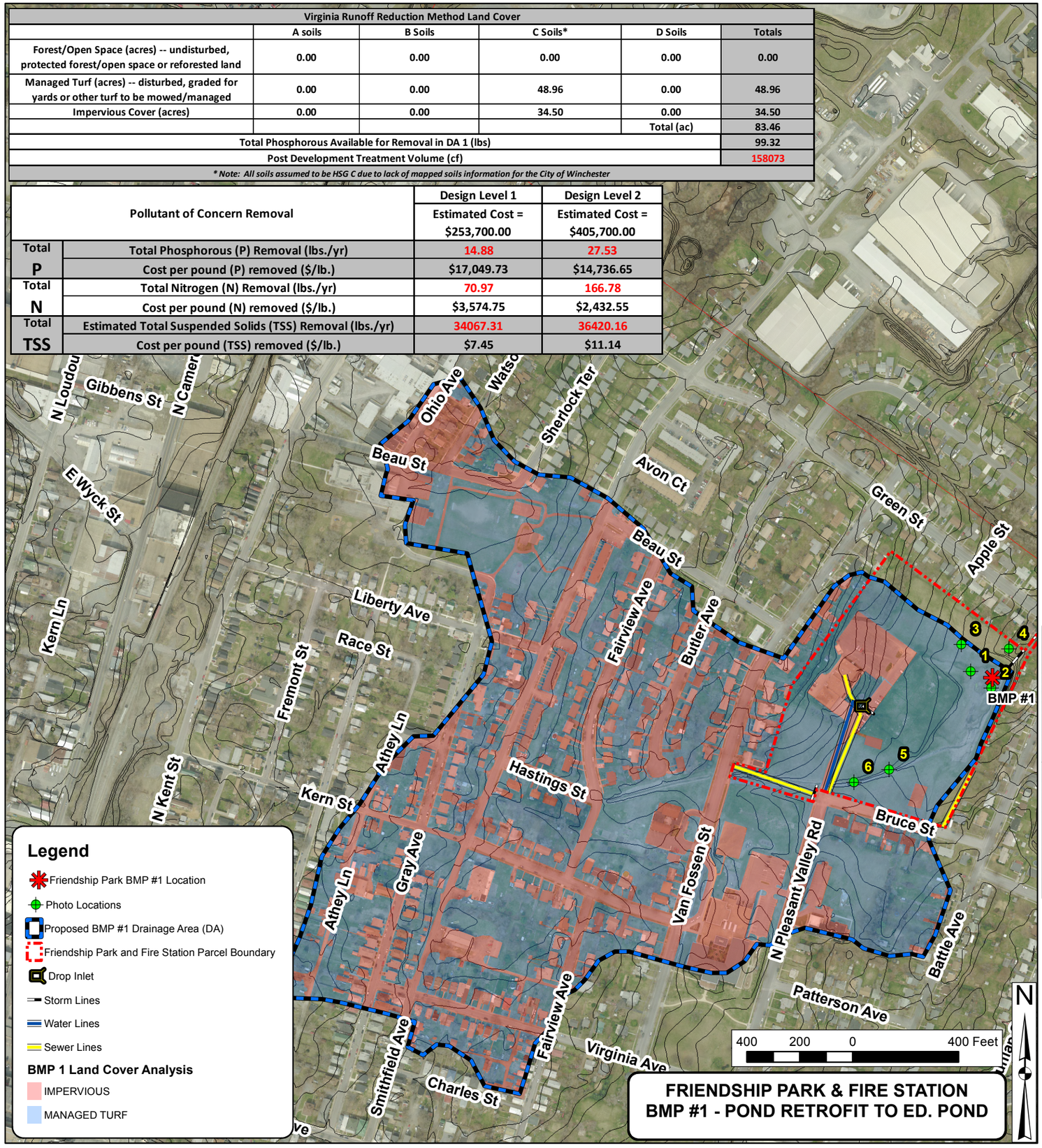


PHOTO #1: EX. POND / PROP. RETROFIT LOC.

PHOTO #2: EXISTING POND CONTROL STRUCTURE

PHOTO #3: EXISTING POND EMBANKMENT

PHOTO #4: EXISTING POND EM. SPILL / ACCESS RD.

PHOTO #5: POND INFLOW CHANNEL

PHOTO #6: POND INFLOW CHANNEL

BMP 1 - Dry Pond Retrofit to Extended Detention Pond	Lat: 39° 11' 25.52" N Long: 78° 8' 58.97" W HUC 12 CODE: 020700040902 Receiving Water: Unnamed Trib. To Abrams River Basin: Potomac River			
Location Features	Notes			Photo #
Proposed BMP Option(s): **Pond Retrofit to ED Pond**	Existing pond was designed as a flood control pond, with no W.Quality benefits			Photo #1, 2, 3
Utility Conflicts: **None**	There are no GIS mapped utilities within the proposed location of the possible Pond Retrofit			Photo #1
Slopes and Drainage Patterns: **Very Good**	All of the site, as well as several offsite acres drain to the existing pond.			Photo #5, 6
Access Constraints: **Minor**	Access can be provided either on-site with minimal constraints, or through the emergency spillway / access road to the pond.			Photo #1, 4
Land Use Estimate (% imp; % turf; % forest):	%IMP:	%TURF:	%FOREST:	
	41.34%	58.66%	0.00%	
New BMP or Retrofit Existing BMP: **Retrofit**				All photos
Potential Permitting Factors*: **Yes**	Dam Safety			Photo #3

Other Notes: It is assumed that the existing on-site pond has no Water-Quality Mechanisms, as such, 100% POC Removal Credit shall be provided for the Retrofit.

** Dam Safety Permits, Impacts to Wetlands or Streams, Floodplain Impacts, Impacts to Trees, Conservation Easements*

APPENDIX B.6 – NUTRIENT TRADING DOCUMENTATION

EXHIBIT 2-2
2019 Nitrogen Trading Ledger: Potomac-Shenandoah River Basin

POTOMAC Basin: Nitrogen Credit Ledger

Compliance Year:	2019	Credit Forecasts		Preliminary Use of Credits				Credit Exchange (Pounds)			
Facility Name	Delivered WLA	Expected Load	Expected Credits	In-Bubble Exchange	Private Exchange	WQIF-Held Credits	Expected Net Credits		Class A Sales	Class A* Purchases	Class B Sales**
								PRICE:	$ 0.08	$ 3.82	$ 0.02
The Exchange (group)	**2,612,604**	**1,932,970**	**679,634**	**-**	**(2,924)**	**(24,365)**	**652,345**		**496,157**	**(11,665)**	**167,853**
ACSA-Fishersville	4,873	1,900	2,973	(2,973)	-	-	-		-	-	-
ACSA-Greenville	1,424	512	912	(479)	-	-	433		433	-	-
ACSA-Harriston	1,025	209	816	(816)	-	-	-		-	-	-
ACSA-Middle River	8,284	3,877	4,407	-	-	-	4,407		4,407	-	-
ACSA-Mt. Sidney	854	1,346	(492)	492	-	-	-		-	-	-
ACSA-Stuarts Draft	2,436	606	1,830	-	-	-	1,830		1,830	-	-
ACSA-Vesper View	1,025	563	462	(462)	-	-	-		-	-	-
ACSA-Weyers Cave	1,462	5,700	(4,238)	4,238	-	-	-		-	-	-
Alexandria Renew Ent.	493,381	371,223	122,158	-	-	-	122,158		91,620	-	30,538
Arlington Co.	365,284	237,554	127,730	-	(2,625)	-	125,105		125,105	-	-
Berryville	5,373	3,377	1,996	-	-	-	1,996		1,900	-	96
Broadway Regional	5,601	4,719	882	-	-	-	882		-	-	882
Fairfax Co-Noman Cole	612,158	470,822	141,336	-	(25)	-	141,311		127,128	-	14,183
FCWSA-Vint Hill	579	244	335	-	-	-	335		-	-	335
Front Royal	29,725	25,359	4,366	-	-	-	4,366		4,000	-	366
FWSA-Opequon	31,681	17,183	14,498	-	-	-	14,498		-	-	14,498
FWSA-Parkins Mill	15,837	6,533	9,304	-	-	-	9,304		-	-	9,304
HRRSA-North River	55,746	38,191	17,555	-	-	-	17,555		15,000	-	2,555
KGCSA-Dahlgren S.D.	9,137	5,025	4,112	(427)	-	-	3,685		-	-	3,685
KGCSA-Fairview Beach	1,827	731	1,096	-	-	-	1,096		-	-	1,096
KGCSA-Purkins Corner	1,096	1,523	(427)	427	-	-	-		-	-	-
Leesburg	97,458	32,898	64,560	-	(274)	(24,365)	39,921		-	-	39,921
Loudoun Water- Broad Run	119,264	48,953	70,311	-	-	-	70,311		57,884	-	12,427
Luray	8,187	2,533	5,654	-	-	-	5,654		5,654	-	-
Massanutten PSC	6,030	2,975	3,055	-	-	-	3,055		-	-	3,055
Merck	4,824	14,473	(9,649)	-	-	-	(9,649)		-	(9,649)	-
MillerCoors LLC	18,091	18,091	-	-	-	-	-		-	-	-
Mt. Jackson	2,900	2,237	663	-	-	-	663		-	-	663
Purcellville	13,157	7,894	5,263	-	-	-	5,263		2,632	-	2,631
PWCSA-HL Mooney	219,280	178,165	41,115	-	-	-	41,115		28,781	-	12,334
Stafford Co-Aquia	73,093	67,063	6,030	-	-	-	6,030		4,462	-	1,568
Stoney Creek	2,891	2,814	77	-	-	-	77		-	-	77
Strasburg	5,134	6,548	(1,414)	-	-	-	(1,414)		-	(2,016)	602
UOSA	302,607	300,006	2,601	-	-	-	2,601		-	-	2,601
VA Am. Water PW Sec. 1	42,029	23,984	18,045	-	-	-	18,045		10,827	-	7,218
VA Am. Water PW Sec. 8	42,029	23,984	18,045	-	-	-	18,045		10,827	-	7,218
Waynesboro	6,822	3,155	3,667	-	-	-	3,667		3,667	-	-
Purchase by Eastern Shore	-	-	-	-	-	-	-		-	-	-

**** For this Compliance Year, 0% of all Class A Credit Purchases are expected to be satisfied using Class B Credits.***

*** Class A and Class B Credit Sales are estimates only; actual Credits generated—and the resulting sales prices—may vary from estimates based on Delivered Loads in the Compliance Year.*

Owner Bubble: Frederick-Winchester Service Authority

The facilities listed below have received an aggregated mass load limit pursuant to 9 VAC 25-820-70, Part 1.B.2., which is also referred to as an "owner bubble". Accordingly, compliance is determined solely on an aggregate basis rather than by comparison of individual facility loads with respective individual WLAs.

The "Credit Transferred within Bubble" section of each table forecasts the use of Credits within the owner bubble during each Compliance Year, and must necessarily sum to zero. The specific Credit transfers shown in this table are provided for internal planning purposes only and, accordingly, are not binding and may change based on the actual performance of individual facilities within the bubble.

Expected Net Credits for an owner bubble may be either positive or negative. If Expected Net Credits is positive, the owner may pledge a percentage of such Credits to the Exchange. If Expected Net Credits is negative, Net Expected Credits identifies the number of Credits that must be purchased to comply with the aggregate Delivered WLA of the bubble.

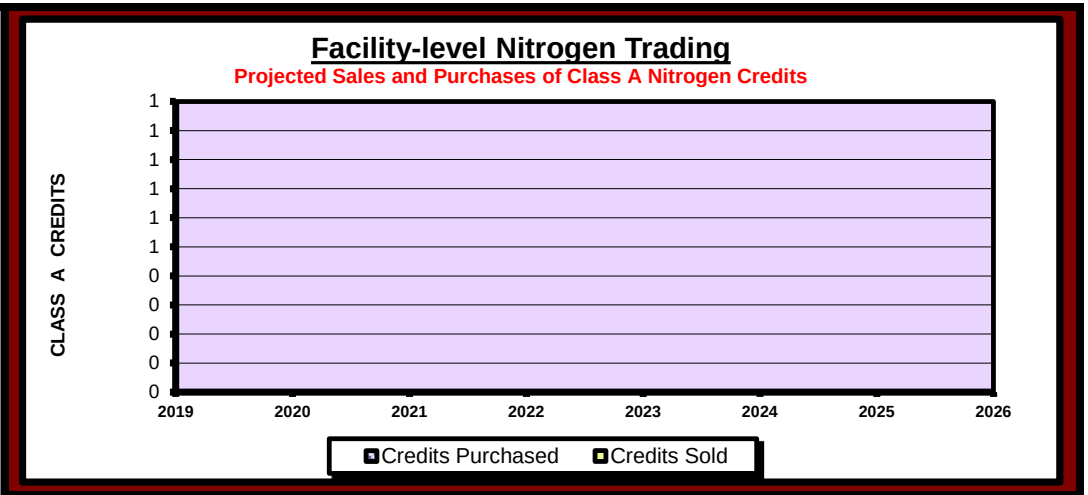
NITROGEN Credits	Exchange 5-year Planning Period					Future Projections		
Credits Transferred within Bubble	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**
Opequon	-	-	-	-	-	-	-	-
Parkins Mill	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-
TOTAL (must sum to 0)	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Credits Available outside Bubble	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**
Opequon	14,498	13,722	10,546	11,678	11,199	10,799	10,431	10,000
Parkins Mill	9,304	8,473	6,363	5,884	5,596	5,212	5,020	4,732
	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-
Expected Net Credits	**23,802**	**22,195**	**16,909**	**17,562**	**16,795**	**16,011**	**15,451**	**14,732**
Class A Sales (Purchases)	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Expected Class B Credits	*23,802*	*22,195*	*16,909*	*17,562*	*16,795*	*16,011*	*15,451*	*14,732*
WQIF-Held Credits	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*

PHOSPHORUS Credits	Exchange 5-year Planning Period					Future Projections		
Credits Transferred within Bubble	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**
Opequon	-	-	-	-	-	-	-	-
Parkins Mill	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-
TOTAL (must sum to 0)	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Credits Available outside Bubble	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**
Opequon	3,031	2,887	2,405	2,298	2,190	2,101	2,019	1,922
Parkins Mill	1,110	938	708	601	537	451	408	343
	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-
Expected Net Credits	**4,141**	**3,825**	**3,113**	**2,899**	**2,727**	**2,552**	**2,427**	**2,265**
Class A Sales (Purchases)	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Expected Class B Credits	*4,141*	*3,825*	*3,113*	*2,899*	*2,727*	*2,552*	*2,427*	*2,265*
WQIF-Held Credits	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*

NITROGEN FACILITY SUMMARY

FWSA-Opequon

POTOMAC Trading Basin

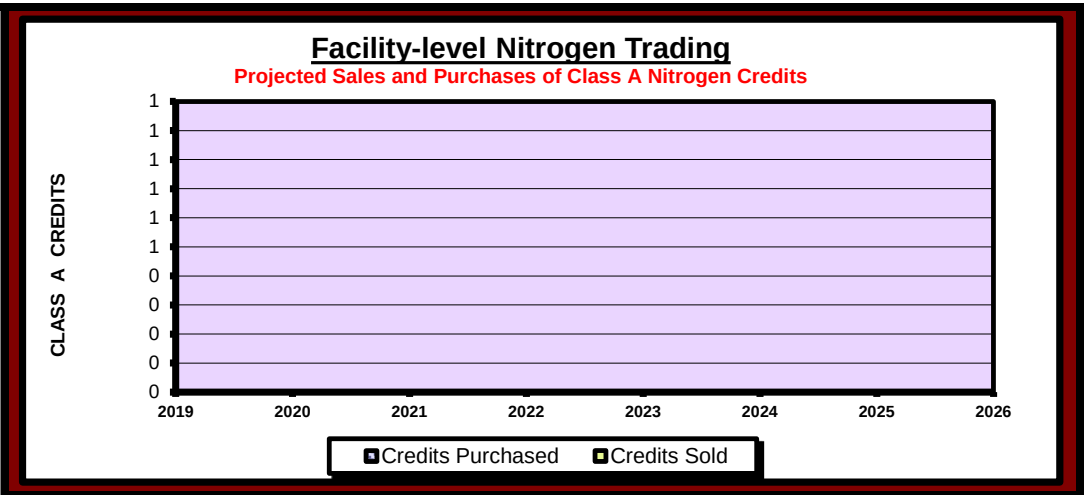


Loading & Credit Summary	2019	2020	2021	2022	2023	2024	2025	2026
	Planning Period					*Future Estimates (non-binding)*		
Design Flow (mgd)	12.60	12.60	12.60	12.60	12.60	12.60	12.60	12.60
Projected Flow (mgd)	7.75	8.10	8.40	8.70	9.00	9.25	9.48	9.75
Projected Avg. Annual Concentration (mg/L)	2.80	2.80	2.80	2.50	2.50	2.50	2.50	2.50
Discharged Load (end of pipe)	66,089	69,073	71,632	66,241	68,525	70,429	72,180	74,236
Delivery Factor	0.26	0.26	0.21	0.21	0.21	0.21	0.21	0.21
Expected Load	17,183	17,959	15,043	13,911	14,390	14,790	15,158	15,589
Delivered WLA	31,681	31,681	25,589	25,589	25,589	25,589	25,589	25,589
Expected Credits (delivered)	14,498	13,722	10,546	11,678	11,199	10,799	10,431	10,000
Transfers In (Out) within Owner Bubble	0	0	0	0	0	0	0	0
Transfers In (Out) from Private Exchange	0	0	0	0	0	0	0	0
WQIF-Held Credits	0	0	0	0	0	0	0	0
Expected Net Credits	**14,498**	**13,722**	**10,546**	**11,678**	**11,199**	**10,799**	**10,431**	**10,000**
Class A Credit Sales (Purchases)	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Expected Class B Credits	**14,498**	**13,722**	**10,546**	**11,678**	**11,199**	**10,799**	**10,431**	**10,000**

NITROGEN FACILITY SUMMARY

FWSA-Parkins Mill

POTOMAC Trading Basin



Loading & Credit Summary	2019	2020	2021	2022	2023	2024	2025	2026
	Planning Period					*Future Estimates (non-binding)*		
Design Flow (mgd)	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00
Projected Flow (mgd)	2.75	3.10	3.35	3.60	3.75	3.95	4.05	4.20
Projected Avg. Annual Concentration (mg/L)	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00
Discharged Load (end of pipe)	25,126	28,324	30,608	32,892	34,263	36,090	37,004	38,374
Delivery Factor	0.26	0.26	0.21	0.21	0.21	0.21	0.21	0.21
Expected Load	6,533	7,364	6,428	6,907	7,195	7,579	7,771	8,059
Delivered WLA	15,837	15,837	12,791	12,791	12,791	12,791	12,791	12,791
Expected Credits (delivered)	9,304	8,473	6,363	5,884	5,596	5,212	5,020	4,732
Transfers In (Out) within Owner Bubble	0	0	0	0	0	0	0	0
Transfers In (Out) from Private Exchange	0	0	0	0	0	0	0	0
WQIF-Held Credits	0	0	0	0	0	0	0	0
Expected Net Credits	**9,304**	**8,473**	**6,363**	**5,884**	**5,596**	**5,212**	**5,020**	**4,732**
Class A Credit Sales (Purchases)	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Expected Class B Credits	**9,304**	**8,473**	**6,363**	**5,884**	**5,596**	**5,212**	**5,020**	**4,732**