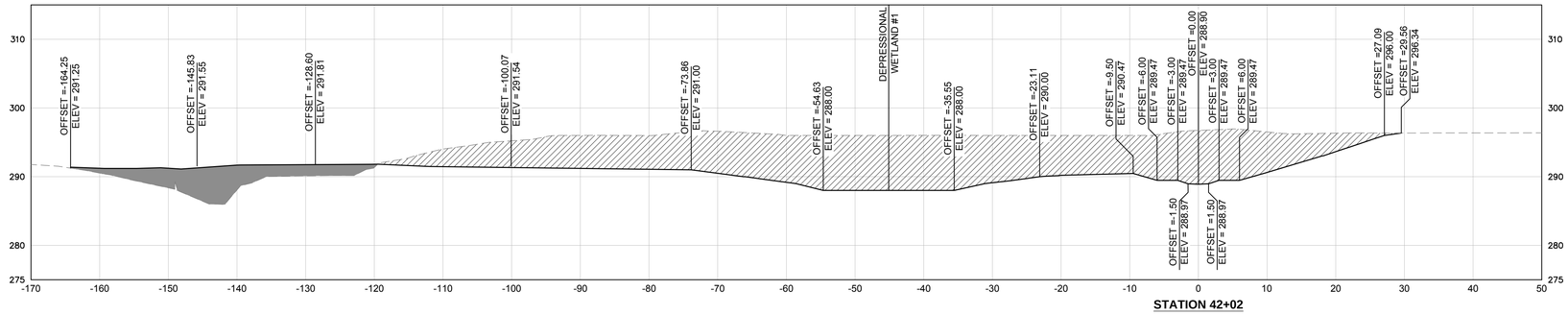
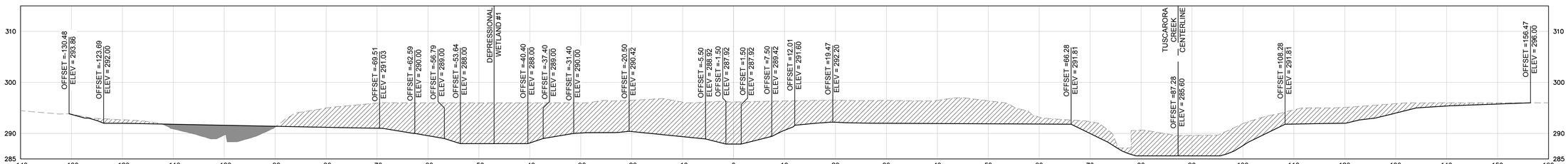


STATION 42+02



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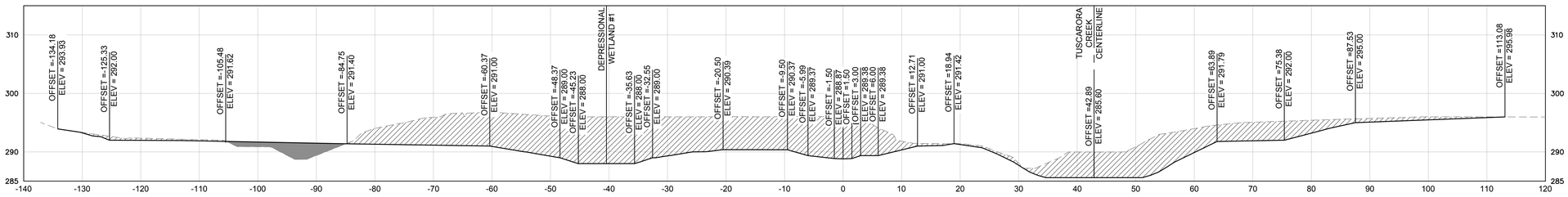

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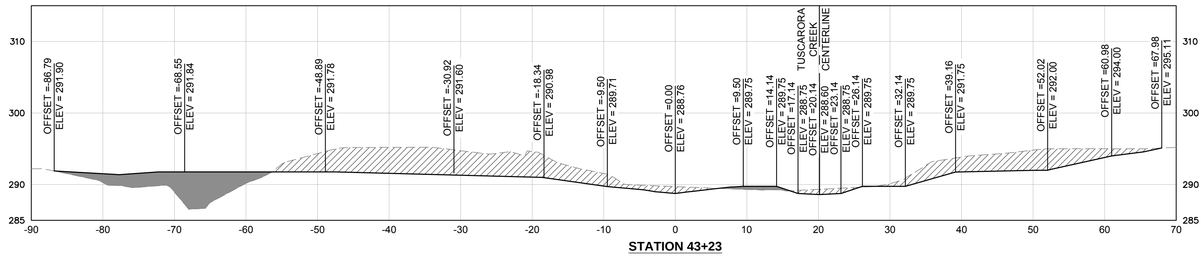


STATION 43+23

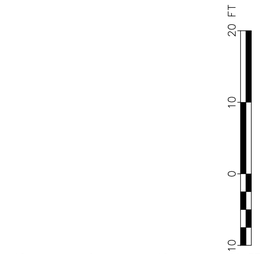
LEGEND

CUT

FILL

NOTES:

1. CROSS SECTIONS ARE DEPICTED LOOKING IN THE DOWNSTREAM DIRECTION.
2. CROSS SECTION LOCATIONS ARE IDENTIFIED ON THE PLAN AND PROFILE SHEETS WITH THE CORRESPONDING STATION NUMBER BASED ON THE RESPECTIVE STREAM ALIGNMENT.
3. STATION NUMBERS ARE SHOWN ALONG THE BASELINE ON THE PLAN AND PROFILE SHEETS.
4. COMPACT FILL TO 90% DRY-WEIGHT DENSITY PER ASTM D698-12.
5. AS THE TAIL OF RIFFLE (SECTIONS TAKEN AT TAIL OF RIFFLE INTERFACE WITH CROSS VANES) APPROACHES THE PROPOSED CROSS VANE, CONTRACTOR SHALL CONSTRUCT THE INNER BERM FEATURE SUCH THAT IT GRADUALLY REDUCES AND FANS OUT / TAPERS INTO THE BACKSIDE OF THE VANE ARM AND DOES NOT IMPEDE OR BLOCK THE FLOW OF WATER THROUGH THE THROAT OF THE CROSS VANE.



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SYM	DESCRIPTION	DATE	APPR

TOWN OF LEESBURG ESTABLISHED 1758 VIRGINIA

TUSCARORA CREEK FLOOD MITIGATION

100% CONSTRUCTION DOCUMENTS

TOWN OF LEESBURG, VIRGINIA

CATOCTIN ELECTION DISTRICT

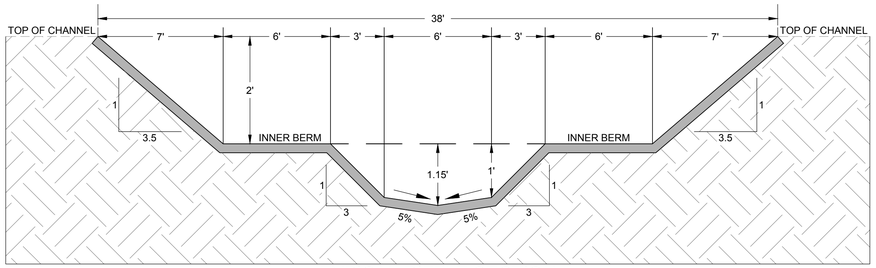
COMMONWEALTH OF VIRGINIA
MATTHEW TROY BIGGS
Lic. No. 041116
9.18.18
PROFESSIONAL ENGINEER
SEAL

DESIGN BY:	MTB
DRAWN BY:	MJH
REVIEWED BY:	MTB & MB
PROJECT MANAGER:	TWC
AMEC FOSTER WHEELER PROJECT #:	565500008
CONTRACT #:	300810-FY15-22
DATE:	2018-09-17
SHEET SIZE:	D
SCALE:	AS SHOWN

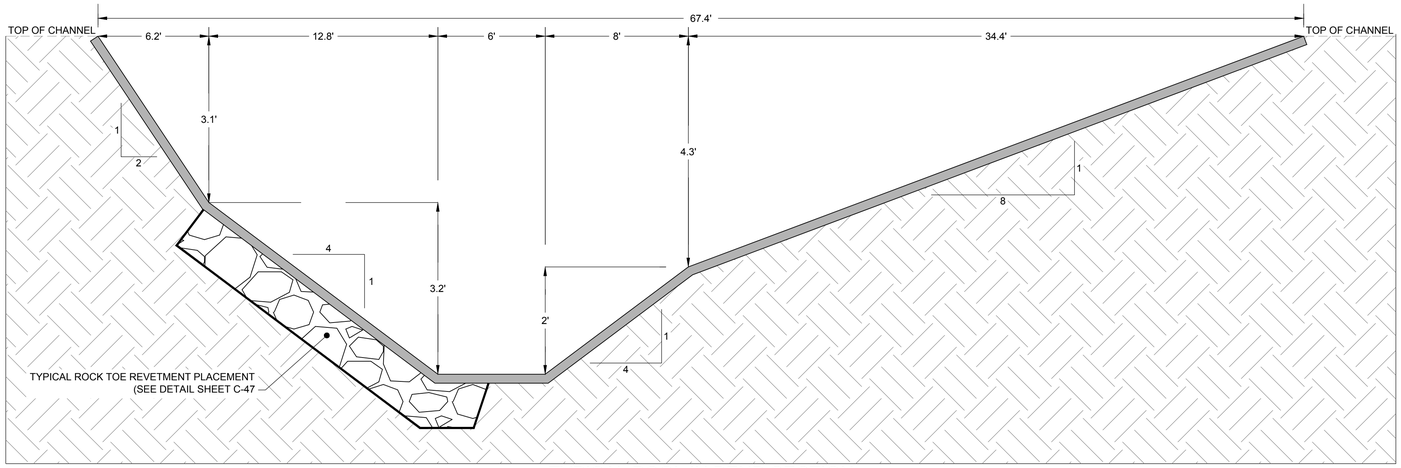
SHEET TITLE:

TOWN BRANCH CROSS SECTIONS

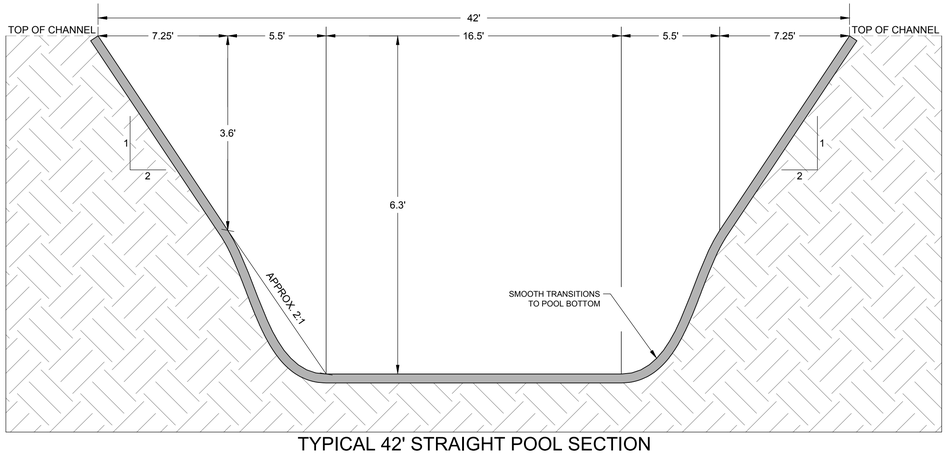
SHEET C-44 OF 91



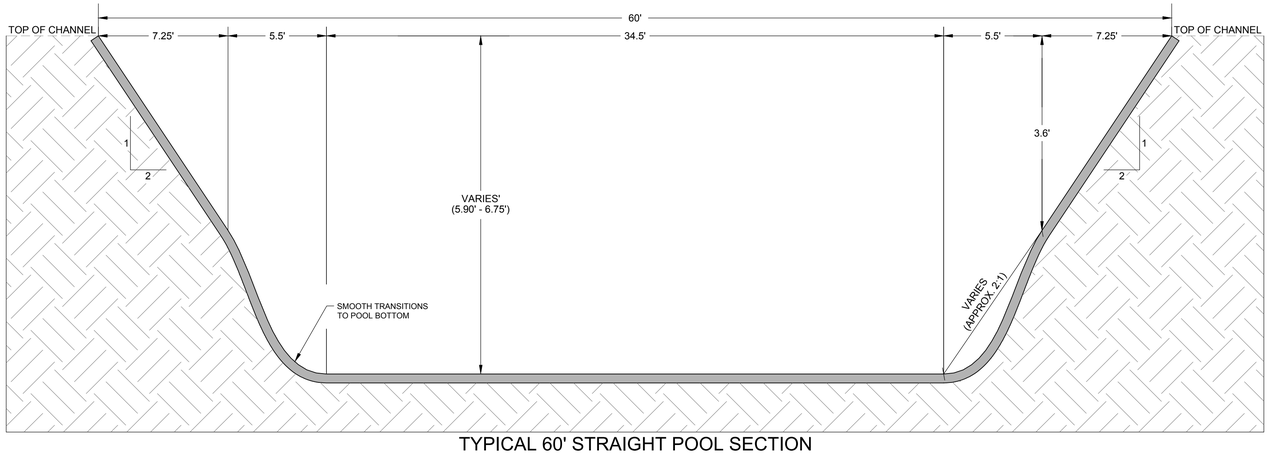
TYPICAL RIFFLE SECTION



TYPICAL POOL IN BEND SECTION



TYPICAL 42' STRAIGHT POOL SECTION



TYPICAL 60' STRAIGHT POOL SECTION

NOTES:
THESE ARE TYPICAL SECTIONS. THERE IS VARIABILITY OF THE CHANNEL THROUGHOUT THE PROFILE LENGTH RESULTING FROM TRANSITIONS AND THE TOP OF BANK WHICH IS A CONTINUALLY SLOPING SURFACE.

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SYM	DESCRIPTION	DATE	APPR

TOWN OF LEESBURG ESTABLISHED 1758 VIRGINIA

TUSCARORA CREEK FLOOD MITIGATION
100% CONSTRUCTION DOCUMENTS
TOWN OF LEESBURG, VIRGINIA
CATOCTIN ELECTION DISTRICT

COMMONWEALTH OF VIRGINIA
MATTHEW TROY HIGGS
Lic. No. 041116
9.18.18
PROFESSIONAL ENGINEER
SEAL

DESIGN BY: MTB	DRAWN BY: MJH
REVIEWED BY: MTB & MB	
PROJECT MANAGER: TWC	
AMEC FOSTER WHEELER PROJECT #: 565500008	
CONTRACT #: 300810-FY15-22	
DATE: 2018-09-17	SHEET SIZE: D
SCALE: AS SHOWN	

SHEET TITLE:
TYPICAL STREAM SECTIONS - TUSCARORA CREEK

SHEET C-45 OF 91

CROSS VANE STRUCTURE TABLE

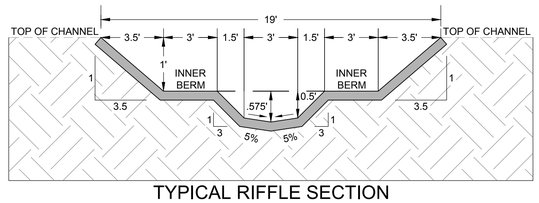
Structure	VaneType	Point	Stream	Station	Offset	Elevation	Description	Slope	
CV1	Offset	A	Tuscarora	10+00.00	0.00	290.50	Center of Throat	-	
CV1		B	Tuscarora	10+01.00	9.00' R	290.65	Right Edge of Throat	2%	
CV1		C	Tuscarora	10+01.00	9.00' L	290.65	Left Edge of Throat	2%	
CV1		D	Tuscarora	10+37.03	21.00' R	292.81	Right Vane	5%	
CV1		E	Tuscarora	10+18.47	21.00' L	291.03	Left Vane	2%	
CV2	Offset	A	Tuscarora	12+42.04	0.00	289.23	Center of Throat	-	
CV2		B	Tuscarora	12+43.04	9.00' R	289.38	Right Edge of Throat	2%	
CV2		C	Tuscarora	12+43.04	9.00' L	289.38	Left Edge of Throat	2%	
CV2		D	Tuscarora	12+55.04	20.64' R	289.76	Right Vane	2%	♦
CV2		E	Tuscarora	12+83.43	21.00' L	291.77	Left Vane	5%	
CV3	Offset	A	Tuscarora	13+89.28	0.00	288.80	Center of Throat	-	
CV3		B	Tuscarora	13+90.28	9.00' R	288.95	Right Edge of Throat	2%	
CV3		C	Tuscarora	13+90.28	9.00' L	288.95	Left Edge of Throat	2%	
CV3		D	Tuscarora	14+30.67	21.00' R	290.39	Right Vane	3%	
CV3		E	Tuscarora	14+07.75	21.00' L	289.33	Left Vane	2%	
CV4	Regular	A	Tuscarora	15+10.36	0.00	288.60	Center of Throat	-	
CV4		B	Tuscarora	15+11.20	9.00' R	288.75	Right Edge of Throat	2%	
CV4		C	Tuscarora	15+11.20	9.00' L	288.75	Left Edge of Throat	2%	
CV4		D	Tuscarora	15+44.17	21.00' R	290.50	Right Vane	5%	
CV4		E	Tuscarora	15+44.17	21.00' L	288.75	Left Vane	0%	♦ PAST CONFLUENCE WITH TOWN BRANCH, VANE TO SLOPE UP @ 0.5%.
CV5	Regular	A	Tuscarora	16+95.85	0.00	288.50	Center of Throat	-	
CV5		B	Tuscarora	16+96.85	9.00' R	288.65	Right Edge of Throat	2%	
CV5		C	Tuscarora	16+96.85	9.00' L	288.65	Left Edge of Throat	2%	
CV5		D	Tuscarora	17+29.82	21.00' R	290.40	Right Vane	5%	♦
CV5		E	Tuscarora	17+29.82	21.00' L	290.40	Left Vane	5%	
CV6	Offset	A	Tuscarora	18+44.24	0.00	288.30	Center of Throat	-	
CV6		B	Tuscarora	18+45.24	9.00' R	288.45	Right Edge of Throat	2%	
CV6		C	Tuscarora	18+45.24	9.00 'L	288.45	Left Edge of Throat	2%	
CV6		D	Tuscarora	18+78.41	21.00' R	290.45	Right Vane	5%	
CV6		E	Tuscarora	18+62.71	21.00' L	288.83	Left Vane	2%	
CV7	Offset	A	Tuscarora	20+16.99	0.00	287.91	Center of Throat	-	
CV7		B	Tuscarora	20+17.99	9.00' R	288.06	Right Edge of Throat	2%	
CV7		C	Tuscarora	20+17.99	9.00' L	288.06	Left Edge of Throat	2%	
CV7		D	Tuscarora	20+35.45	21.00'R	288.44	Right Vane	2%	
CV7		E	Tuscarora	20+51.16	21.00' L	290.06	Left Vane	5%	
CV8	Regular	A	Tuscarora	22+04.11	0.00	287.57	Center of Throat	-	
CV8		B	Tuscarora	22+05.11	9.00' R	287.72	Right Edge of Throat	2%	
CV8		C	Tuscarora	22+05.11	9.00' L	287.72	Left Edge of Throat	2%	
CV8		D	Tuscarora	22+38.08	21.00' R	289.47	Right Vane	5%	
CV8		E	Tuscarora	22+38.08	21.00' L	289.47	Left Vane	5%	
CV9	Regular	A	Tuscarora	24+08.00	0.00	286.20	Center of Throat	-	
CV9		B	Tuscarora	24+09.00	9.00' R	286.35	Right Edge of Throat	2%	
CV9		C	Tuscarora	24+09.00	9.00' L	286.35	Left Edge of Throat	2%	
CV9		D	Tuscarora	24+41.97	21.00' R	288.11	Right Vane	5%	
CV9		E	Tuscarora	24+41.97	21.00' L	288.11	Left Vane	5%	♦
CV10	Regular	A	Tuscarora	26+32.85	0.00	284.37	Center of Throat	-	
CV10		B	Tuscarora	26+33.85	9.00' R	284.52	Right Edge of Throat	2%	
CV10		C	Tuscarora	26+33.85	9.00' L	284.52	Left Edge of Throat	2%	
CV10		D	Tuscarora	26+66.82	21.00' R	286.27	Right Vane	5%	
CV10		E	Tuscarora	26+66.82	21.00' L	286.27	Left Vane	5%	
CV11	Regular	A	Tuscarora	27+92.91	0.00	284.15	Center of Throat	-	
CV11		B	Tuscarora	27+93.91	12.00' R	284.30	Right Edge of Throat	2%	
CV11		C	Tuscarora	27+93.91	12.00' L	284.30	Left Edge of Throat	2%	
CV11		D	Tuscarora	28+43.36	30.00' R	285.88	Right Vane	3%	
CV11		E	Tuscarora	28+43.36	30.00' L	285.73	Left Vane	3%	♦
CV12	Regular	A	Tuscarora	28+72.91	0.00	283.02	Center of Throat	-	
CV12		B	Tuscarora	28+73.91	12.00' R	283.17	Right Edge of Throat	2%	
CV12		C	Tuscarora	28+73.91	12.00' L	283.17	Left Edge of Throat	2%	
CV12		D	Tuscarora	29+23.56	30.00' R	284.22	Right Vane	2%	
CV12		E	Tuscarora	29+23.56	30.00' L	284.75	Left Vane	3%	
CV13	Regular	A	Tuscarora	29+52.19	0.00	281.90	Center of Throat	-	
CV13		B	Tuscarora	29+53.19	12.00' R	282.05	Right Edge of Throat	2%	
CV13		C	Tuscarora	29+53.19	12.00' L	282.05	Left Edge of Throat	2%	
CV13		D	Tuscarora	30+02.48	30.00' R	284.68	Right Vane	5%	♦
CV13		E	Tuscarora	30+02.48	30.00' L	283.63	Left Vane	3%	
CV14	Offset	A	Town Branch	40+00.00	0.00	289.80	Center of Throat	-	
CV14		B	Town Branch	40+01.00	6.00' R	289.875	Right Edge of Throat	1%	
CV14		C	Town Branch	40+01.00	6.00' L	289.875	Left Edge of Throat	1%	
CV14		D	Town Branch	40+11.95	15.00' R	290.14	Right Vane	2%	
CV14		E	Town Branch	40+26.31	15.00' L	291.34	Left Vane	5%	
CV15	Regular	A	Town Branch	41+19.41	0.00	289.40	Center of Throat	-	
CV15		B	Town Branch	41+20.41	4.50' R	289.48	Right Edge of Throat	1%	
CV15		C	Town Branch	41+20.41	4.50' L	289.48	Left Edge of Throat	1%	
CV15		D	Town Branch	41+42.39	12.50' R	289.94	Right Vane	2%	
CV15		E	Town Branch	41+42.39	12.50' L	289.94	Left Vane	2%	
CV16	Offset	A	Town Branch	42+01.68	0.00	288.90	Center of Throat	-	
CV16		B	Town Branch	42+02.68	6.00' R	288.98	Right Edge of Throat	1%	
CV16		C	Town Branch	42+02.68	6.00' L	288.98	Left Edge of Throat	1%	
CV16		D	Town Branch	42+29.30	15.00' R	290.63	Right Vane	5%	
CV16		E	Town Branch	42+19.15	15.00' L	289.29	Left Vane	2%	

NOTE:
SLOPES SHOWN IN THE TABLE ARE DESIGN SLOPES. HOWEVER, VALUES MAY VARY DUE TO VARIABILITY IN THE CONSTRUCTED STRUCTURES. VANE ARM SLOPES MAY VARY BETWEEN 3-5% VERTICALLY AND THE ANGLE OF THE VANE ARM MAY VARY BETWEEN 20-30° HORIZONTALLY WITH THE BANK. THIS TABLE IS BASED ON A VANE ARM ANGLES OF 20° (OUTSIDE) AND 45° (INSIDE) AND AN ARM SLOPE AS SPECIFIED IN THE TABLE.

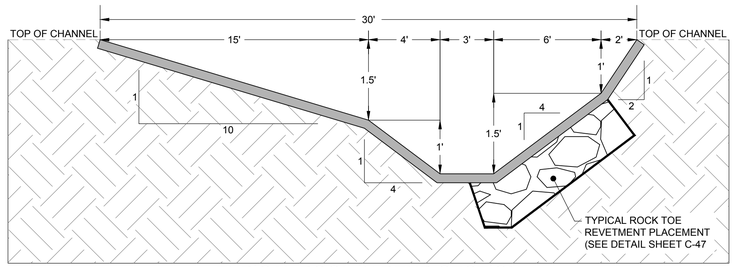
♦ ENSURE TRIBUTARY CHANNEL FLOWS OVER VANE ARM AND INTO MAIN CHANNEL OF TUSCARORA CREEK.

ROCK VANE STRUCTURE TABLE

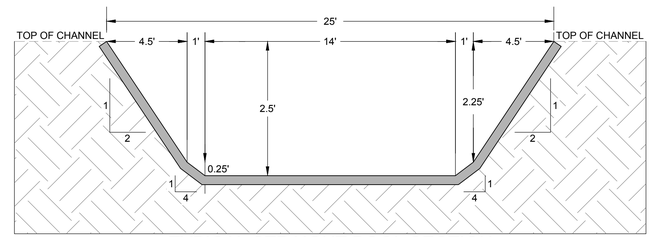
Structure	VaneType	Point	Stream	Station	Offset	Elevation	Description	Slope
RV1	Rock	A	Tuscarora	10+86.05	12.50' R	291.90	Rock Invert	-
RV1		B	Tuscarora	11+03.43	22.00' R	292.58	Bank Tie In	3%
RV2	Rock	A	Tuscarora	13+25.85	12.50' L	289.92	Rock Invert	-
RV2		B	Tuscarora	13+43.24	22.00' L	290.60	Bank Tie In	3%
RV3	Rock	A	Tuscarora	14+42.36	12.50' R	287.47	Rock Invert	-
RV3		B	Tuscarora	14+58.82	22.00' R	288.04	Bank Tie In	3%
RV4	Rock	A	Tuscarora	19+09.86	12.50' R	288.49	Rock Invert	-
RV4		B	Tuscarora	19+27.24	22.00' R	289.17	Bank Tie In	3%
RV5	Rock	A	Tuscarora	21+27.81	12.50' L	288.32	Rock Invert	-
RV5		B	Tuscarora	21+45.20	22.00' L	289.00	Bank Tie In	3%
RV6	Rock	A	Tuscarora	27+43.76	12.50' L	284.48	Rock Invert	-
RV6		B	Tuscarora	27+60.62	22.00' L	285.11	Bank Tie In	3%
RV7	Rock	A	Town Branch	40+79.01	4.75' L	290.28	Rock Invert	-
RV7		B	Town Branch	40+95.45	9.50' L	290.58	Bank Tie In	3%
RV8	Rock	A	Town Branch	42+70.77	4.75' R	288.74	Rock Invert	-
RV8		B	Town Branch	42+85.99	9.50' R	289.08	Bank Tie In	3%



TYPICAL RIFFLE SECTION

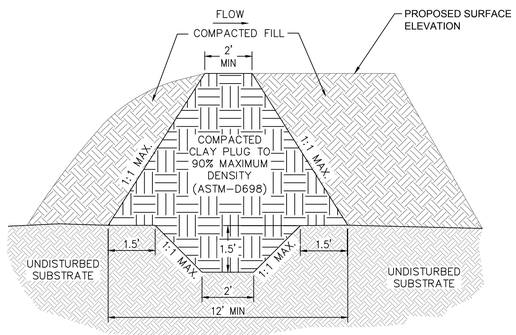


TYPICAL POOL IN BEND SECTION



TYPICAL STRAIGHT POOL SECTION

NOTE:
THESE ARE TYPICAL SECTIONS, THERE IS VARIABILITY OF THE CHANNEL THROUGHOUT THE PROFILE LENGTH RESULTING FROM TRANSITIONS AND THE TOP OF BANK WHICH IS A CONTINUALLY SLOPING SURFACE.



CLAY PLUG DETAIL

N.T.S.

COIR MATTING AND GEOTEXTILE

*** COIR MATTING SHALL BE OPEN WEAVE WITH A MINIMUM WEIGHT OF 700 GRAMS PER SQUARE METER, SUCH AS BIOD-MAT 70 (BY ROLANKA INTERNATIONAL, INC.) OR AN EQUIVALENT APPROVED BY THE TOWN OF LEESBURG. ***

*** FILTER FABRIC USED FOR STRUCTURES SHALL BE NONWOVEN, NEEDLE PUNCHED GEOTEXTILE 180 LBS. (TENSILE STRENGTH) SUCH AS US 180NW (BY US FABRICS, INC.) OR AN EQUIVALENT APPROVED BY THE TOWN OF LEESBURG. ***

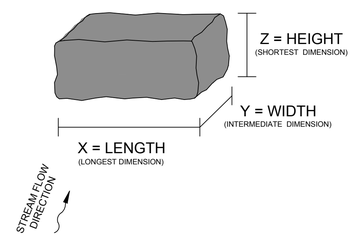
STRUCTURE STONE SIZE TABLE

STRUCTURE TYPE	DIMENSION (FT.) X	Y	Z
HEADER STONE	4'	3'	2'
FOOTER STONE	4'	3'	2'
SPLASH ROCKS	3'	2'	1.5'
FLOOR ROCKS	2'	2'	1'

*** 3' DS OF FOOTER BOULDERS, SPLASH ROCKS SHALL BE PLACED. FIRST HALF OF POOL BED BELOW CROSS VANES SHALL BE LINED WITH FLOOR ROCKS. ***

*** "X" AND "Y" DIMENSION CAN RANGE FROM 3.5' – 4' AND 2.5' – 3', RESPECTIVELY, FOR HEADER STONES, FOOTER STONES, WITH APPROVAL OF THE TOWN OF LEESBURG. NO "Z" DIMENSION SHALL BE LESS THAN 1.5' (EXCEPT FOR FLOOR ROCKS) IN THE LOWER SECTION OF THE PROJECT REACH (STATION 20+00 ONWARD) OR AT THE BRIDGE SECTION. DIMENSIONS IN THESE AREAS SHALL NOT BE SMALLER THAN THE DIMENSIONS QUOTED IN THE STRUCTURE STONE SIZE TABLE ABOVE. ***

*** FOOTER STONES SHALL HAVE A MINIMUM OF ONE (1) CONTACT POINT WITH HEADER STONES. FOOTER STONES MAY BE MORE ROUNDED THAN HEADER STONES. FOR VANE ARMS, MULTIPLE FOOTERS MAY BE REQUIRED FOR HEADER STONES DEPENDING UPON HEADER STONE SIZE.***



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SYM	DESCRIPTION	DATE	APPR

TOWN OF LEESBURG ESTABLISHED 1758 VIRGINIA

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TOWN OF LEESBURG

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CONTRACT #: 300810-FY15-22	
DATE: 2018-09-17	SHEET SIZE: D
SCALE: AS SHOWN	

SHEET TITLE:
TYPICAL STREAM SECTIONS - TOWN BRANCH & STONE DETAILS

SHEET C-46 OF 91

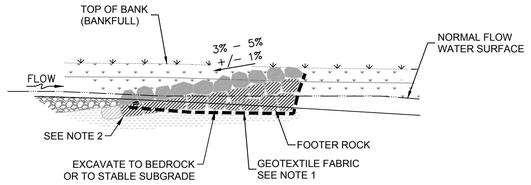
PLOTTED BY:HEPP, MICHAEL SHEET SET:Tuscarora Creek LAYOUT:C-46 TYPICAL STREAM SECTIONS – TOWN BRANCH & STONE DETAILS September 17, 2018 07:40:30pm Q:\565500008_TUSCARORA CREEK-100%\PLANSHEETS\VX – STRUCTURE DETAILS.DWG

ROCK VANE DETAIL - PLAN VIEW

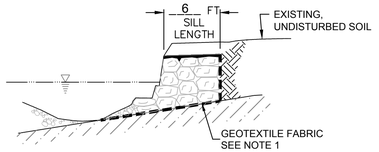
NTS

TYPICAL USES:

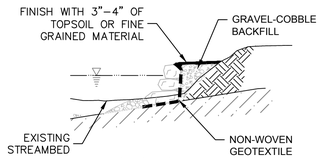
- RE-DIRECTION OF FLOW AWAY FROM LOCALIZED AREA OF BANK EROSION WHERE A FULL J-HOOK VANE IS NOT PRACTICAL.
- IN SHARP STREAM BENDS WHERE THERE IS NOT ENOUGH SPACE FOR A J-HOOK VANE.
- LOWER COST ALTERNATIVE TO FULL J-HOOK STRUCTURE. HOWEVER, A J-HOOK VANE PROVIDES MORE BENEFITS.



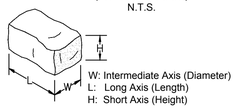
PROFILE
(ALONG ARM)
N.T.S.



SECTION A
(AT CUTOFF SILL)
N.T.S.



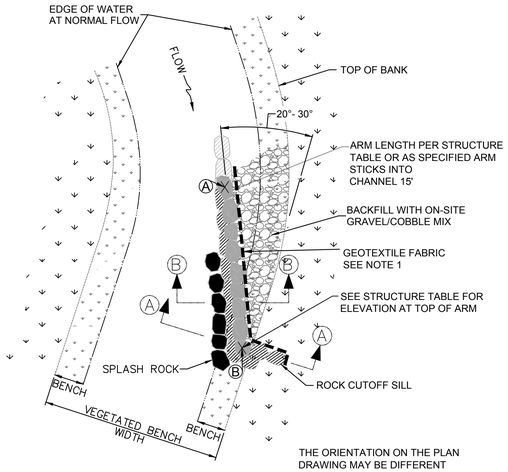
SECTION B
(AT VANE ARM)
N.T.S.



W: Intermediate Axis (Diameter)
L: Long Axis (Length)
H: Short Axis (Height)

STRUCTURE ROCK SIZE				
	Representative Size			
	W or Dia (Feet)	Length (Feet)	Height (Feet)	Weight (Ton)
Minimum	3	4	2	2

Assumed Rock Density: 165 LB/CU-FT



PLAN VIEW
N.T.S.

THE ORIENTATION ON THE PLAN DRAWING MAY BE DIFFERENT AND MAY NOT BE IN A BEND. THE LOW END OF THE ARM POINTS UPSTREAM.

NOTES:

1. USE 180 LB, NON-WOVEN GEOTEXTILE FABRIC. PLACE GEOTEXTILE BEHIND THE VANE ARM (UPSTREAM SIDE), DRAPED FROM TOP OF ROCK STRUCTURE TO BOTTOM OF FOOTER ROCK(S) AND EXTEND A MINIMUM OF HALF THE TRENCH BOTTOM WIDTH. TRIM EXCESS OR VISIBLE FABRIC. EXTEND GEOTEXTILE ALONG HALF OF THE SILL LENGTH.
2. ON BEDROCK STREAM BEDS, EXCAVATE POOL BEFORE INSTALLING STRUCTURE. EXCAVATION AND BACKFILL WORK RELATED TO THIS

ROCK NOTES:

A. PROVIDE A RANGE OF ROCK SIZES FOR FLEXIBILITY TO MEET DESIGN GRADES & LINES. AT LEAST 80% OF THE ROCK SHALL MEET OR EXCEED THE AVERAGE SIZE ROCK REQUIREMENTS; UP TO 15% OF ROCK MAY BE IN THE MINIMUM TO AVERAGE SIZE CATEGORY; AND 5% MAY BE SMALLER FRAGMENTS FOR CHINKING USE.
B. SMALLER HEIGHT ROCKS ARE REQUIRED TO TAPER STRUCTURES AT APEX ON BEDROCK. FOOTER ROCKS SHALL MEET STRUCTURE ROCK REQUIREMENTS.
C. FOR MAIN STRUCTURE ROCK, SILL, AND FOOTER ROCK, THE ROCK SOURCE SHALL BE FROM AN APPROVED VDOT PRODUCER AND LOCATION OR FROM A TOWN APPROVED SOURCE.
D. ON-SITE COBBLE AND BOULDERS MAY BE USED TO FILL VOIDS AND FOR SPLASH ROCKS, BUT NOT FOR USE AS ANY MAIN STRUCTURE ROCK, UNLESS APPROVED BY THE TOWN.

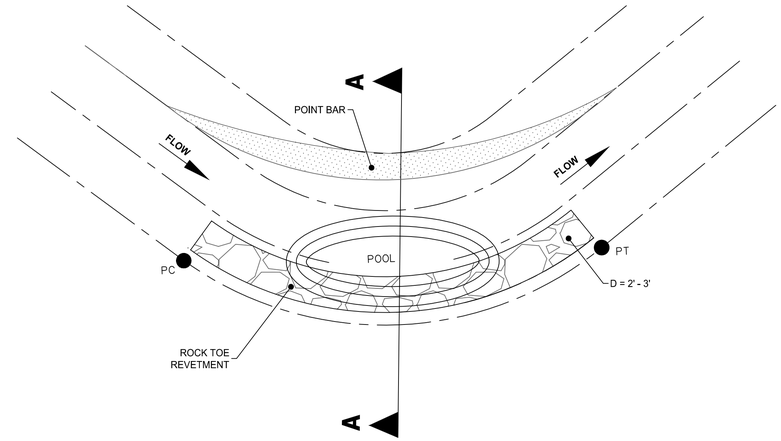
ROCK VANE DETAIL

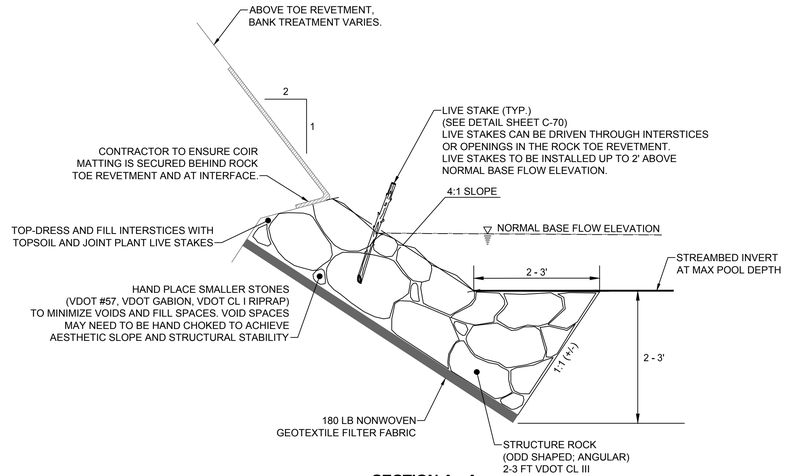
NOT TO SCALE

EXAMPLE ROCK VANES
(SHOWN FOR INFORMATION ONLY)

ROCK TOE REVETMENT - PLAN VIEW

NTS





SECTION A - A

EXAMPLE ROCK TOE REVETMENT
(SHOWN FOR INFORMATION ONLY)

ROCK TOE REVETMENT NOTES:

1. ALL STRUCTURE ROCK TOE SHALL BE 2-3 FT DIAMETER BOULDER (LARGE ANGULAR ODD SHAPED) OR APPROVED BY THE ENGINEER BEFORE INSTALLATION.
2. ROCK TOE SHALL BE PLACED SUCH THAT MATERIALS LOCK TOGETHER.
3. SELECT BACKFILL AND SOIL BACKFILL MATERIAL SHALL BE COMPACTED SUCH THAT FUTURE SETTLEMENT OF THE MATERIAL IS KEPT TO A MINIMUM.
4. ASSUMED ROCK DENSITY = 165 LB/FT3.
5. IF BEDROCK IS ENCOUNTERED, SEAT FOOTER REVETMENT IN BEDROCK AT DIRECTION OF THE FIELD ENGINEER.
6. ROCK TOE REVETMENT TO BEGIN AT CROSS VANE ARM AND END AT PT (HEAD OF RIFFLE)
7. CONTRACTOR TO DIG 1" PILOT HOLES FOR PLACEMENT OF LIVE STAKES IN ROCK TOE REVETMENT.
8. CONTRACTOR TO INSTALL ROCK TOE REVETMENT TO A DEPTH 2-3' BELOW MAXIMUM POOL DEPTH INVERT THE ENTIRE LENGTH OF THE ROCK TOE REVETMENT.

INSTALLATION GUIDELINES:

1. EXCAVATE A TRENCH ALONG THE TOE OF THE STREAMBANK TO 2-3 FT BELOW THE STREAMBED INVERT.
2. PLACE FILTER CLOTH ALONG THE BACKSIDE OF THE TRENCH. PLACE FILTER FABRIC LOOSELY AND EVENLY ON THE PREPARED SLOPE AND SECURED WITH STAKES ON 2 FOOT CENTERS. ADJACENT STRIPS SHOULD OVERLAP 12 INCHES AND BE STAPLED ON 12 INCH CENTERS. THE UPSTREAM OR UPSLOPE FILTER FABRIC SHOULD ALWAYS BE PLACED OVER THE DOWNSTREAM OR DOWNSLOPE FILTER FABRIC. IF THE FILTER FABRIC IS TORN OR DAMAGED, IT SHOULD BE REPAIRED OR REPLACED.
3. PLACE STRUCTURE ROCK STARTING IN THE BOTTOM OF THE TRENCH WORKING UP THE BANK. ROCK MAY HAVE TO BE HAND PLACED IN VOIDS TO ACHIEVE THE DESIRED RESULTS OF LOCKING THE REVETMENT.

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SYM	DESCRIPTION	DATE	APPR

TOWN OF LEESBURG VIRGINIA ESTABLISHED 1758

TUSCARORA CREEK
FLOOD MITIGATION
100% CONSTRUCTION DOCUMENTS
TOWN OF LEESBURG, VIRGINIA
CATOCTIN ELECTION DISTRICT

COMMONWEALTH OF VIRGINIA
MATTHEW TROY BIGGS
Lic. No. 041116
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PROFESSIONAL ENGINEER
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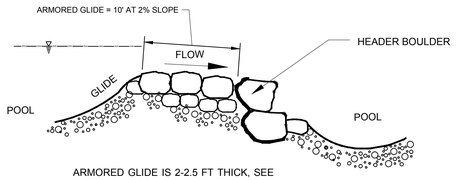
DESIGN BY:	MTB	DRAWN BY:	MJH
REVIEWED BY:	MTB & MB		
PROJECT MANAGER:	TWC		
AMEC FOSTER WHEELER PROJECT #:	565500008		
CONTRACT #:	300810-FY15-22		
DATE:	2018-09-17	SHEET SIZE:	D
SCALE:	AS SHOWN		

SHEET TITLE:
ROCK VANE AND ROCK TOE REVETMENT DETAILS

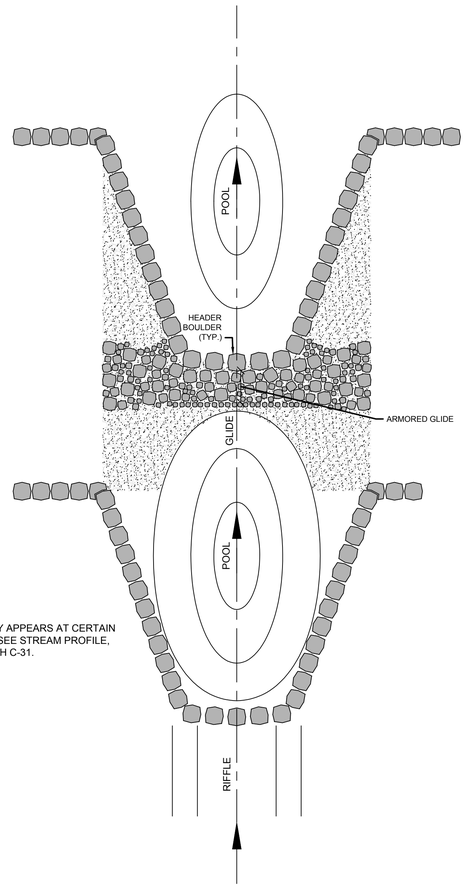
SHEET C-47 OF 91

ARMORED GLIDE

NTS



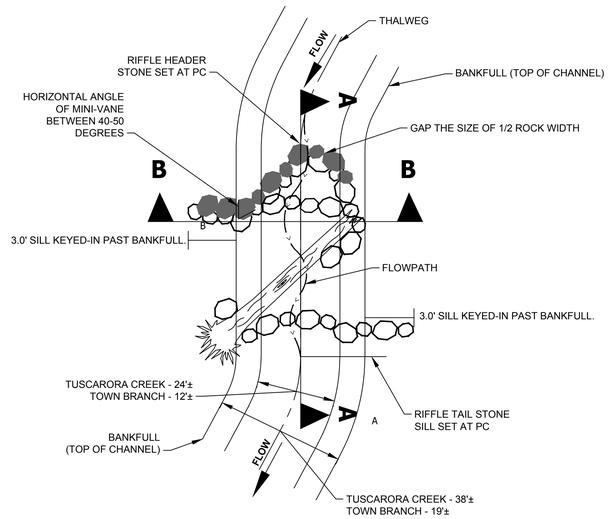
ARMORED GLIDE IS 2-2.5 FT THICK, SEE RIFFLE MATERIAL MIXTURE (THIS SHEET) FOR ARMORED GLIDE MATERIAL

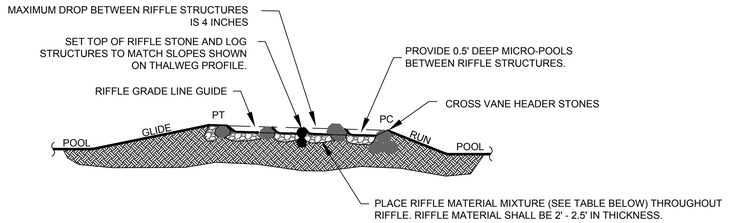


NOTE:
ARMORED GLIDE ONLY APPEARS AT CERTAIN STREAM LOCATIONS. SEE STREAM PROFILE, SHEETS C-28 THROUGH C-31.

RIFFLE SECTION STRUCTURES

NTS

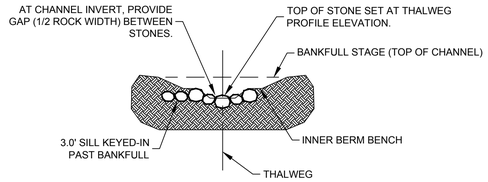




TYPICAL RIFFLE STRUCTURE INSTALLATION PROFILE
(NOT TO SCALE)

SECTION A-A

EXAMPLE RIFFLE
(SHOWN FOR INFORMATION ONLY)



TYPICAL RIFFLE STRUCTURE INSTALLATION CROSS SECTION
(NOT TO SCALE)

SECTION B-B

RIFFLE MATERIAL MIXTURE

4' X 3' X 2' STRUCTURE STONE
CLASS I (D_{50} = 1.1')
CLASS III (D_{50} = 2.2')
57 STONE
SUPPLEMENTAL EX. BED MATERIAL

*CLASS I, CLASS III, AND 57 STONE SHALL BE EQUALLY MIXED AND SUPPLEMENTED WITH EXISTING BED MATERIAL AT THE DIRECTION OF THE FIELD ENGINEER.

RIFFLE HEADER AND FOOTERS ARE BASED ON SIZES SHOWN IN THE STRUCTURE STONE SIZE TABLE ON SHEET C-46. RIFFLE MATERIAL SHALL BE 2 - 2.5 FEET IN THICKNESS.

NOTE:
ARMORED GLIDE TO CONSIST OF SAME MIXTURE AS RIFFLE MATERIAL. USE WELL GRADED BED MIX TO PACK UPSTREAM OF BOULDERS.

RIFFLE NOTES:

1. THE MAXIMUM AMOUNT OF DROP FROM ONE MINI-VANE TO THE NEXT SHALL BE NO GREATER THAN 4-INCHES. THE COMBINED AMOUNT OF DROP OVER ALL THE MINI-VANES SHALL NOT EXCEED THE TOTAL AMOUNT OF FALL ALONG THE RIFFLE SLOPE.
2. MINI-VANES SHALL BE EQUALLY SPACED ALONG THE RIFFLE.
3. A HYDRAULIC EXCAVATOR WITH A BUCKET THAT CONTAINS A HYDRAULIC THUMB SHALL BE USED TO PLACE BOULDERS AND LOGS WITH THE SUPERVISION OF THE ENGINEER.
4. LOGS FOR CONSTRUCTED RIFFLE SHALL BE A MINIMUM OF 1.5-FOOT IN DIAMETER WITH A LENGTH OF 10± FEET. LOGS AND BOULDERS CAN BE SUBSTITUTED DURING CONSTRUCTION WITH THE APPROVAL OF THE TOWN OF LEESBURG.
5. ½ OF THE WAY ACROSS THE CHANNEL FROM THE OUTSIDE BANK, THE HEADER ROCK SHALL BE PLACED AT 2 INCHES ABOVE THE CHANNEL INVERT ELEVATION.
6. THERE SHALL BE A GAP BETWEEN THE HEADER ROCKS OF 1/2 ROCK WIDTH.
7. THE BOULDERS SHALL SLOPE FROM THE BED ELEVATION, AT THE HEAD OF THE VANE, TO ½ BANKFULL ELEVATION AT A SLOPE OF 3%-5%. HEADER AND FOOTER BOULDERS SHALL BE TIED SECURELY INTO THE BANK IN SUCH A WAY THAT IT ELIMINATES THE POSSIBILITY OF STREAMFLOW DIVERTING AROUND THEM.
8. ANY SOIL DISTURBED DURING THE PLACEMENT OF THE RIFFLE SHALL BE SEEDED USING TEMPORARY AND PERMANENT SEEDING METHODS.
9. THE THALWEG OR LOW POINT IN THE CHANNEL SHALL ALTERNATE LEFT AND RIGHT OF THE CHANNEL CENTERLINE BY 10 INCHES.
10. THE GAP BETWEEN THE HEADER AND FOOTER BOULDERS SHALL BE CHINKED BY HAND WITH GRAVEL AND COBBLE FROM THE UPSTREAM DIRECTION.
11. THE HORIZONTAL ANGLE OF THE HEADER BOULDERS OF THE MINI-VANE AND THE BANK SHALL BE BETWEEN 40-50 DEGREES.
12. RIFFLE MATERIAL SHALL CONSIST OF A 2' - 2.5' THICKNESS OF CLASS I, CLASS III AND 57 STONE MIXED IN EQUAL PARTS BY THE CONTRACTOR AND SUPPLEMENTED WITH EXISTING BED MATERIAL AT THE DIRECTION OF THE ON-SITE TECHNICAL REPRESENTATIVE. ANY DEVIATION FROM THE SPECIFIED MIX DESIGN SHALL BE APPROVED BY THE TOWN OF LEESBURG.
13. IF A ROOT WADS IS USED IN THE STRUCTURE, THE ROOT WAD SHALL BE A MINIMUM OF 7 FT IN LENGTH, WITH A ROOT FAN WITH A DIAMETER OF AT LEAST 4 FT AND A DIAMETER OF 1.5 FT. 90% OF THE ROOT FAN SHALL BE BURIED IN THE BANK OF THE STRUCTURE.
14. THE ELEVATION OF THE STRUCTURES CAN BE INTERPOLATED FROM THE DESIGN PROFILE AT THE LOCATION AND STATIONING OF EACH INDIVIDUAL STRUCTURE.
15. AS THE TAIL OD THE RIFFLE APPROACHES THE PROPOSED CROSS VANES, THE CONTRACTOR SHALL CONSTRUCT THE INNER BERM FEATURE SUCH THAT IT GRADUALLY REDUCES AND FANS OUT/TAPERS INTO THE BACKSIDE OF THE VANE ARM AND DOES NOT IMPEDE OR BLOCK THE FLOW OF WATER THROUGH THE THROAT OF THE CROSS VANE.

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PROJECT MANAGER: TWC	
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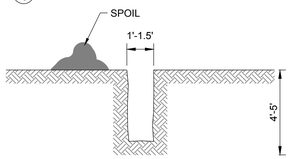
CONTRACT #: 300810-FY15-22	
DATE: 2018-09-17	SHEET SIZE: D
SCALE: AS SHOWN	
SHEET TITLE: RIFFLE DETAIL	

SHEET C-48 OF 91

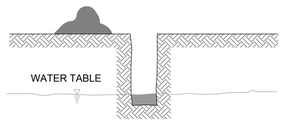
PLOTTED BY:HEPP, MICHAEL SHEET SET:Tuscarora Creek LAYOUT:Riffle September 17, 2018 07:40:50pm Q:\565500008_TUSCARORA CREEK-100%\PLANSHEETS\X - STRUCTURE DETAILS.DWG

SLIT TRENCH INSTALLATION PROCEDURE

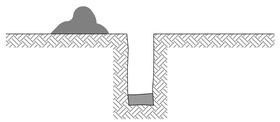
NOT TO SCALE



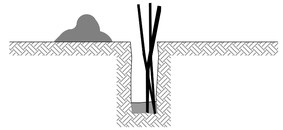
DIG THE TRENCH DOWN INTO THE CAPILLARY (VADOSE) ZONE - MOIST AREA ABOVE THE PERMANENT WATER TABLE.



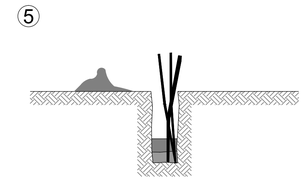
EXCAVATOR DIGS 4-5 FT DEEP TRENCH WITH A NARROW BUCKET UNTIL WATER TABLE IS HIT.



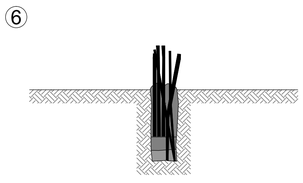
TAKE THE LAST SCOOP OF SOIL DUG FROM THE TRENCH AND PLACE IT BACK INTO THE TRENCH. SOFT MATERIAL NEEDED FOR ROOT GROWTH.



PLACE PLANTS (SYCAMORE, SILKY DOGWOOD, RIVER BIRCH) INTO SOIL AT BOTTOM OF TRENCH. TYPICALLY 3 POLES / FT.



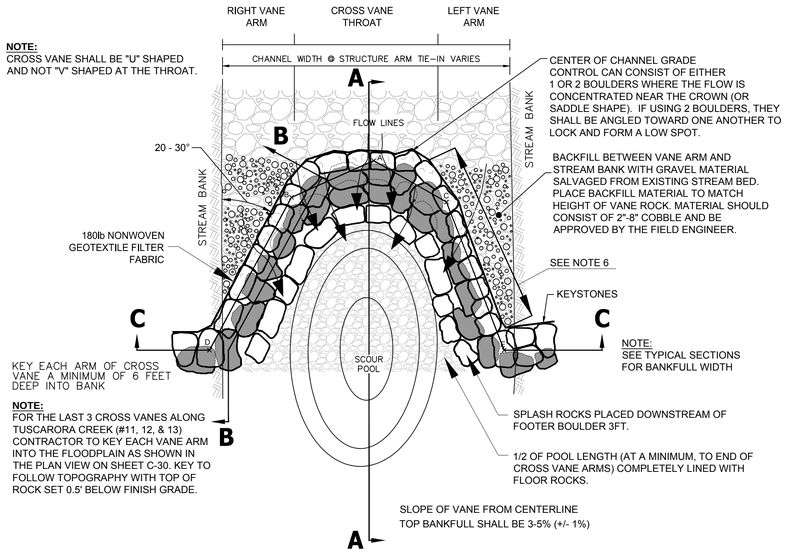
PARTIALLY BACKFILL THE TRENCH



COMPLETLY BACKFILL TRENCH AND WATER PLANTS IN.

EXAMPLE SLIT TRENCH
(SHOWN FOR INFORMATION ONLY)

CROSS VANE - PLAN VIEW



NOTE:
CROSS VANE SHALL BE "U" SHAPED AND NOT "V" SHAPED AT THE THROAT.

CENTER OF CHANNEL GRADE CONTROL CAN CONSIST OF EITHER 1 OR 2 BOULDERS WHERE THE FLOW IS CONCENTRATED NEAR THE CROWN (OR SADDLE SHAPE). IF USING 2 BOULDERS, THEY SHALL BE ANGLED TOWARD ONE ANOTHER TO LOCK AND FORM A LOW SPOT.

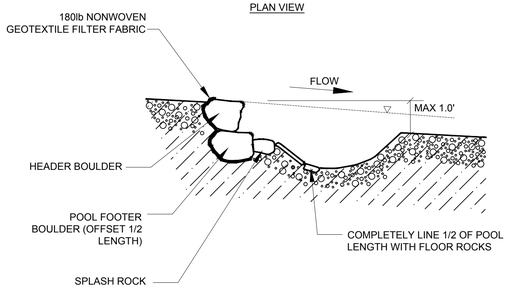
BACKFILL BETWEEN VANE ARM AND STREAM BANK WITH GRAVEL MATERIAL SALVAGED FROM EXISTING STREAM BED. PLACE BACKFILL MATERIAL TO MATCH HEIGHT OF VANE ROCK. MATERIAL SHOULD CONSIST OF 2"-8" COBBLE AND BE APPROVED BY THE FIELD ENGINEER.

KEY EACH ARM OF CROSS VANE A MINIMUM OF 6 FEET DEEP INTO BANK

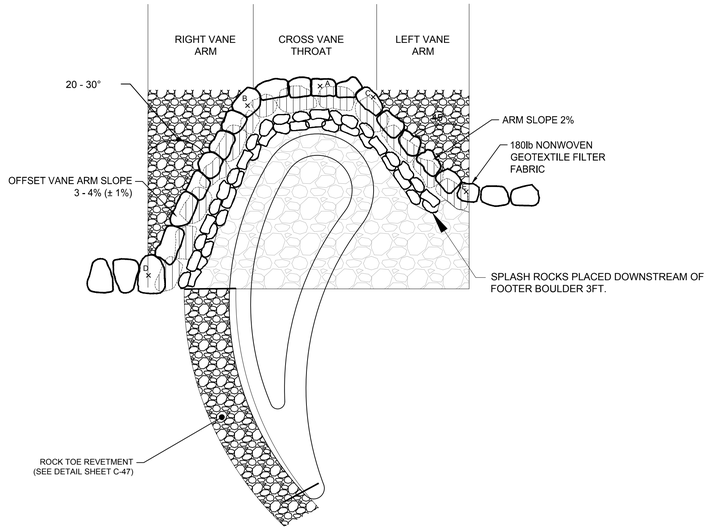
NOTE:
FOR THE LAST 3 CROSS VANES ALONG TUSCARORA CREEK (#11, 12, & 13) CONTRACTOR TO KEY EACH VANE ARM INTO THE FLOODPLAIN AS SHOWN IN THE PLAN VIEW ON SHEET C-30. KEY TO FOLLOW TOPOGRAPHY WITH TOP OF ROCK SET 0.5' BELOW FINISH GRADE.

NOTE:
SEE TYPICAL SECTIONS FOR BANKFULL WIDTH

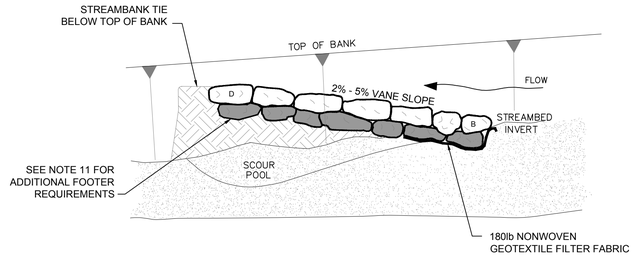
PLAN VIEW



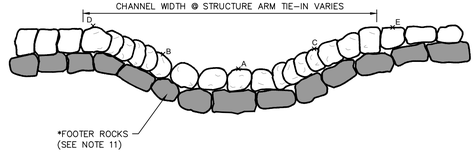
SECTION A-A
PROFILE THROUGH CENTER OF CROSS VANE



PLAN VIEW
OFFSET CROSS VANE



SECTION B-B
PROFILE OF VANE ARM



SECTION C-C
CROSS SECTION THROUGH CENTER OF CROSS VANE

CROSS VANE NOTES

1. ALL STONES ARE TO BE STRUCTURE STONE. STRUCTURE STONE IS DEFINED AS BLOCK LIKE, CUBICAL, OR STRAIGHT EDGED BOULDERS.
2. GAPS BETWEEN BOULDERS SHALL BE MINIMIZED BY FITTING BOULDERS TOGETHER, PLUGGING WITH STRUCTURE STONE CLASS A AND NO.57 OR CHINKING STONE, AS APPROVED BY THE TOWN OF LEESBURG, AND LINING WITH FILTER FABRIC.
3. DIMENSIONS AND SLOPES MAY BE ADJUSTED TO FIT BY THE TOWN OF LEESBURG'S QUALIFIED REPRESENTATIVE.
4. CONTRACTOR WILL BE REQUIRED TO FIT BOULDERS TIGHTLY.
5. FOOTER BOULDERS AND VANE BOULDERS SHALL BE NATIVE STONE OR SHOT ROCK, CUBICAL OR RECTANGULAR IN NATURE.
6. THE SLOPE OF THE VANE ARM FROM CENTERLINE ELEVATION TO THE TIE-IN AT THE BANK SHALL BE 2-5%.
7. THERE SHALL BE NO DROP GREATER THAN 1.0 FOOT. VERTICAL TOLERANCE SHALL BE 0.1' FOR CROSS VANE STRUCTURES.
8. THE ELEVATION OF EACH GRADE CONTROL STRUCTURE SHOULD BE EQUAL TO OR GREATER THAN THE ELEVATION OF THE TOP OF THE FOOTER BOULDER DIRECTLY UPSTREAM.
9. FILTER FABRIC SHALL BE PLACED ON THE UPSTREAM SIDE OF THE STRUCTURE TO PREVENT WASHOUT OF SEDIMENT THROUGH BOULDER GAPS. FILTER FABRIC SHALL EXTEND FROM THE BOTTOM OF THE FOOTER BOULDER TO THE FINISHED GRADE ELEVATION AND SHALL BE PLACED THE ENTIRE LENGTH OF STRUCTURE.
10. ½ THE POOL LENGTH OR POOL LENGTH TO THE END OF THE CROSS VANE ARMS (WHICHEVER IS GREATER) IS TO BE LINED WITH FLOOR ROCKS. SPLASH ROCKS SHALL EXTEND A MINIMUM LENGTH OF 3 FEET DOWNSTREAM OF THE FOOTER BOULDERS AND BE PLACED TO PROVIDE A ROUGH SURFACE SUCH THAT ROCK EDGES PROTRUDE 0.3 TO 0.5 FT ABOVE THE BED SURFACE.
11. IF BEDROCK IS PRESENT DIRECTLY BELOW SURFACE BOULDER, FOOTING MAY NOT BE NECESSARY. HOWEVER, BASED ON THE DEPTH TO BEDROCK, ADDITIONAL FOOTER BOULDERS MAY BE REQUIRED IN ORDER TO SEAT FOOTERS ON BEDROCK. CHIP BEDROCK 0.5' FOR PLACEMENT AND SEAT FOOTER BOULDERS IN BEDROCK AT THE DIRECTION OF THE FIELD ENGINEER. IF BEDROCK IS NOT ENCOUNTERED, ADDITIONAL FOOTER BOULDERS MAY BE REQUIRED. IN THIS CASE THE ADDITIONAL TIER OF FOOTER BOULDERS SHALL EXTEND BELOW THE MAX SCOUR DEPTH (CHANNEL INVERT).
12. AS THE TAIL OF RIFFLE APPROACHES THE PROPOSED CROSS VANES, THE CONTRACTOR SHALL CONSTRUCT THE INNER BERM FEATURE SUCH THAT IT GRADUALLY REDUCES AND FANS OUT/TAPERS INTO THE BACKSIDE OF THE VANE ARM AND DOES NOT IMPEDE OR BLOCK THE FLOW OF WATER THROUGH THE THROAT OF THE CROSS VANE.

EXAMPLE CROSS VANE
(SHOWN FOR INFORMATION ONLY)

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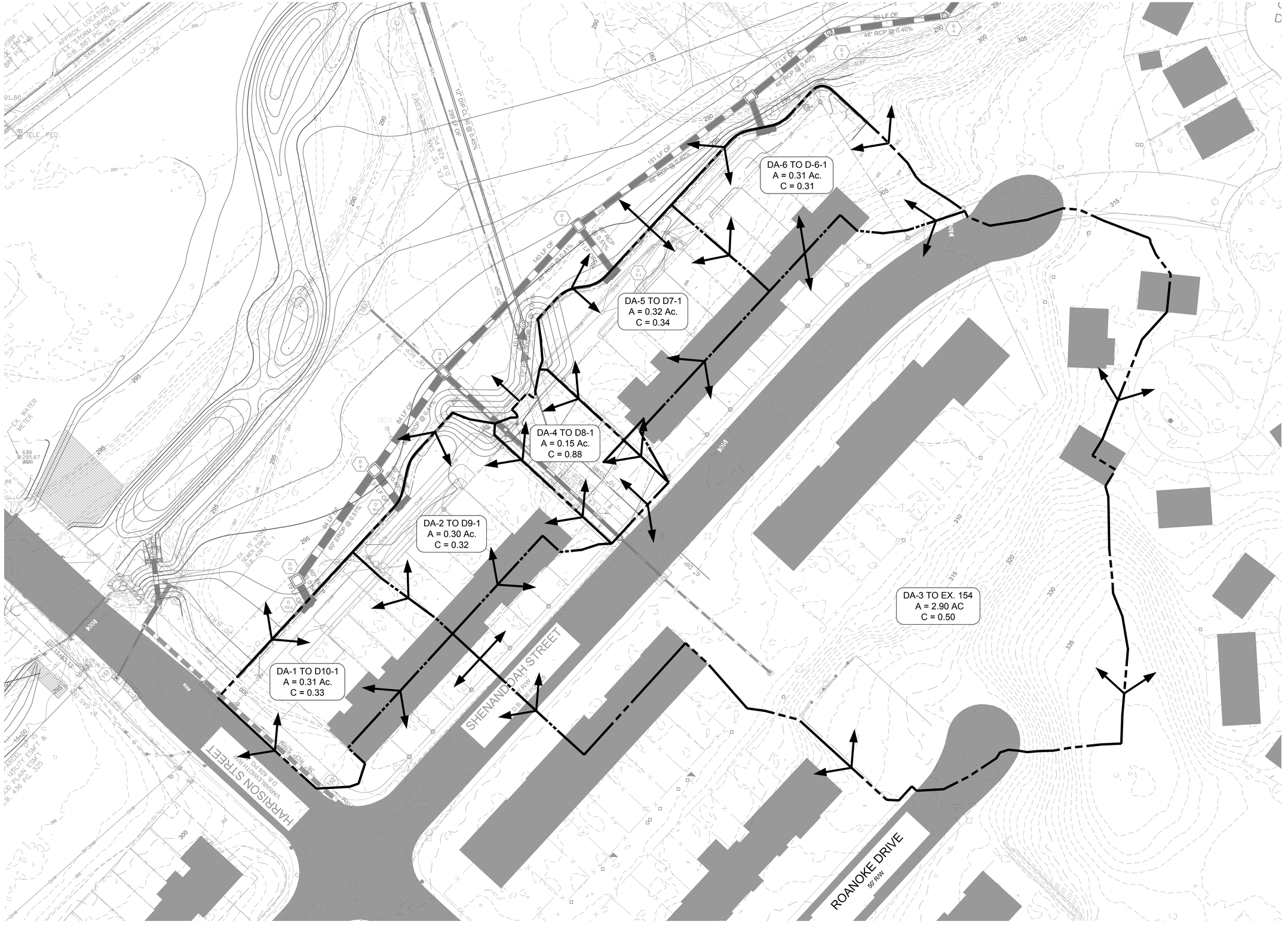
SCALE: AS SHOWN	

SHEET TITLE:
CROSS VANE AND SLIT TRENCH DETAILS

SHEET C-49 OF 91



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MATTHEW TROY BIGGS
Lic. No. 041116
9·18·18
SEAL

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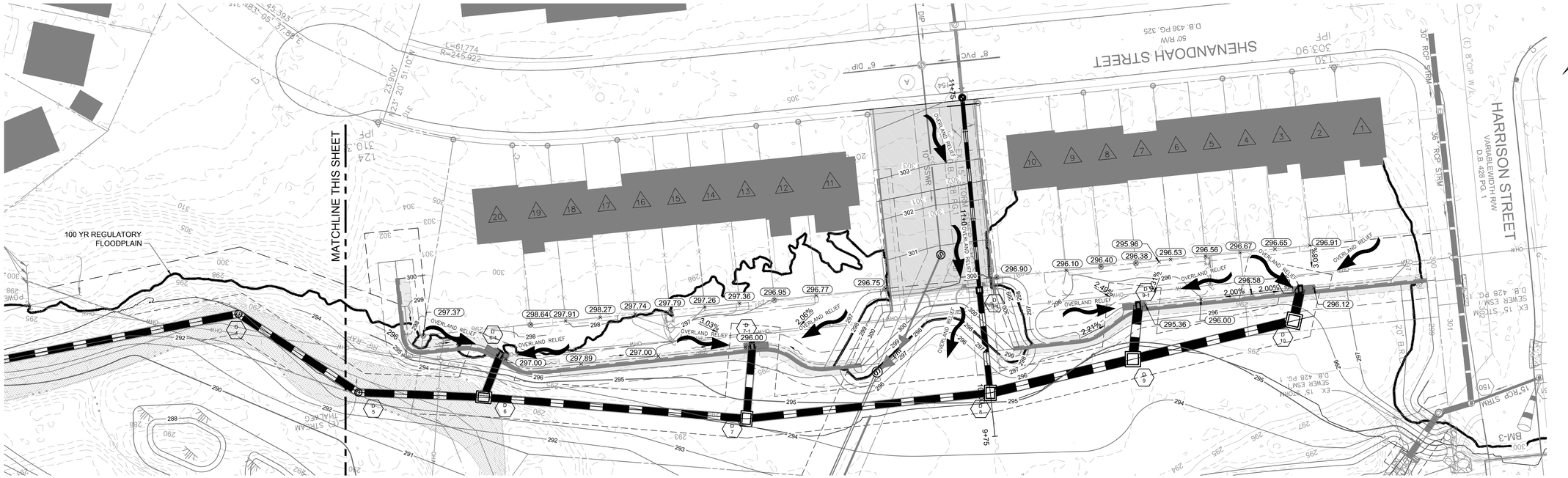
REVIEWED BY: MTB & MB	
PROJECT MANAGER: TWC	
AMEC FOSTER WHEELER PROJECT #: 565500008	
CONTRACT #: 300810-FY15-22	
DATE: 2018-09-17	SHEET SIZE: D
SCALE: AS SHOWN	

SHEET TITLE:

STORM SEWER
DRAINAGE AREA MAP

SHEET C-50 OF 91

PLOTTED BY:HEPP, MICHAEL SHEET SET:Tuscarora Creek LAYOUT:C-50 STORM SEWER DRAINAGE AREA MAP September 17, 2018 07:42:39pm Q:\565500008_TUSCARORA CREEK-100%\PLANSHEETS\STORM -DRAINAGE AREA.DWG



OVERLAND RELIEF PLAN VIEW

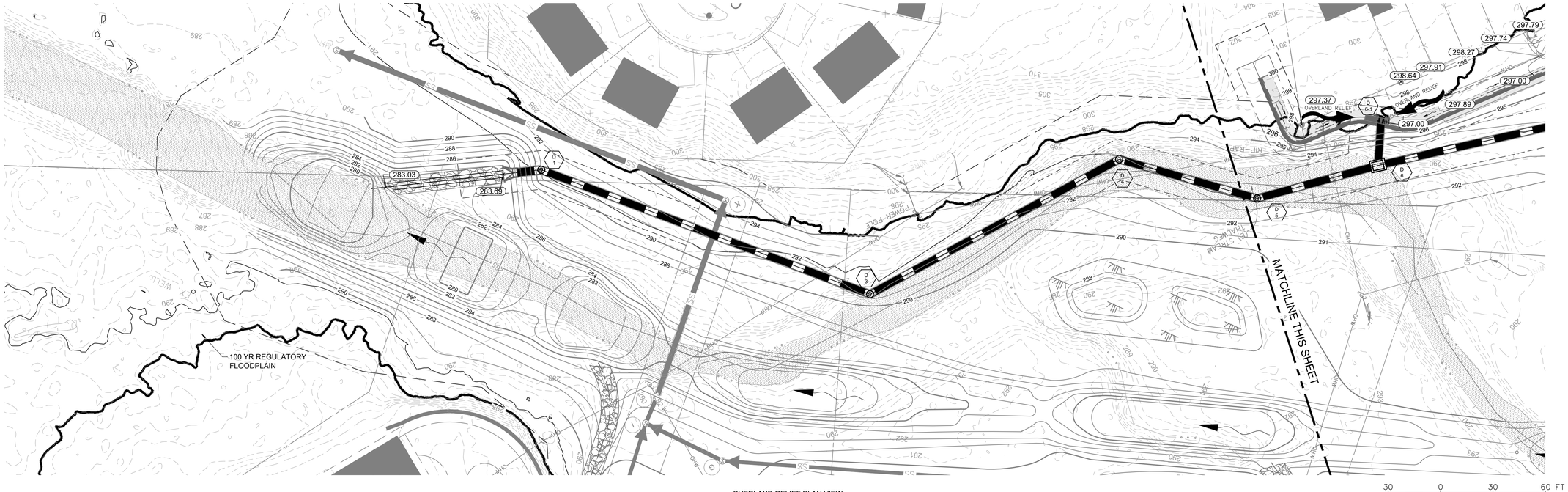
SCALE 1" = 30'

OVERLAND RELIEF NOTES

OVERLAND RELIEF BEHIND PROPOSED RETAINING WALL:
THE 100-YR OVERLAND RELIEF HAS BE STUDIED AS PART OF THE INTERIOR DRAINAGE ALONG THE PROPOSED FLOOD WALL BETWEEN THE VA KNOLLS TOWNHOMES AND TUSCARORA CREEK. WATER WILL FLOW FROM THE BACK OF THE TOWNHOMES INTO A SERIES OF STORM INLET WHICH RUN ADJACENT TO THE PROPOSED FLOOD WALL. WATER WILL THEN DISCHARGE FROM THESE INLETS INTO A 48" STORM SEWER ON THE CREEK-SIDE OF THE FLOOD WALL AND ULTIMATELY DISCHARGE INTO TUSCARORA CREEK AT THE PROJECT EXTENTS. AS SUCH, A MODIFICATION HAS BEEN REQUESTED TO THE REQUIREMENTS SET FORTH IN THE DCSM TO CONSIDER THE ENTIRE PORTION OF THE OVERLAND FLOW (10 YR + 100 YR + INFLOW FROM EX. 18" RCP) TO BE ROUTED THROUGH THE PROPOSED UNDERGROUND 48" RCP STORM PIPE DRAINAGE SYSTEM.

THE CONCENTRATED DISCHARGE FOR THE 100 YEAR OVERLAND RELIEF WILL BE PROPERLY CONVEYED AND ROUTED THROUGH THE PROPOSED 48" RCP STORM SEWER SYSTEM (PER DCSM SECTION 5-200) AND DISCHARGE NORTHEARSTERLY INTO TUSCARORA CREEK. THE OVERLAND RELIEF CONSISTS OF THE 10-YR PLUS 100-YR DISCHARGES, AND THE CAPACITY AND DISCHARGE (UNDER SUBMERGED 100-YR TAILWATER CONDITIONS). COMPUTATIONS ARE SHOWN ON SHEETS C-56 AND C-58. AS LONG AS THE PIPE SYSTEM IS MAINTAINED FREE OF DEBRIS AND TUSCARORA CREEK IS ALLOWED TO FLOW FREELY WITHOUT BACKUPS CAUSED BY CHANNEL BLOCKAGES, IT IS OUR OPINION THAT THE OVERLAND RELIEF IS ADEQUATE.

OVERLAND RELIEF FOR THE PARKING LOT WILL BE CONVEYED DOWN THE PARKING LOT, OVER THE PROPOSED EARTHEN BERM, AND INTO TUSCARORA CREEK. PROPOSED GRADING, CURB AND GUTTER, AND RETAINING WALLS ALONG THE PARKING LOT WILL PREVENT OVERLAND RELIEF FLOW FROM THE PARKING LOT FROM FLOWING INTO THE PROPOSED UNDERGROUND STORM SEWER SYSTEM.



OVERLAND RELIEF PLAN VIEW

SCALE 1" = 30'

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SYM	DESCRIPTION	DATE	APPR

TOWN OF LEESBURG VIRGINIA ESTABLISHED 1758

TUSCARORA CREEK FLOOD MITIGATION

100% CONSTRUCTION DOCUMENTS

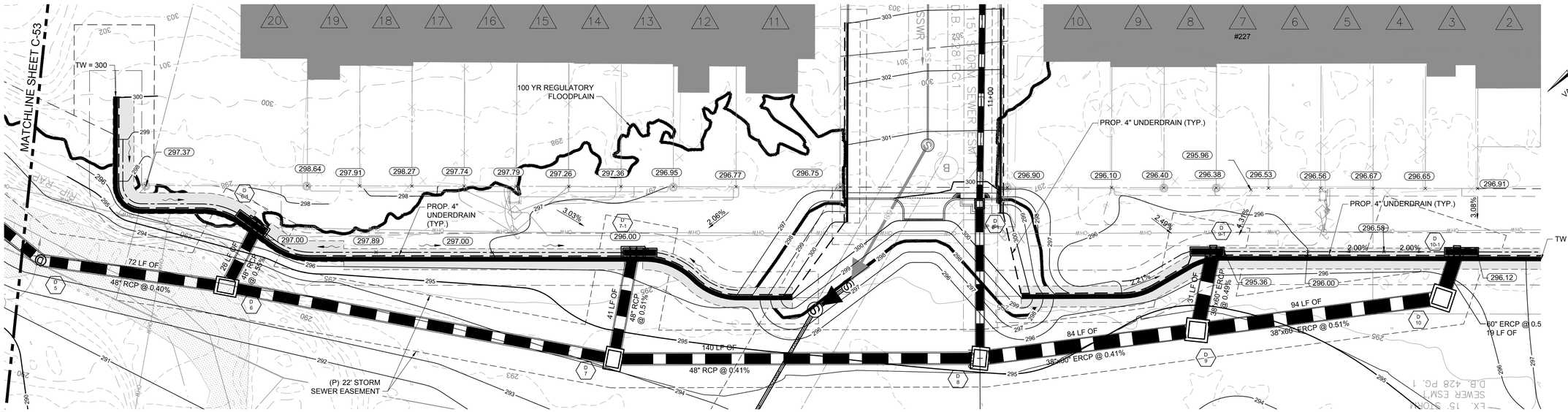
TOWN OF LEESBURG, VIRGINIA

CATOCTIN ELECTION DISTRICT

COMMONWEALTH OF VIRGINIA
MATTHEW T. BIGGS
Lic. No. 041116
9.18.18
PROFESSIONAL ENGINEER
SEAL

DESIGN BY: MTB	DRAWN BY: MJH
REVIEWED BY: MTB & MB	
PROJECT MANAGER: TWC	
AMEC FOSTER WHEELER PROJECT #: 565500008	
CONTRACT #: 300810-FY15-22	
DATE: 2018-09-17	SHEET SIZE: D
SCALE: AS SHOWN	
SHEET TITLE: OVERLAND RELIEF PLAN	

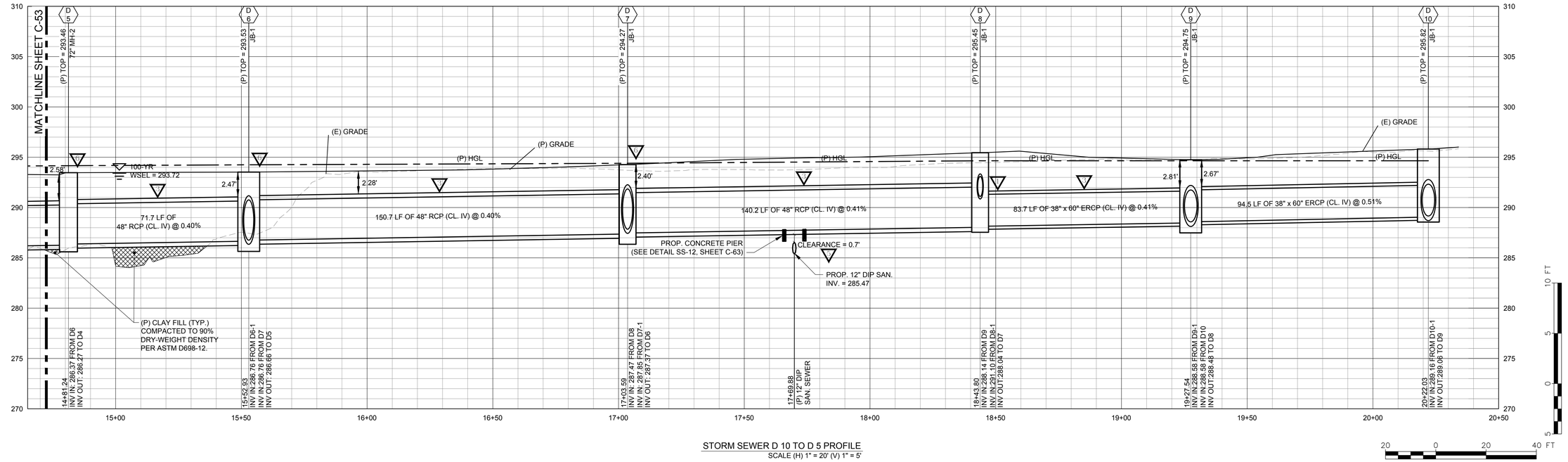
SHEET C-51 OF 91



NOTES:
CONTRACTOR TO FINE GRADE BEHIND THE WALL TO ENSURE POSITIVE DRAINAGE AWAY FROM WALLS AND DRAINAGE TO ALL PROPOSED INLETS.

SPOT SHOTS SHOWN ALONG PROPERTY LINE ARE SHOWN PER LOUDOUN COUNTY LIDAR DATA.

ALL STORM SEWER PIPE IN A PRESSURE FLOW CONDITION ARE TO BE CONSTRUCTED WITH WATERTIGHT GASKET PIPE AND ALL MANHOLE ACCESS TOPS TO BE BOLTED DOWN AND WATERTIGHT.



STORM SEWER D 10 TO D 5 PROFILE
SCALE (H) 1" = 20' (V) 1" = 5'

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CATOCTIN ELECTION DISTRICT

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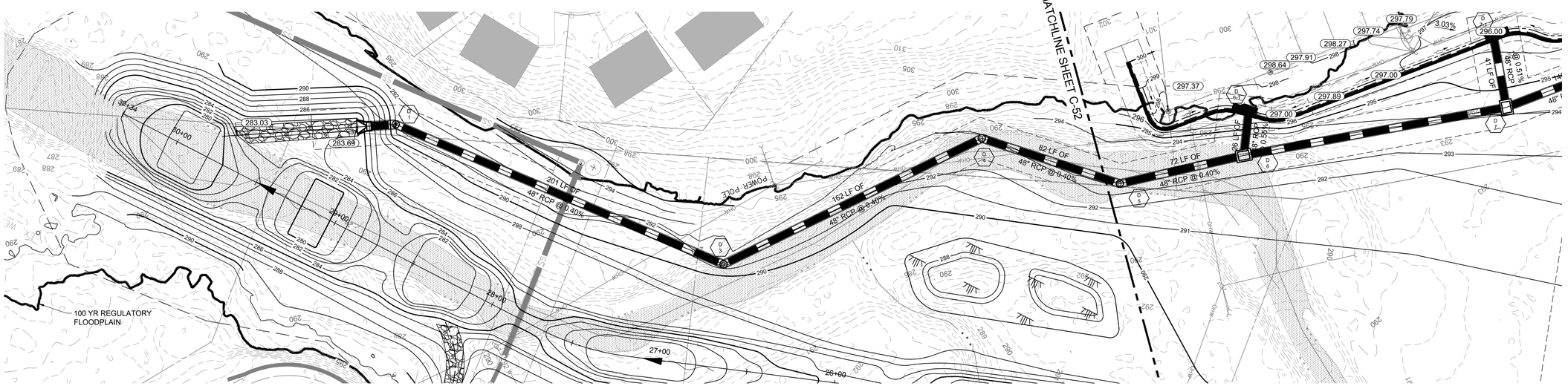
DESIGN BY: MTB	DRAWN BY: MJH
REVIEWED BY: MTB & MB	
PROJECT MANAGER: TWC	
AMEC FOSTER WHEELER PROJECT #: 565500008	
CONTRACT #: 300810-FY15-22	
DATE: 2018-09-17	SHEET SIZE: D
SCALE: AS SHOWN	

SHEET TITLE:
STORM SEWER PLAN & PROFILE

SHEET C-52 OF 91

PLOTTED BY:HEPP, MICHAEL SHEET SET:Tuscarora Creek LAYOUT:C-52 STORM SEWER PLAN & PROFILE September 18, 2018 01:06:54pm Q:\565500008_TUSCARORA CREEK-100%\PLANSHEETS\STORM - PLAN.DWG

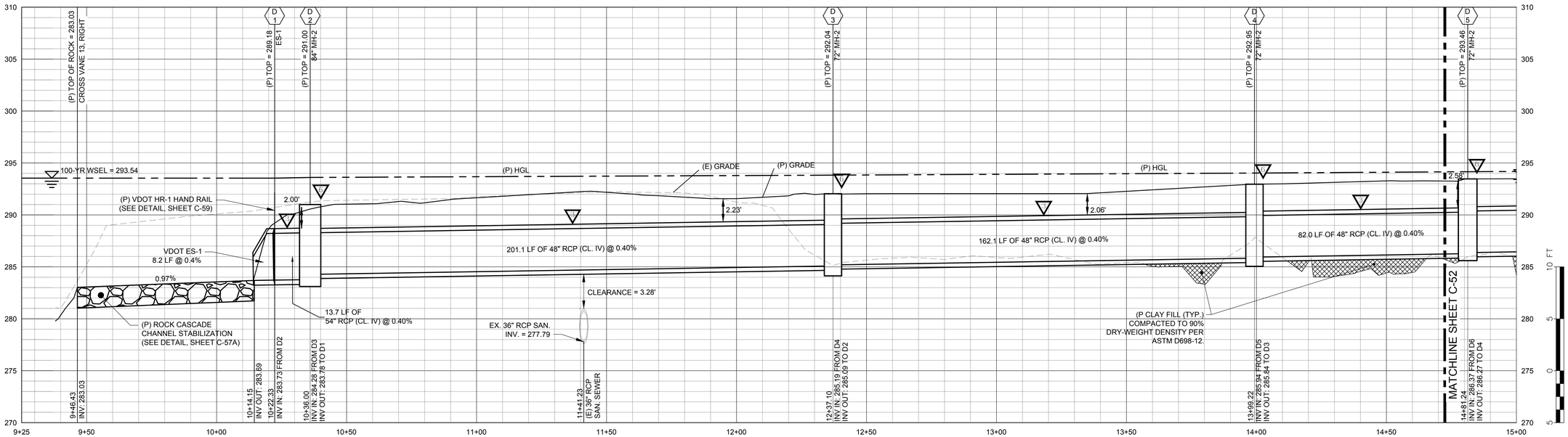


VA STATE GRID NORTH
NAD 1983 / MAYD 88

20 0 20 40 FT

STORM SEWER D 5 TO D 1 PLAN VIEW
SCALE 1" = 20'

NOTE:
ALL STORM SEWER PIPE IN A PRESSURE FLOW CONDITION ARE TO BE CONSTRUCTED WITH WATERTIGHT GASKET PIPE AND ALL MANHOLE ACCESS TOPS TO BE BOLTED DOWN AND WATERTIGHT.



STORM SEWER D 1 TO D 5 PROFILE
SCALE (H) 1" = 20' (V) 1" = 5'

20 0 20 40 FT

10 FT 5 0 5

PLOTTED BY:HEPP, MICHAEL SHEET SET:Tuscarora Creek LAYOUT:C-53 STORM SEWER PLAN & PROFILE September 17, 2018 07:47:10pm Q:\565500008_TUSCARORA CREEK-100%\PLANSHEETS\STORM - PLAN.DWG

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REVIEWED BY: MTB & MB	
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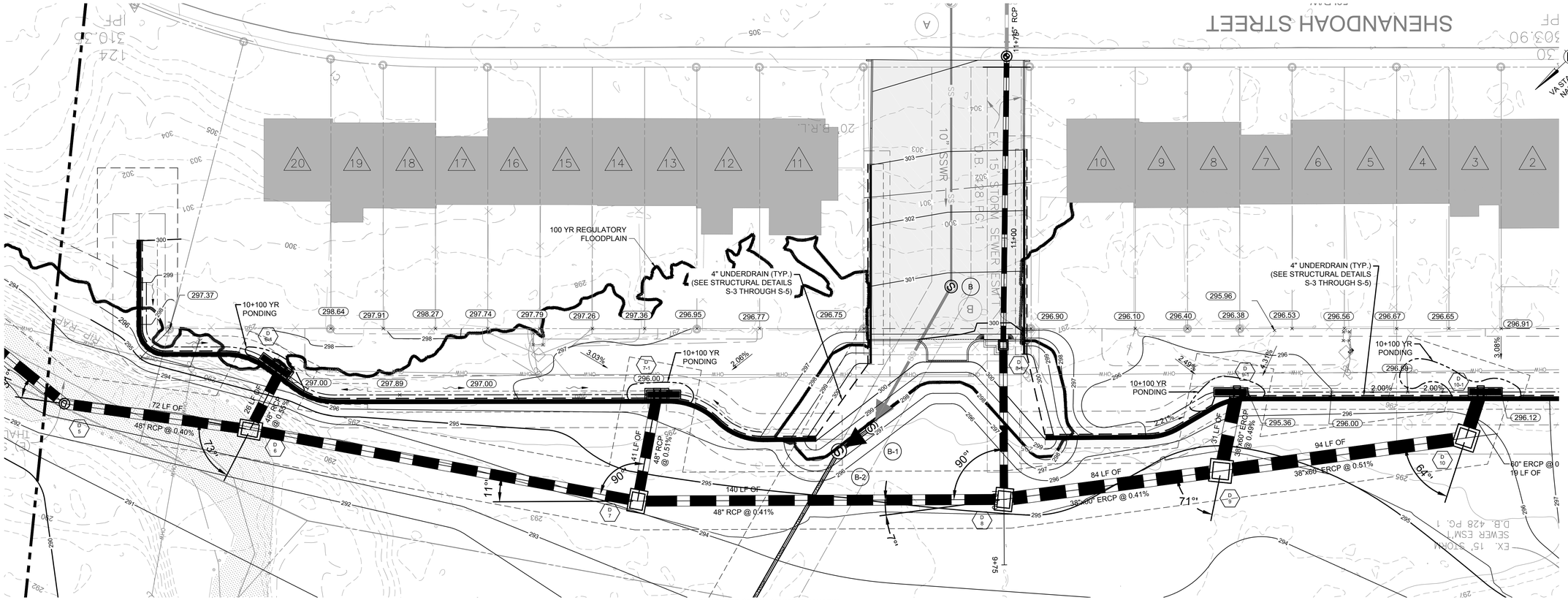
AMEC FOSTER WHEELER PROJECT #: 565500008	
CONTRACT #: 300810-FY15-22	
DATE: 2018-09-17	SHEET SIZE: D
SCALE: AS SHOWN	

SHEET TITLE:
STORM SEWER PLAN & PROFILE

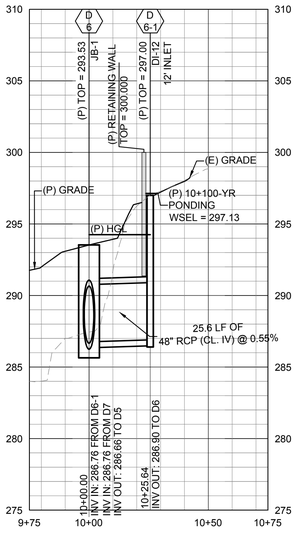


PROPOSED STORM SEWER PLAN VIEW
SCALE 1" = 20'

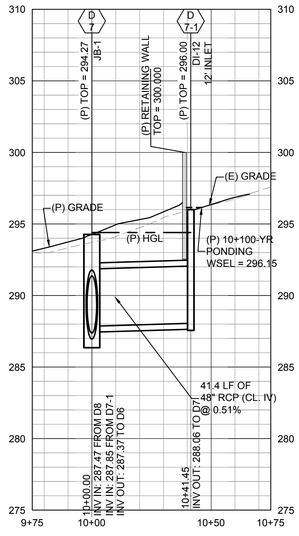
20 0 20 40 FT

NOTES:
CONTRACTOR TO FINE GRADE BEHIND THE WALL TO ENSURE POSITIVE DRAINAGE AWAY FROM WALLS AND DRAINAGE TO ALL PROPOSED INLETS.

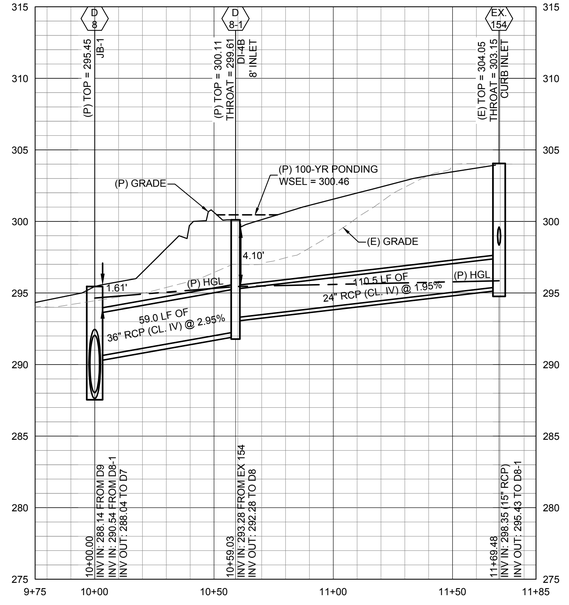
ALL STORM SEWER PIPE IN A PRESSURE FLOW CONDITION ARE TO BE CONSTRUCTED WITH WATERTIGHT GASKET PIPE AND ALL MANHOLE ACCESS TOPS TO BE BOLTED DOWN AND WATERTIGHT.



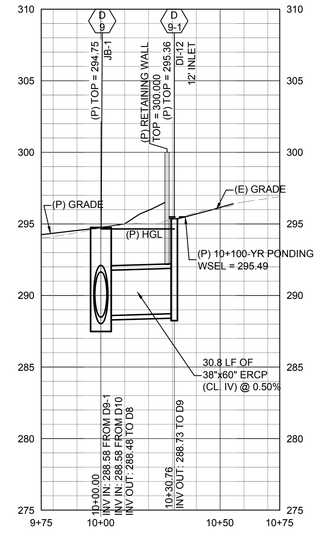
D 6-1 TO D 6 PROFILE
SCALE (H) 1" = 30' (V) 1" = 5'



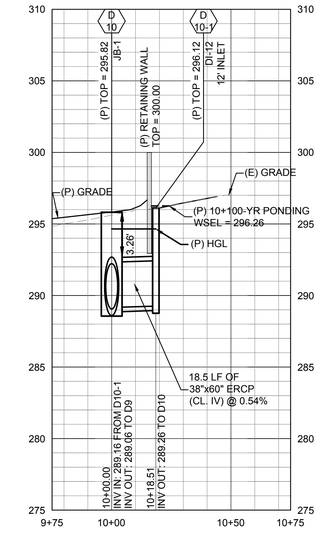
D 7-1 TO D 7 PROFILE
SCALE (H) 1" = 30' (V) 1" = 5'



EX. 154 TO D 8 PROFILE
SCALE (H) 1" = 30' (V) 1" = 5'



D 9-1 TO D 9 PROFILE
SCALE (H) 1" = 30' (V) 1" = 5'



D 10-1 TO D 10 PROFILE
SCALE (H) 1" = 30' (V) 1" = 5'

30 0 30 60 FT

10 FT 5 0 5

NOTE:
RETAINING WALLS SHALL BE CONSTRUCTED USING DESIGN FOUND IN STRUCTURAL SHEETS.
RETAINING WALL INFORMATION ON THESE SHEETS IS SHOWN FOR INFORMATION ONLY.

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SYM	DESCRIPTION	DATE	APPR

TOWN OF LEESBURG ESTABLISHED 1758 VIRGINIA

TUSCARORA CREEK FLOOD MITIGATION

100% CONSTRUCTION DOCUMENTS

TOWN OF LEESBURG, VIRGINIA

CATOCTIN ELECTION DISTRICT

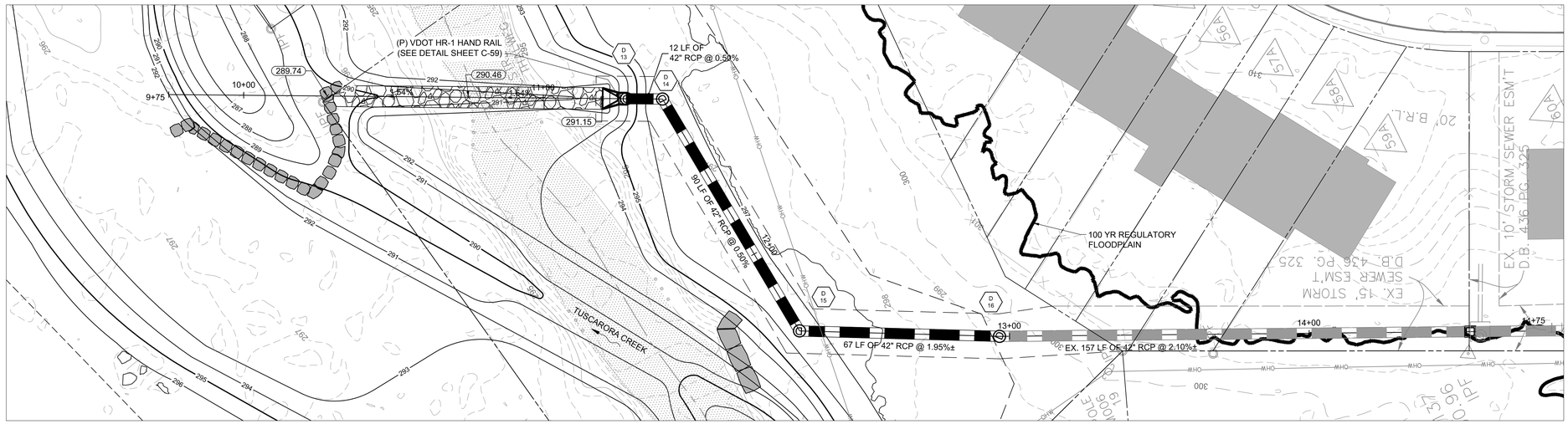
COMMONWEALTH OF VIRGINIA
MATTHEW TROY BIGGS
Lic. No. 041116
9.18.18
PROFESSIONAL ENGINEER
SEAL

DESIGN BY:	MTB	DRAWN BY:	MJH
REVIEWED BY:	MTB & MB		
PROJECT MANAGER:	TWC		
AMEC FOSTER WHEELER PROJECT #	565500008		
CONTRACT #:	300810-FY15-22		
DATE:	2018-09-17	SHEET SIZE:	D
SCALE:	AS SHOWN		

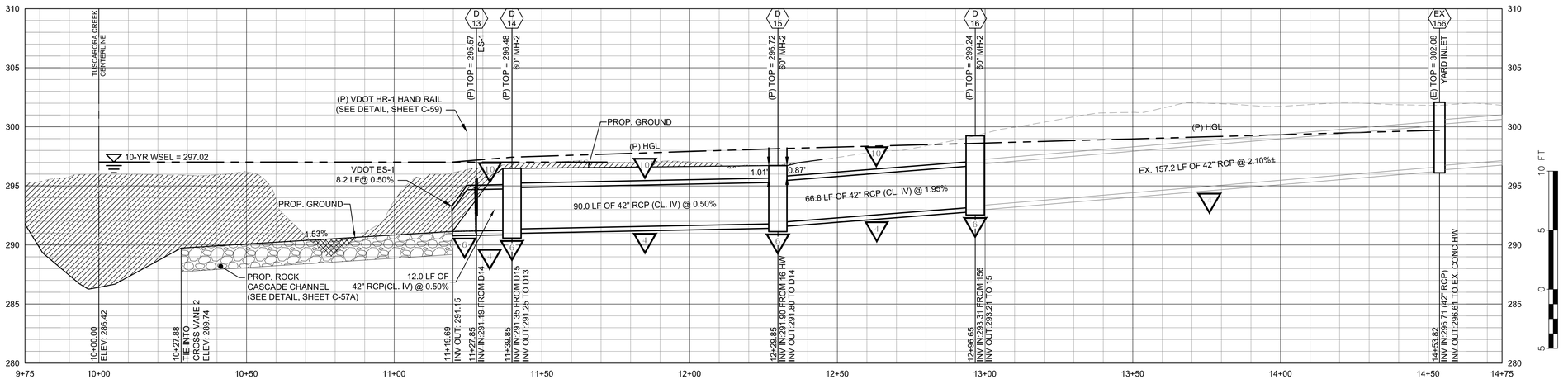
SHEET TITLE:
STORM SEWER PLAN & PROFILE

SHEET C-54 OF 91

PLOTTED BY:HEPP, MICHAEL SHEET SET:Tuscarora Creek LAYOUT:C-54 STORM SEWER PLAN & PROFILE September 18, 2018 01:07:58pm Q:\565500008_TUSCARORA CREEK-100%\PLANSHEETS\STORM - PLAN.DWG



PROPOSED STORM SEWER EX. 156 TO D13 PLAN VIEW
SCALE 1" = 20'

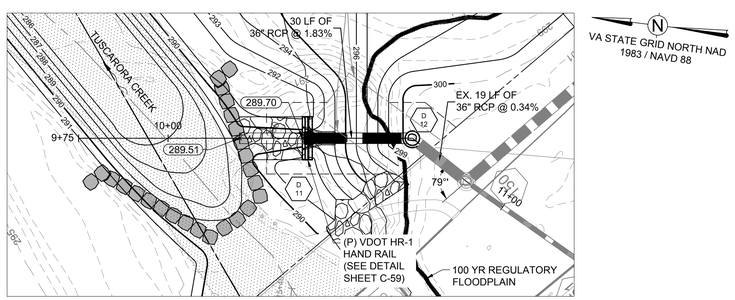


D15 TO D13 PROFILE
SCALE (H) 1" = 20' (V) 1" = 5'

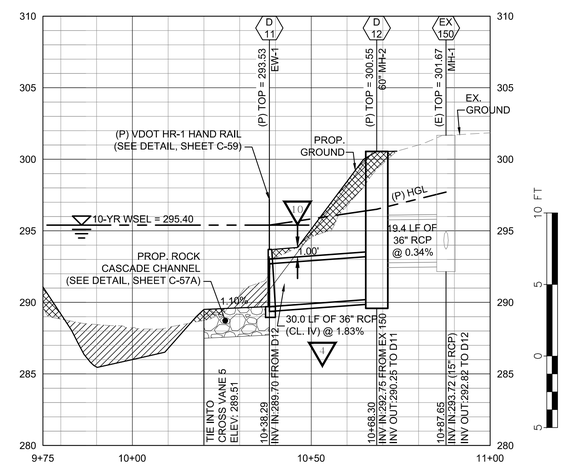
NOTES:
AT EXISTING HEADWALL (EX HW) PIPE MATERIAL CHANGES FROM RCP TO CMP. THERE IS NO STRUCTURE ACCESS TO OBTAIN INVERT INFORMATION AT THIS LOCATION. THE SLOPE OF THE PIPE SYSTEM IS BASED ON THE FIELD SURVEY FROM EXISTING 156 TO THE EXISTING OUTFALL AT TUSCARORA CREEK (EX 155). DURING EXCAVATION AND CONSTRUCTION OF PROPOSED STRUCTURE D15, IT IS RESPONSIBILITY OF THE CONTRACTOR TO CONFIRM THE EXISTING INVERT IN FROM EX 156 AND TO NOTIFY THE OWNER WHERE ADJUSTMENTS MAY BE REQUIRED TO TIE INTO THE EXISTING STORM SEWER AND PRODUCE THE DESIRED RESULT.

THE INVERT SHOWN AT THE EXISTING HEADWALL HAS BEEN INTERPOLATED FROM UPSTREAM AND DOWNSTREAM SURVEY ELEVATIONS. THEREFORE, THE CONTRACTOR IS TO COORDINATE WITH THE TOWN AND SHALL TEST PIT AND CONFIRM ELEVATIONS PRIOR TO PURCHASING STRUCTURES.

ALL STORM SEWER PIPES IN A PRESSURE FLOW CONDITION ARE TO BE CONSTRUCTED WITH WATERTIGHT GASKETED PIPE AND ALL MANHOLE ACCESS TOPS TO BE BOLTED DOWN AND WATERTIGHT.



PROPOSED STORM SEWER D12 TO D11 PLAN VIEW
SCALE 1" = 20'



D12 TO D11 PROFILE
SCALE (H) 1" = 20' (V) 1" = 5'

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CATOCTIN ELECTION DISTRICT

COMMONWEALTH OF VIRGINIA
MATTHEW TROY HEPP
Lic. No. 041116
9.18.18
PROFESSIONAL ENGINEER
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DESIGN BY:	MTB	DRAWN BY:	MJH
REVIEWED BY:	MTB & MB		
PROJECT MANAGER:	TWC		
AMEC FOSTER WHEELER PROJECT #:	565500008		
CONTRACT #:	300810-FY15-22		
DATE:	2018-09-17	SHEET SIZE:	D
SCALE:	AS SHOWN		

SHEET TITLE:
STORM SEWER
PLAN & PROFILE

SHEET C-55 OF 91

STORM SEWER STRUCTURE SCHEDULE				
STRUCTURE NAME	STRUCTURE TYPE	STRUCTURE STANDARD	DESCRIPTION	STRUCTURE HEIGHT
D 1	END SECTION	ES-1 (VDOT 102.01)	PIPE DIAMETER 54"	–
D 2	MANHOLE	MH-2 (VDOT 106.07)	7' I.D.	6.55'
D 3	MANHOLE	MH-2 (VDOT 106.07)	6' I.D.	6.28'
D 4	MANHOLE	MH-2 (VDOT 106.07)	6' I.D.	6.44'
D 5	MANHOLE	MH-2 (VDOT 106.07)	6' I.D.	6.52'
D 6	JUNCTION BOX	JB-1 (VDOT 106.10)	6' x 6'	6.87'
D 6-1	MULTIGRATE DROP INLET	DI-12 (VDOT 104.30)	THROAT 12' TYPE II	10.10'
D 7	JUNCTION BOX	JB-1 (VDOT 106.10)	6' x 6'	6.90'
D 7-1	MULTIGRATE DROP INLET	DI-12 (VDOT 104.30)	THROAT 12' TYPE II	7.94'
D 8	JUNCTION BOX	JB-1 (VDOT 106.10)	4' x 7'	7.41'
D 9	JUNCTION BOX	JB-1 (VDOT 106.10)	8' x 7'	6.27'
D 9-1	MULTIGRATE DROP INLET	DI-12 (VDOT 104.30)	THROAT 12' TYPE II	6.63'
D 10	JUNCTION BOX	JB-1 (VDOT 106.10)	7' x 7'	6.76'
D 10-1	MULTIGRATE DROP INLET	DI-12 (VDOT 104.30)	THROAT 12' TYPE II	6.86'
D 8-1	CURB DROP INLET	DI-4B (VDOT 104.15)	8' THROAT	7.83'
D 11	END WALL	EW-1 (VDOT 101.01) HR-1 (601.05)	PIPE DIAMETER 36"	–
D 12	MANHOLE	MH-2 (VDOT 106.07)	5' I.D.	9.63'
D 13	END SECTION	ES-1 (VDOT 102.01)	PIPE DIAMETER 42"	–
D 14	MANHOLE	MH-2 (VDOT 106.07)	5' I.D.	4.56'
D 15	MANHOLE	MH-2 (VDOT 106.07)	5' I.D.	4.25'
D 16	MANHOLE	MH-2 (VDOT 106.07)	5' I.D.	

NOTE:
ALL PROPOSED STORM SEWER MANHOLE WITHIN THE 100-YEAR FLOODPLAIN SHALL BE CONSTRUCTED WITH WATERTIGHT GASKETED PIPE AND ALL MANHOLE ACCESS TOPS TO BE BOLTED DOWN AND WATERTIGHT. GASKETED CONNECTIONS SHALL BE MADE IN ACCORDANCE WITH VDOT APPROVED LIST 14 - PIPE JOINTS AND CONNECTIONS AND COATINGS.

INTERIOR DRAINAGE STORM COMPUTATIONS

RATIONAL METHOD – Overland Relief

DA = 4.292 acres
T_C = 5 minutes
$i_{10\text{-}yr}$ = 7.27 iph
$i_{100\text{-}yr}$ = 9.84 iph
$C_{f10\text{-}yr}$ = 1.0 (*Saturation Factor for Rational Formula, VDOT Ch. 6 Drainage Manual*)
$C_{f100\text{-}yr}$ = 1.25 (*Saturation Factor for Rational Formula, VDOT Ch. 6 Drainage Manual*)
C = 0.46 (*Area weighted Rational coefficient*)

$Q_{10\text{-}YR} = CIAC_f$
$Q_{10\text{-}YR} = (0.46)(7.27)(4.292)(1.0)$
$Q_{10\text{-}YR}$ = 14.4 cfs

$Q_{100\text{-}YR} = CIAC_f$
$Q_{100\text{-}YR} = (0.46)(9.84)(4.292)(1.25)$
$Q_{100\text{-}YR}$ = 24.4 cfs

OVERLAND FLOW CONTAINED IN THE PIPE MUST BE THE Q_{10} PLUS Q_{100}:

THEREFORE, $Q_{TOTAL} = Q_{10} + Q_{100} = 14.4 + 24.4 =$ 38.8 cfs

PIPE CAPACITY

Pipe Diam = 48" RCP
Mannings n = 0.013
Minimum Slope = 0.4%
$Q_{capacity}$ = 90.8 cfs

ANALYSIS

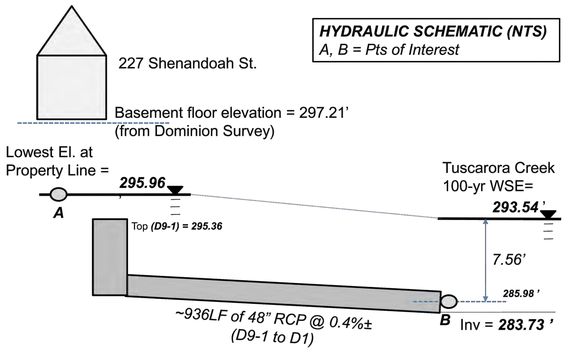
THE STORM SEWER OUTFALL SYSTEM SHALL BE ANALYZED USING 2 DIFFERENT METHODS: (1) BERNOULLI'S EQUATION TO FIND THE DISCHARGE WHEN WATER REACHES THE LOWEST ELEVATION AT THE PROPERTY LINE BEHIND 227 SHENANDOAH STREET AND (2) VDOT HGL ANALYSIS. THE HGL ANALYSIS IS BASED ON THE WORST CASE SCENARIO (10YR + 100YR Q). WITH BOTH THESE METHODS, THE HGL IS ABOVE THE CROWN OF THE PIPE AND PRESSURE FLOW HYDRAULIC CALCULATIONS ARE APPROPRIATE.

DISCHARGE AT PIPE OUTLET DURING 100-YR SUBMERGED CONDITIONS

THE LOWEST SPOT AT THE EDGE OF THE PROPERTY BOUNDARY DOWNSTREAM OF THE HARRISON STREET BRIDGE OCCURS AT 227 SHENANDOAH STREET. THE LOWEST ELEVATION OCCURS AT 295.96' AT THE HOA PROPERTY BOUNDARY. ANALYZING A PARTICULAR WORST CASE/CONSERVATIVE SCENARIO ASSUMES THE WATER IS PONDED TO THE EDGE OF THE PROPERTY LINE AND THE WATER IN TUSCARORA CREEK HAS RISENT TO THE 100-YR FLOODPLAIN ELEVATION (293.54') AND THE 54" OUTLET PIPE IS SUBMERGED. IN THE SUBMERGED CONDITION, THE 54" RCP DISCHARGE AT THE TUSCARORA CREEK OUTLET, ACCOUNTING FOR ALL MAJOR, MINOR, AND VALVE LOSSES IS COMPUTED BELOW. IN ORDER TO BE CONSERVATIVE, THE ENTIRE PIPE LENGTH IS USED IN THE COMPUTATIONS TO ACCOUNT FOR MAXIMUM MAJOR LOSSES IN THE SYSTEM, AND THE OUTLET DIAMETER IS ASSUMED TO BE A 48" RCP.

NOTE:
THE ROCK CASCADE CHANNEL, WHICH RUNS FROM THE OUTFALL AT STORM STRUCTURE D-1 TO THE RIGHT ARM OF CROSS VANE 13, IS DESIGNED TO CARRY THE Q10 + Q100 = 38.8 CFS (ASSUMES NO BACKWATER FROM TUSCARORA CREEK).

n = 0.02
s = 0.97%
Q = 38.8 cfs
d = 1'



HYDRAULIC SCHEMATIC (NTS)
A, B = Pts of Interest

BERNOULLI'S EQUATION:

$P_A/Y + Z_A + V_A^2/2g = P_B/Y + Z_B + V_B^2/2g + H_L$

$P_A/Y = 0$
$V_A^2/2g = 0$

$Z_A = P_B/Y + Z_B + V_B^2/2g + H_L$

REARRANGING YIELDS:

(1) $V_B^2/2g = Z_A - Z_B - P_B/Y - H_L$

(2) $H_L = h_f + h_m$

ABSOLUTE ROUGHNESS OF CONCRETE PIPE

- € = 0.004 FT (FROM *CIVL ENGINEERING REFERENCE MANUAL, 9TH ED.)*

RELATIVE ROUGHNESS OF CONCRETE PIPE

- €/D = 0.004/4 = 0.001

MINOR LOSSES IN PIPE SYSTEM

Hm = ENTRANCE LOSSES + EXIT LOSSES + BEND LOSSES
WHERE JUNCTION LOSSES = ENTRANCE LOSSES + EXIT LOSSES

IN THIS SCENARIO, PLUNGING FLOW WOULD NOT BE EXPERIENCED. ADDITIONALLY, BECAUSE INLET SHAPING HAS BEEN SPECIFIED, A FACTOR OF 0.5 IS APPLIED TO THE MINOR LOSSES:

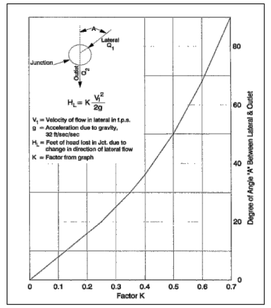
Hm = 0.5*(ENTRANCE LOSSES + EXIT LOSSES + BEND LOSSES)

- *Entrance to VDOT = 0.50*
- *Enlargement at Exit, K_e = 1.0*
- *Exit = 0.25 x 8 Structures = 2.0*
- *Entrance = 0.35 x 8 Structures = 2.8*
- *71 degree bend, K_b = 0.60*
- *7 degree bend, K_b = 0.10*
- *11 degree bend, K_b = 0.15*
- *2 degree bend, K_b = 0.01*
- *31 degree bend, K_b = 0.35*
- *44 degree bend, K_b = 0.43*
- *49 degree bend, K_b = 0.47*
- *27 degree bend, K_b = 0.30*

THERFORE, $K_{B\text{-}TOTAL}$ = 0.5*(8.71) = 4.4

$h_m = K_{B\text{-}TOTAL} (V^2/2g) = 4.4 (V^2/2g)$

$h_m = 4.4 (V^2/2g)$



MAJOR LOSSES IN PIPE SYSTEM

DETERMINE REYNOLDS NUMBER BASED ON VELOCITY ASSUMPTION, V = 5.8 FPS

- *$R = VD/\nu = (5.8)(4)/(1.21 X 10^{-5}) = 1.9 x 10^6$*

THEREFORE, FRICTION FACTOR, *f = 0.0198* (Using Moody Diagram)

$h_f = f(L/D)(V^2/2g) = 0.0198(970/4)(V^2/2g) = 4.8(V^2/2g)$

$h_f = 4.8(V^2/2g)$

SOLVE FOR VELOCITY AND DISCHARGE DURING THESE CONDITIONS

$V_B^2/2g = Z_A - Z_B - P_B/Y - H_L$

$V_B^2/2g = 295.96 - 283.73 - 7.56 - (4.4+4.8)\ V_B^2/2g$

$10.2\ V_B^2/2g = 4.7$

$V_B^2 = (4.7/10.2)(2*32.2)$

V_B = 5.4 FPS

$Q = VA = (5.4)(\pi/4)(48/12)^2$ (USE 48" PIPE)

Q = 68 CFS

RECOMPUTING THE REYNOLDS NUMBER, *f checks*

SUMMARY

UNDER THIS PARTICULAR WORST CASE/CONSERVATIVE CONDITION,

$Q_{PASSABLE}$ = 68 CFS >>38.8 CFS (THE SYSTEM CAN PASS MORE DISCHARGE THAN ENTERING)

WITH THE HEAD DIFFERENTIAL (2.42') FROM THE LOW SPOT AT THE EDGE OF THE PROPERTY LINE AT 227 SHENANDOAH ST. (295.96') TO THE SUBMERGED 54" RCP OUTLET IN TUSCARORA CREEK DURING THE 100-YR FLOOD EVENT (293.54'), THE DISCHARGE WHICH CAN BE PASSED INCORPORATING THE MINOR AND MAJOR LOSSES IS, Q = 68 CFS (VELOCITY AT OUTLET = 5.4 FPS) WHICH IS APPROXIMATELY 75% GREATER THAN THE OVERLAND FLOW DISCHARGE (10-YR PLUS THE 100-YR DISCHARGE: Q10+Q100 = 38.8 CFS). SINCE THE INFLOW MINUS THE OUTFLOW IS EQUAL TO THE CHANGE IN STORAGE, UNDER THIS SITUATION WE HAVE A NEGATIVE STORAGE INDICATING THAT THE SYSTEM CAN DISCHARGE MORE FLOW THAN ENTERS THE SYSTEM. IN ADDITION, THE 100-YR DISCHARGE IS BASED ON USING A SATURATION COEFFICIENT WHICH IN EFFECT, INCREASES THE COMPUTED DISCHARGE BY 25%.

STORM DRAIN PIPE CAPACITY COMPUTATIONS (10 + 100YR)																							
FROM STR # or *DA*	TO STR # or *DA*	DRAINAGE AREA I.D. (DA-#)	DRAINAGE AC	RUNOFF C	CA IN	CA ADD	CA ACCUM	TIME OF CONC. TO MIN	TIME OF CONC. ACCU. MIN	I 10-YR IN/HR	I 100-YR IN/HR	INC. CFS	TOTAL CFS	PIPE DIAM (IN)	Equivalent PIPE DIA IN.	LENGTH IN FEET	SLOPE FT/FT	n	Qcap	Q/Qcap	VELOCITY FULL FPS	VELOCITY Velocity factor	VELOCITY ACTU. FPS	INV. ELEV. UPPER END (ft)	INV. ELEV. LOWER END (ft)	Remarks
D10-1	D10	DA-1	0.31	0.33	0.10	0.00	0.10	5	5	7.27	9.84	1.98	1.98	38x60	48	18.5	0.0054	0.013	105.58	0.02	8.40	0.38	3.19	289.26	289.16	Equivalent Area for 38 x 60 HERCP
D9-1	D9	DA-2	0.30	0.32	0.10	0.00	0.10	5	5	7.27	9.84	1.89	1.89	38x60	48	30.8	0.0049	0.013	100.31	0.02	7.98	0.38	3.03	288.73	288.58	Equivalent Area for 38 x 60 HERCP
D10	D9	-	-	-	-	-	0.10	-	-	7.27	-	-	1.98	38x60	48	94.5	0.0051	0.013	102.38	0.02	8.15	0.38	3.10	289.06	288.58	Equivalent Area for 38 x 60 HERCP
EX. 154	D8-1	DA-3	2.90	0.50	1.45	0.00	1.45	5	5	7.27	9.84	28.29	28.29	24	24	110.5	0.0200	0.013	32.00	0.88	10.19	1.13	11.51	295.43	293.22	
D8-1	D8	DA-4	0.15	0.88	0.13	1.45	1.58	5	5	7.27	9.84	30.84	30.84	24	24	59.0	0.0295	0.013	38.84	0.79	12.36	1.11	13.72	292.28	290.54	
D9	D8	-	-	-	-	-	0.20	5	5	7.27	-	-	3.87	38x60	48	83.7	0.0041	0.013	91.53	0.04	7.28	0.47	3.42	288.48	288.14	Equivalent Area for 38 x 60 HERCP
D7-1	D7	DA-5	0.32	0.34	0.11	0	0.11	5	5	7.27	9.84	2.18	2.18	48	48	41.5	0.0051	0.013	102.24	0.02	8.14	0.38	3.09	288.06	287.85	
D8	D7	-	-	-	-	-	1.77	5	5	7.27	9.84	34.71	34.71	48	48	140.2	0.0041	0.013	91.59	0.38	7.29	0.93	6.78	288.04	287.47	
D6-1	D6	DA-6	0.31	0.31	0.10	0.00	0.10	5	5	7.27	9.84	1.86	1.86	48	48	25.6	0.0055	0.013	106.14	0.02	8.45	0.38	3.21	286.90	286.76	
D7	D6	-	-	-	-	-	1.88	5	5	7.27	9.84	36.89	36.89	48	48	150.7	0.0040	0.013	91.40	0.40	7.27	0.94	6.84	287.37	286.76	
D6	D5	-	-	-	-	-	1.98	5	5	7.27	9.84	38.75	38.75	48	48	71.7	0.0040	0.013	91.35	0.42	7.27	0.95	6.91	286.66	286.37	
D5	D4	-	-	-	-	-	1.98	5	5	7.27	9.84	38.75	38.75	48	48	82.0	0.0040	0.013	91.11	0.43	7.25	0.96	6.96	286.27	285.94	
D4	D3	-	-	-	-	-	1.98	5	5	7.27	9.84	38.75	38.75	48	48	162.1	0.0040	0.013	90.95	0.43	7.24	0.96	6.95	285.84	285.19	
D3	D2	-	-	-	-	-	1.98	5	5	7.27	9.84	38.75	38.75	48	48	201.1	0.0040	0.013	91.16	0.43	7.25	0.96	6.96	285.09	284.28	
D2	D1	-	-	-	-	-	1.98	5	5	7.27	9.84	38.75	38.75	54	54	21.9	0.0041	0.013	126.06	0.31	7.93	0.89	7.05	283.78	283.69	Includes ES-1 Length

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SYM	DESCRIPTION	DATE	APPR

TOWN OF LEESBURG ESTABLISHED 1758 VIRGINIA

TUSCARORA CREEK FLOOD MITIGATION
100% CONSTRUCTION DOCUMENTS
TOWN OF LEESBURG, VIRGINIA
CATOCTIN ELECTION DISTRICT

COMMONWEALTH OF VIRGINIA
MATTHEW TROY BIGGS
Lic. No. 041116
9.18.18
PROFESSIONAL ENGINEER
SEAL

DESIGN BY:	MTB
DRAWN BY:	MJH
REVIEWED BY:	MTB & MB
PROJECT MANAGER:	TWC
AMEC FOSTER WHEELER PROJECT #:	565500008
CONTRACT #:	300810-FY15-22
DATE:	2018-09-17
SHEET SIZE:	D
SCALE:	AS SHOWN

SHEET TITLE:
STORM SEWER COMPUTATIONS & STUCTURE SCHEDULE

SHEET C-56 OF 91

STORM DRAIN PIPE CAPACITY COMPUTATIONS (10YR)

FROM STR # or DA	STR TYPE	ADD. STR #	TO STR # or DA	STR TYPE	DRAINAGE AREA I.D. (DA–#)	DRAINAGE AC	RUNOFF C	CA IN	CA ADD	CA ACCUM	TIME OF CONC. TO MIN	TIME OF CONC. ACCU. MIN	I 10–YR IN/HR	INC. CFS	ADDITION. CFS	TOTAL CFS	PIPE DIAM (IN)	Equivalent PIPE DIA IN.	LENGTH IN FEET	SLOPE FT/FT	n	Qcap	Q/Qcap	VELOCITY FULL FPS	VELOCITY Velocity factor	VELOCITY ACTU. FPS	DEPTH ACTU. FPS	DEPTH ACTU. FPS	INV. ELEV. UPPER END (ft)	INV. ELEV. LOWER END (ft)	TOP ELEV.	Remarks
D10–1			D10		DA–1	0.31	0.33	0.10	0.00	0.10	5	5	7.27	0.74		0.74	38x60	48	18.5	0.0054	0.013	105.58	0.01	8.40	0.32	2.69			289.26	289.16		Equivalent Area for 38 x 60 HERCP
D9–1			D9		DA–2	0.30	0.32	0.10	0.00	0.10	5	5	7.27	0.70		0.70	38x60	48	30.8	0.0049	0.013	100.31	0.01	7.98	0.32	2.55			288.73	288.58		Equivalent Area for 38 x 60 HERCP
D10			D9		–	–	–	–	–	0.10	–	–	7.27	0.74		0.74	38x60	48	94.5	0.0051	0.013	102.38	0.01	8.15	0.32	2.61			289.06	288.58		Equivalent Area for 38 x 60 HERCP
EX. 154			D8–1		DA–3	2.90	0.50	1.45	0.00	1.45	5	5	7.27	10.51		10.51	24	24	110.5	0.0195	0.013	31.56	0.33	10.05	0.90	9.04			295.43	293.28		
D8–1			D8		DA–4	0.15	0.88	0.13	1.45	1.58	5	5	7.27	11.46		11.46	36	36	59.0	0.0295	0.013	114.51	0.10	16.20	0.86	13.93			292.28	290.54		
D9			D8		–	–	–	–	–	0.20	5	5	7.27	1.44		1.44	38x60	48	83.7	0.0041	0.013	91.53	0.02	7.28	0.38	2.77			288.48	288.14		Equivalent Area for 38 x 60 HERCP
D7–1			D7		DA–5	0.32	0.34	0.11	0	0.11	5	5	7.27	0.81		0.81	48	48	41.5	0.0051	0.013	102.24	0.01	8.14	0.32	2.60			288.06	287.85		
D8			D7		–	–	–	–	–	1.77	5	5	7.27	12.89		12.89	48	48	140.2	0.0041	0.013	91.59	0.14	7.29	0.72	5.25			288.04	287.47		
D6–1	DI–3		D6	DI–3	DA–6	0.31	0.31	0.10	0.00	0.10	5	5	7.27	0.69		0.69	48	48	25.6	0.0055	0.013	106.14	0.01	8.45	0.32	2.70			286.90	286.76		
D7	DI–3		D6	DI–3	–	–	–	–	–	1.88	5	5	7.27	13.70		13.70	48	48	150.7	0.0040	0.013	91.40	0.15	7.27	0.73	5.31			287.37	286.76		
D6			D5		–	–	–	–	–	1.98	5	5	7.27	14.39		14.39	48	48	71.7	0.0040	0.013	91.35	0.16	7.27	0.73	5.31			286.66	286.37		
D5	DI–3		D4	di–3	–	–	–	–	–	1.98	5	5	7.27	14.39		14.39	48	48	82.0	0.0040	0.013	91.11	0.16	7.25	0.73	5.29			286.27	285.94		
D4			D3		–	–	–	–	–	1.98	5	5	7.27	14.39		14.39	48	48	162.1	0.0040	0.013	90.95	0.16	7.24	0.73	5.28			285.84	285.19		
D3			D2		–	–	–	–	–	1.98	5	5	7.27	14.39		14.39	48	48	201.1	0.0040	0.013	91.16	0.16	7.25	0.73	5.30			285.09	284.28		
D2	DI–3		D1	di–3	–	–	–	–	–	1.98	5	5	7.27	14.39		14.39	54	54	21.9	0.0041	0.013	126.06	0.11	7.93	0.69	5.47			283.78	283.69		Includes ES–1 Length
D12			D11		–	27.83	0.43	11.97	–	11.97	10	10	5.92	70.84		70.8	36	36	30.0	0.0183	0.013	90.30	0.78	12.77	1.11	14.18			290.25	289.70		
EX. 156			D16		–	17.13	0.50	8.57	–	8.57	5	5	7.27	62.3		62.3	42	42	157.2	0.0210	0.024	78.96	0.79	8.21	1.11	9.11			296.61	293.31		
D16			D15		–	–	–	–	–	8.57	5	5	7.27	62.3		62.3	42	42	66.8	0.0196	0.013	140.89	0.44	14.64	0.97	14.20			293.21	291.90		
D15			D14		–	–	–	–	–	8.57	5	5	7.27	62.3		62.3	42	42	90.0	0.0050	0.013	71.14	0.88	7.39	1.13	8.36			291.80	291.35		
D14			D13		–	–	–	–	–	8.57	5	5	7.27	62.3		62.3	42	42	20.2	0.0050	0.013	70.79	0.88	7.36	1.13	8.31			291.25	291.15		Includes ES–1 Length

NOTES:

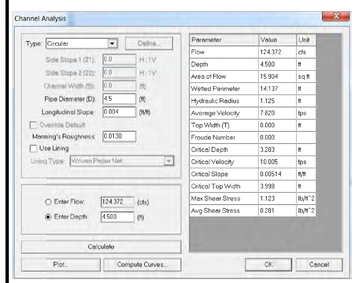
RUNOFF COEFFICIENT C VALUES WERE DETERMINED FROM THE TOWN OF LEESBURG DCSM DRAWING DD-1 - PAVEMENT = 0.90, LAWNS = 0.22, AND FOREST = 0.20.

FOR STRUCTURES D12 - D11 AND D-15 - D14 - D13 THERE WAS NO AS-BUILT COMPUTATIONAL DISCHARGE DATA AVAILABLE. IN 2016 AMEC FOSTER WHEELER DELINEATED MS-4 OUTFALLS FOR THE TOWN. FOR THE ABOVE MENTIONED OUTFALLS, DRAINAGE AREAS AND LAND USE INFORMATION IS PROVIDED FROM THIS STUDY. FOR OUTFALL D-15 TO D-13 THERE IS AN EXISTING UPSTREAM DETENTION POND IN LOCATED IN THE BROOKDALE CONDOMINIUMS. HOWEVER, IT WAS CONSERVATIVELY ASSUMED THAT THE POND WOULD NOT BE IN FUNCTION.

OUTFALL COMPUTATIONS

Structure D2-D1

Assume the pipe is flowing full and determine the outlet velocity exiting the pipe.



The outlet velocity is 8 ft/s

Use the Isbash Method and the USBR method to determine rock size for imbricated rock cascade channel.

▽1

Isbash (1936) developed for construction of dams by depositing rocks into moving water

Critical Velocity	(fps)	8
C value for high turbulence	(dim)	0.86
γs (stone density)	(lb/cf)	165.00
γw (water density)	(lb/cf)	62.40
D_{50}	(ft)	0.8
D_{50}	(in)	9.8

$$V_c = Cx\left(2xgx\frac{\gamma_s - \gamma_w}{\gamma_w}\right)^{0.5} x(D_{50})^{0.50}$$

USBR developed for sizing riprap below a stilling basin

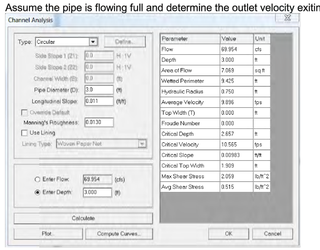
Critical Velocity	(fps)	8
D_{50}	(ft)	0.9
D_{50}	(in)	10.6

$$D_{50} = 0.0122V^{2.06}$$

The channel shall be lined with platy large rocks (1.5-2 ft) with 0.5 thickness. The interstitial spaces shall be filled with a mixture of VDOT #57 Stone and VDOT Gabion Stone.

Structure D12-D11

Assume the pipe is flowing full and determine the outlet velocity exiting the pipe.



The outlet velocity is 10 ft/s

Use the Isbash Method and the USBR method to determine rock size for imbricated rock cascade channel.

▽1

Isbash (1936) developed for construction of dams by depositing rocks into moving water

Critical Velocity	(fps)	10
C value for high turbulence	(dim)	0.86
γs (stone density)	(lb/cf)	165.00
γw (water density)	(lb/cf)	62.40
D_{50}	(ft)	1.3
D_{50}	(in)	15.9

$$V_c = Cx\left(2xgx\frac{\gamma_s - \gamma_w}{\gamma_w}\right)^{0.5} x(D_{50})^{0.50}$$

USBR developed for sizing riprap below a stilling basin

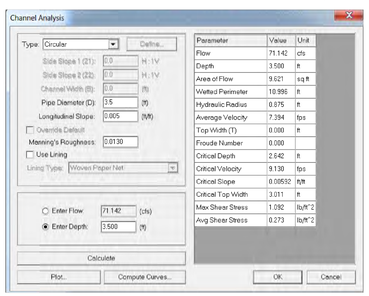
Critical Velocity	(fps)	10
D_{50}	(ft)	1.5
D_{50}	(in)	17.6

$$D_{50} = 0.0122V^{2.06}$$

The channel shall be lined with platy large rocks (1.5-2 ft) with 0.5 thickness. The interstitial spaces shall be filled with a mixture of VDOT #57 Stone and VDOT Gabion Stone.

Structure D14-D13

Assume the pipe is flowing full and determine the outlet velocity exiting the pipe.



The outlet velocity is 7.4 ft/s

Use the Isbash Method and the USBR method to determine rock size for imbricated rock cascade channel.

▽1

Isbash (1936) developed for construction of dams by depositing rocks into moving water

Critical Velocity	(fps)	7
C value for high turbulence	(dim)	0.86
γs (stone density)	(lb/cf)	165.00
γw (water density)	(lb/cf)	62.40
D_{50}	(ft)	0.7
D_{50}	(in)	8.4

$$V_c = Cx\left(2xgx\frac{\gamma_s - \gamma_w}{\gamma_w}\right)^{0.5} x(D_{50})^{0.50}$$

USBR developed for sizing riprap below a stilling basin

Critical Velocity	(fps)	7
D_{50}	(ft)	0.8
D_{50}	(in)	9.0

$$D_{50} = 0.0122V^{2.06}$$

The channel shall be lined with platy large rocks (1.5-2 ft) with 0.5 thickness. The interstitial spaces shall be filled with a mixture of VDOT #57 Stone and VDOT Gabion Stone.

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SYM	DESCRIPTION	DATE	APPR

TOWN OF LEESBURG VIRGINIA ESTABLISHED 1758

TUSCARORA CREEK FLOOD MITIGATION

100% CONSTRUCTION DOCUMENTS

TOWN OF LEESBURG, VIRGINIA

CATOCTIN ELECTION DISTRICT

COMMONWEALTH OF VIRGINIA
MATTHEW TROY BRIGGS
Lic. No. 041116
9.18.18
PROFESSIONAL ENGINEER
SEAL

DESIGN BY:	MTB
DRAWN BY:	MJH
REVIEWED BY:	MTB & MB
PROJECT MANAGER:	TWC
AMEC FOSTER WHEELER PROJECT #:	565500008
CONTRACT #:	300810-FY15-22
DATE:	2018-09-17
SHEET SIZE:	D
SCALE:	AS SHOWN

SHEET TITLE:
STORM SEWER COMPUTATIONS & OUTFALL COMPUTATIONS

SHEET C-57 OF 91