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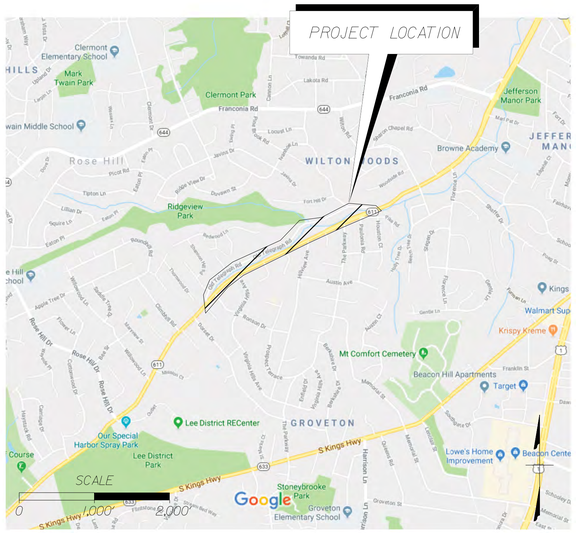
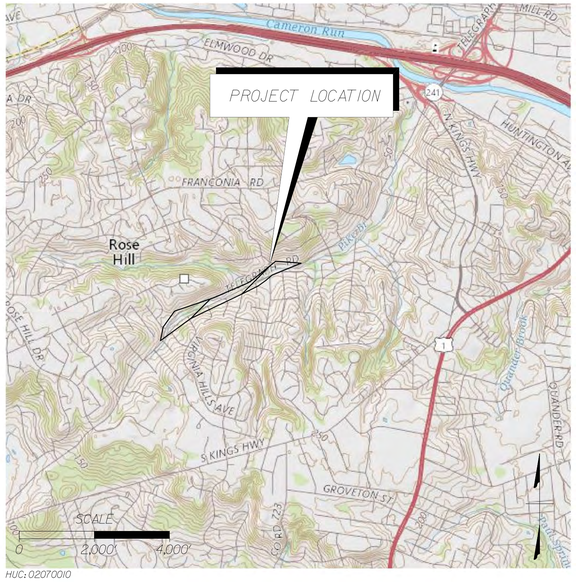
PROJECT MANAGER..TRACEY..HARMON..(804).371-6834
SURVEYED BY ..GEORGE..GIBSON..SEPT..2016..
DESIGN SUPERVISED BY..JOSEPH..F..CATERINO..JR..PE..(804).729-9113
DESIGNED BY ..JOE..CATERINO..NOV..2017..PE..(804).729-9113

STATE	FEDERAL AID PROJECT	STATE ROUTE	STATE PROJECT	SHEET NO.
VA.		611	00000-029-22356817	1





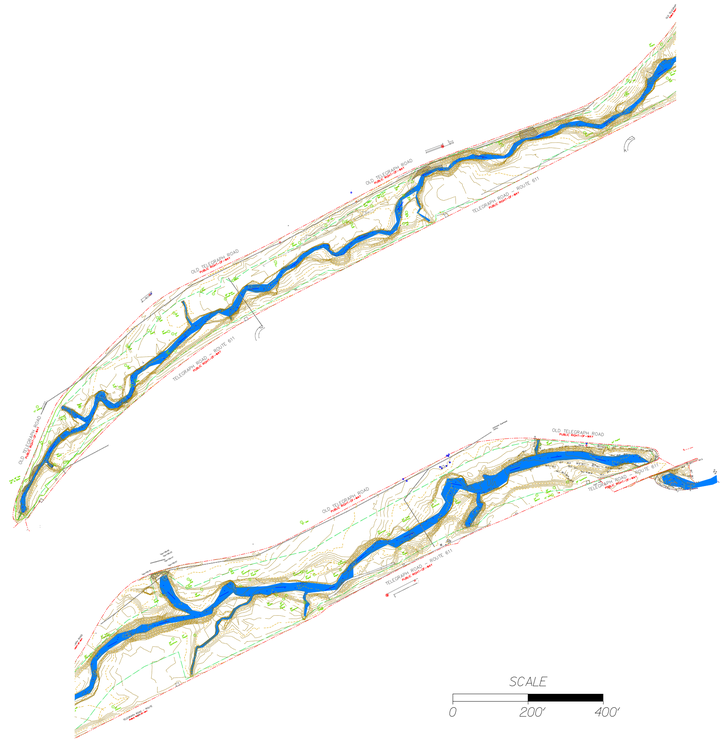
HUC: 02070010
LAT / LONG: 38.7839, -77.0096

COMMONWEALTH OF VIRGINIA
DEPARTMENT OF TRANSPORTATION

CONCEPTUAL PLAN

PIKES BRANCH

FAIRFAX COUNTY, VIRGINIA



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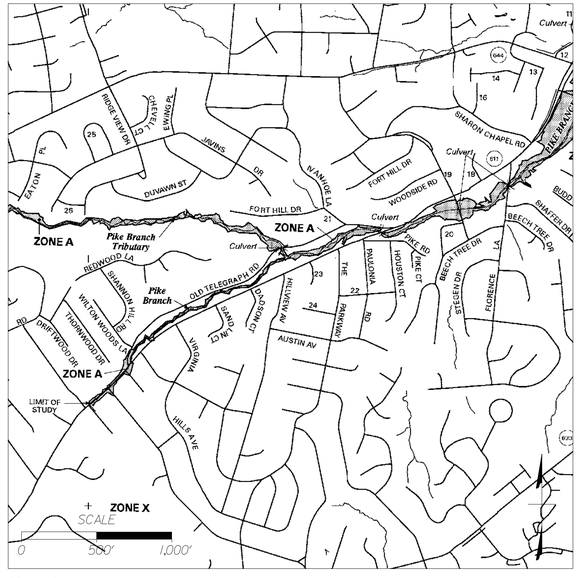

FEMA MAP

STATE PROJECT NO.	SECTION	FEDERAL AID PROJECT NO.	TYPE CODE	CSC NO.	EQUALITIES	LENGTH INCLUDING BRIDGE(S)		LENGTH EXCLUDING BRIDGE(S)		BRIDGE PROJECT NO.	TYPE PROJECT	DESCRIPTION
					FEET	FEET	MILES	FEET	MILES			
00000-047-299,N501		N/A									ENVIRONMENTAL	PIKES BRANCH EAST OF ROUTE 611 AND
												SOUTH OF I-95, APPROXIMATELY --
												LINEAR FEET (+/-) STREAM STABILIZATION

RECOMMENDED FOR APPROVAL FOR CONSTRUCTION	
DATE	PROGRAMMING DIVISION DIRECTOR
DATE	STATE LOCATION AND DESIGN ENGINEER
DATE	STATE STRUCTURE AND BRIDGE ENGINEER
DATE	CHIEF OF PROGRAMMING AND PLANNING

APPROVED FOR CONSTRUCTION	
DATE	CHIEF ENGINEER

APPROVED	
DATE	DIVISION ADMINISTRATOR FEDERAL HIGHWAY ADMINISTRATION U.S.DEPARTMENT OF TRANSPORTATION

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PROJECT 00000-029-22356817 | SHEET NO. 1

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$DGNLEV $LEV001 $LEV002 $LEV003 $LEV004 $LEV005 $LEV006

PROJECT MANAGER_TRACEY HARMON_(804) 371-6834 _____
SURVEYED BY, DATE GEORGE GIBSON, SEPT 2016 (703) 674-5790 _
IMPLEMENTATION DESIGN BY, DATE_JOE CATERINO, NOV 2017 (804) 729-9113_

DESIGN NARRATIVE

REVISED	STATE	ROUTE	STATE PROJECT	SHEET NO.
	VA.		00000-029-22356817	2

1.0 SUMMARY

PIKES BRANCH WILL BE RESTORED USING NATURAL CHANNEL DESIGN (NCD) PRINCIPLES BASED ON APPLIED FLUVIAL GEOMORPHOLOGY. THE GOAL OF NCD IS TO PROVIDE FUNCTIONAL UPLIFT TO STREAM CHANNELS BY WORKING WITH EXISTING STREAM PROCESSES TO CREATE A CHANNEL THAT IS DYNAMICALLY STABLE UNDER CURRENT HYDROLOGY AND SEDIMENT CONDITIONS.

REGULATORY COMPLIANCE

RESTORATION PROJECTS ARE REQUIRED TO USE NCD AND TO SHOW FUNCTIONAL UPLIFT TO QUALIFY FOR NATIONWIDE PERMIT 27. THE INFORMATION BELOW DOCUMENTS THE NCD FOR THIS STREAM PROJECT AND FUNCTIONAL UPLIFT TO THE EXISTING DEGRADED STREAM.

SUMMARY OF PROPOSED RESTORATION

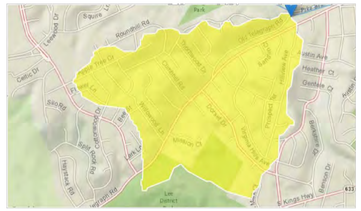
VDOT IS PROPOSING THE RESTORATION OF PIKES BRANCH TO ADDRESS EXISTING DEGRADATION AND IMPACTS TO WATER QUALITY AND BIOLOGY OF THE STREAM. CONCURRENT WITH THE RESTORATION OF THIS REACH, FAIRFAX COUNTY IS DESIGNING THE RESTORATION OF THE REACH IMMEDIATELY DOWNSTREAM OF TELEGRAPH ROAD AND UNNAMED TRIBUTARY #2 UPSTREAM OF TELEGRAPH ROAD WITHIN RIDGEVIEW PARK. BETWEEN 2018 AND 2020, THE CONSTRUCTION OF ALL THREE RESTORATION PROJECTS SHOULD BE COMPLETE.

THE RESTORATION WILL IMPROVE CHANNEL ALIGNMENT ALONG APPROXIMATELY 4,000 LINEAR FEET OF PIKES BRANCH, PULLING THE CHANNEL AWAY FROM THE ERODING VALLEY WALLS. THE RESTORATION WILL ALSO REMOVE FISH PASSAGE BARRIERS, STABILIZE ERODING OUTFALLS, REMOVE GABIONS AND CONCRETE FROM THE CHANNEL, AND REMOVE INVASIVE SPECIES. THE CHANNEL CROSS SECTION WILL PROVIDE FOR STABILITY AND FREQUENT FLOODPLAIN CONNECTION. THE PROPOSED RESTORATION WILL REDUCE ANNUAL LOADINGS OF SEDIMENT, PHOSPHORUS AND NITROGEN FROM THESE REACHES BY 50% TO 85%.

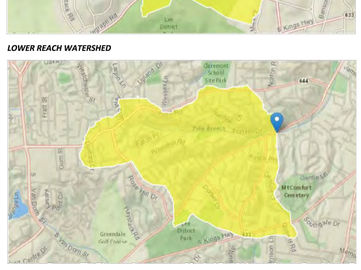
2.0 DESIGN ANALYSIS

THE STREAM DESIGN FOR PIKES BRANCH WAS DIVIDED INTO TWO PHASES (UPPER REACH AND LOWER REACH) DUE TO A SIGNIFICANT INCREASE IN DRAINAGE AREA WHERE SEVERAL TRIBUTARIES COMBINE WITH THE MAIN CHANNEL OF PIKES BRANCH. THE UPPER REACH HAS A DRAINAGE AREA OF 340 ACRES OR 0.53 SQUARE MILES. THE LOWER REACH HAS A CUMULATIVE DRAINAGE AREA OF 1,097 ACRES OR 1.71 SQUARE MILES.

UPPER REACH WATERSHED



LOWER REACH WATERSHED



2.1 HYDROLOGY

A WATERSHED HYDROLOGY ANALYSIS FOR PIKES BRANCH WAS PERFORMED TO EVALUATE THE HYDROLOGIC CONTRIBUTIONS TO THE STREAM FROM ON-SITE AND OFF-SITE AREAS. HYDROLOGIC CALCULATIONS THAT WERE PROVIDED BY STANTEC IN THE CONCEPTUAL DESIGN PHASE WERE VERIFIED AND USED FOR THIS DESIGN ANALYSIS.

BASEFLOW TO PIKES BRANCH WAS ESTIMATED BY REVIEWING BASEFLOW FOR STREAM GAUGE DATA ON FOUR MILE RUN, A STREAM WITH SIMILAR WATERSHED LAND USE CHARACTERISTICS. THE BASEFLOW FROM THE GAGE WAS ADJUSTED TO REFLECT THE DRAINAGE AREA OF PIKE BRANCH. THE BASEFLOW TO THE LOWER REACH OF PIKES BRANCH SHOULD VARY SEASONALLY FROM 0.5 TO 2.0 CFS. BASEFLOW TO THE UPPER REACH WOULD TYPICALLY BE LESS THAN 1 CFS.

REGIONAL CURVES FOR BANKFULL FLOW DISCHARGE ESTIMATES

BASED ON THE DRAINAGE AREA OF PIKES BRANCH, THE FOLLOWING REGIONAL CURVES FROM MIDATLANTIC STATES PREDICT THE DISCHARGE AND DIMENSIONS PROVIDED IN THE TABLE BELOW:

UPPER REACH (340 ACRES OR 0.53 SQUARE MILES)

DIMENSION	NC PIEDMONT	VIRGINIA PIEDMONT	NC PIEDMONT	MD PIEDMONT
	URBAN	RURAL	RURAL	RURAL
$Q_{BKF\ (CFS)}$	206	24.11	58.47	52.29
$A_{BKF\ (SF)}$	40.0	7.02	14.58	10.98
$W_{BKF\ (FT)}$	19.80	9.88	11.56	11.55
$D_{BKF\ (FT)}$	1.97	0.70	1.37	0.95

LOWER REACH (1,097 ACRES OR 1.71 SQUARE MILES)

DIMENSION	NC PIEDMONT	VIRGINIA PIEDMONT	NC PIEDMONT	MD PIEDMONT
	URBAN	RURAL	RURAL	RURAL
$Q_{BKF\ (CFS)}$	430.8	73.1	134	127.4
$A_{BKF\ (SF)}$	85.7	17.9	31.2	25.8
$W_{BKF\ (FT)}$	29.1	16.3	17.6	18.2
$D_{BKF\ (FT)}$	2.9	1.1	1.9	1.4

THE RURAL CURVES ARE BASED ON UNDEVELOPED WATERSHEDS, WHICH WILL UNDER ESTIMATE THE PARAMETERS FOR THIS DEVELOPED WATERSHED. HOWEVER, THESE ESTIMATES PROVIDE SOME UNDERSTANDING OF THE AMOUNT OF CHANNEL ENLARGEMENT AND INCISION THAT HAS BEEN DRIVEN BY WATERSHED DEVELOPMENT. THE NC PIEDMONT CURVE WAS DEVELOPED FROM STABLE URBAN WATERSHEDS (30% IMPERVIOUS SURFACE), AND MAY PROVIDE SOME VALIDATION OF OTHER FLOW ESTIMATES FOR BANKFULL CHANNEL. COMPARISON OF THE RURAL VERSUS URBAN CURVES INDICATES THAT URBAN CHANNELS OFTEN EXPERIENCE A 4-FOLD INCREASE IN FLOW, 2-FOLD INCREASE IN WIDTH AND DEPTH.

USGS REGIONAL REGRESSIONS FOR FLOWS

USING THE USGS 2011 URBAN FLOW DISCHARGES FROM STREAMSTATS (STREAMSTATSAGS.CR.USGS.GOV), THE PREDICTED FLOWS WITH THE URBAN REGRESSIONS ARE SIMILAR TO THE MODEL RESULTS FOR THE LARGER STORM EVENTS. THE 1.11 YEAR RETURN DISCHARGES ARE WITHIN THE MAGNITUDE OF THE NC URBAN CURVE.

	1.11-YEAR	2-YEAR	10-YEAR	100-YEAR
UPPER REACH	254 CFS	379 CFS	685 CFS	1430 CFS
LOWER REACH	352 CFS	603 CFS	1190 CFS	2860 CFS

WATERSHED HYDROLOGIC ANALYSIS TR-55 POND PACK RESULTS

BENTLEY'S PONDPACK (V8I) WAS USED TO MODEL THE WATERSHEDS' PEAK DISCHARGES USING THE NRCS SOILS DATA AND AERIAL LAND USE IMAGERY. STANTEC EVALUATED THE 24-HOUR STORM DISTRIBUTION IN PONDPACK BASED ON THE 24-HR RAINFALL DEPTH TABLE PROVIDED IN APPENDIX 6B-02 OF THE VDOT DRAINAGE MANUAL'S CHAPTER 6 – HYDROLOGY FOR FAIRFAX COUNTY USING NOAA, C 24-HR RAINFALL DISTRIBUTIONS. THE 1, 2, 10 AND 100 YEAR 24-HOUR STORM EVENTS WERE ASSESSED FOR THIS ANALYSIS. THERE IS REASONABLE AGREEMENT BETWEEN FLOWS DERIVED FROM THE USGS REGRESSIONS AND THE WATERSHED SPECIFIC MODELING EFFORT. THE AGREEMENT BETWEEN THE MODEL RESULTS AND THE NC REGIONAL CURVE IS SURPRISINGLY CLOSE FOR THE 1-YEAR EVENT.

REACH	1-YEAR	2-YEAR	10-YEAR	100-YEAR	500-YEAR
UPPER REACH	137 CFS	200 CFS	418 CFS	901 CFS	1714 CFS
LOWER REACH	431 CFS	614 CFS	1231 CFS	2589 CFS	3966 CFS

2.2 REFERENCE REACH DATA AND GEOMORPHIC ASSESSMENT

DUE TO THE EXTENSIVE CHANNEL EROSION, INTERNAL REFERENCE REACH INFORMATION WAS LIMITED FOR THIS PROJECT. DURING FIELD INVESTIGATION THREE RELATIVELY STABLE RIFFLE CROSS SECTIONS WERE IDENTIFIED. BASED ON THE ON-SITE BANKFULL SURVEY INDICATORS, THE FOLLOWING BANKFULL DIMENSIONS WERE DETERMINED FROM THESE INTERNAL REFERENCE REACHES, AND THE BANKFULL FLOWS PREDICTED:

	UPPER REACH #1	UPPER REACH #2	LOWER REACH
Wbkf	11.59	17.68	18.35
Dbkf	0.78	1.05	1.19
Abkf	9.08	18.65	24.13
Qbkf	29.8	89.95	105.87

AS WOULD BE EXPECTED, THE REFERENCE RIFFLE CROSS SECTION EXPAND IN THE DOWNSTREAM DIRECTION. HOWEVER, THE RIFFLE IN THE LOWER REACH DOES NOT APPEAR TO REFLECT THE SIGNIFICANT INCREASE IN FLOW IN THE LOWER REACH. THIS REACH HAS A VERY HIGH BED LOAD, AND THE VOLUME OF SEDIMENT MAY BE OVERWHELMING THE CHANNEL'S ABILITY TO MAINTAIN A BANKFULL CHANNEL. THE LOWER REACH REFERENCE WAS NOT USED IN THE DESIGN EFFORT.

2.3 DESIGN CRITERIA, DISCHARGE AND CHANNEL DIMENSIONS

THE CHANNEL WILL BE RESTORED WITH A GRAVEL/COBBLE RIFFLE/POOL MORPHOLOGY (I.E. ROSGEN C4) TYPICAL OF PIEDMONT AND UPPER COASTAL PLAIN STREAMS IN VIRGINIA. THE SLOPE OF THE CHANNEL IS CONSTRAINED BY THE UPSTREAM AND DOWNSTREAM CULVERTS, RESULTING IN A CHANNEL SLOPE OF 1.4 TO 1.6% (0.014-0.016 FT/FT). THIS SLOPE IS COMPATIBLE WITH A RIFFLE/POOL MORPHOLOGY.

THE NARROW WIDTH OF THE PROPERTY LIMITS THE AMOUNT OF BELT WIDTH THAT CAN BE CREATED THROUGH THE EXCAVATION OF A NEW FLOODPLAIN. THE PROPOSED FLOODPLAIN WOULD RANGE FROM 50 TO 90 FEET WIDE, AS THE CHANNEL PROGRESSES DOWNSTREAM. THE NEW FLOODPLAIN ALLOWS FOR A SINUOSITY OF BETWEEN 1.1 AND 1.2.

DESIGN DISCHARGES

THE DESIGN DISCHARGES WERE SELECTED BASED ON A REVIEW OF THE ABOVE REFERENCED HYDROLOGY DATA. THE DESIGN DISCHARGE (Q) FOR BOTH REACHES WAS SELECTED TO BE SLIGHTLY LOWER THAN THE PREDICTED 1-YEAR RETURN EVENT. THE BANKFULL DESIGN DISCHARGE WILL HELP DISSIPATE ENERGY ACROSS THE NEW FLOODPLAIN AND PROMOTE MORE WETLAND FLOODPLAINS THAN A DESIGN DISCHARGE GREATER THAN A 1-YEAR RETURN INTERVAL.

DESIGN DISCHARGES

	UPPER REACH	LOWER REACH
DESIGN Q (BANKFULL)	121 CFS	319 CFS

FOR THE UPPER REACH, THE DESIGN STORM IS SLIGHTLY MORE THAN REGIONAL CURVE AND THE ON-SITE REFERENCE RIFFLE, AND SLIGHTLY LESS THAN THE TR-55 MODEL RESULTS. THE DESIGN DISCHARGE FOR THE LOWER REACH IS SLIGHTLY LOWER THAN THE TR-55 MODEL RESULTS, THE USGS REGRESSION PREDICTION, AND THE REGIONAL CURVE.

DESIGN CHANNEL DIMENSIONS

PHASE I - UPPER REACH DESIGN DIMENSIONS

PROPOSED DESIGN PARAMETER	BASEFLOW DESIGN	FLOODPLAIN DESIGN
SLOPE	1.54%	1.69%
SINUOSITY	1.1 TO 1.2	N/A
DESIGN WIDTH	15.6	57
AVERAGE DEPTH	1 FT	1.53 FT
DESIGN RIFFLE DEPTH MAX	2.4 FT	4.0 FT
ROUGHNESS N	0.04	0.1
Q BASED ON DESIGN	~120 CFS	~780 CFS
AVERAGE VELOCITY	4-6 FPS	

THE UPPER REACH DIMENSIONS ARE BASED ON PROVIDING A STABLE CHANNEL WITH IMPROVED HABITAT AND A LARGER FLOODPLAIN CHANNEL THAT ACCOMMODATES THE INCREASED HYDROLOGY DUE TO DEVELOPMENT OF THE WATERSHED. LARGER ANNUAL STORMS WILL ACCESS THE FLOODPLAIN, DISSIPATING ENERGY ACROSS THE FLOODPLAIN WHILE IMPROVING WETLAND HABITAT.

THE MEANDER RADIUS WILL BE BETWEEN 2 AND 3 TIMES THE BANKFULL DESIGN WIDTH (32-48 FT). THE POOLS WILL BE 2-2.5 FEET DEEP AT BASE FLOW AND 4-4.5 FEET AT BANKFULL FLOWS.

PHASE II - LOWER REACH DESIGN DIMENSIONS

PROPOSED DESIGN PARAMETER	BASEFLOW DESIGN	FLOODPLAIN DESIGN
SLOPE	1.35%	1.43%
DESIGN WIDTH	23.6	94
AVERAGE DEPTH	1.94 FT	1.53 FT
DESIGN RIFFLE DEPTH MAX	3.6 FT	4.0 FT
ROUGHNESS N	0.04	0.1
Q BASED ON DESIGN	~319 CFS	~1815 CFS
AVERAGE VELOCITY	6-8 FPS	

THE CHANNEL AND FLOODPLAIN VELOCITIES ARE TAMPED DOWN BY THE BACKWATER FROM THE DOWNSTREAM CULVERT UNDER TELEGRAPH ROAD FOR THE LOWER REACH. THE MEANDER RADIUS WILL BE BETWEEN 2 AND 3 TIMES THE BANKFULL DESIGN WIDTH (48-72 FT). THE POOLS WILL BE 3-3.5 FEET DEEP AT BASE FLOW AND 6-6.5 FEET AT BANKFULL FLOWS.

2.4 SEDIMENT TRANSPORT ANALYSIS OF PROPOSED DESIGN

THERE ARE SEVERAL PERENNIAL STREAMS THAT FLOW INTO THE UPPER REACH. HOWEVER, THESE TRIBUTARIES ARE PIPED, AND DO NOT DELIVER BEDLOAD TO THE UPPER REACH. THUS THIS REACH IS A SEDIMENT STARVED AND HISTORICALLY HAS INCISED AS IT HAS MOVED ITS BED MATERIALS DOWNSTREAM. AS SUCH, THE CHANNEL WILL BE DESIGNED TO MINIMIZE TRANSPORT OF GRAVELS AND COBBLES.

AS AN URBAN WATERSHED, SAND AND FINES ARE EXPECTED TO BE DELIVERED DURING STORM EVENTS, PARTICULARLY AFTER WINTER SANDING OPERATIONS ON ROADWAYS. AS SUCH, THE CHANNEL WILL BE DESIGNED TO TRANSPORT SMALL GRAVEL, SANDS AND FINES, AND DEPOSIT THEM ON THE FLOODPLAIN.

SUBSTRATE SIZING FOR GRADE CONTROL

SINCE THESE URBAN STREAMS ARE MOSTLY SEDIMENT STARVED, A THRESHOLD CHANNEL DESIGN IS REQUIRED TO PREVENT FUTURE INCISION BY OVER MOBILIZATION OF THE STREAM BED MATERIALS. STONE SIZING CALCULATIONS USING ARMY CORP OF ENGINEER AND OTHER SIZING CALCULATIONS INDICATES THAT CLASS IA RIPRAP (10 INCH) WOULD BE USED AS GRADE CONTROL STONE IN THE RIFFLES IN THE UPPER REACH AND CLASS 1 (13 INCH) IN THE LOWER REACH RIFFLES.

THE SURFACE OF THE RIFFLES WILL BE A GRAVEL/COBBLE MIX TO PROVIDE HABITAT FUNCTIONS. BASED ON THE BANKFULL HYDRAULICS, THE D84 OF THE GRAVEL/COBBLE MIX WOULD BE 66 MM FOR THE UPPER REACH AND 87 MM FOR THE LOWER REACH.

SEDIMENT MOBILITY

AN EVALUATION OF THE SEDIMENT CONVEYANCE AND COMPETENCY WAS COMPLETED FOR THIS STREAM. THE ANALYSIS WAS CONDUCTED WITH THE BEDLOAD ASSESSMENT FOR GRAVEL STREAMS (BAGS) SPREADSHEET. A STABLE CHANNEL SHOULD HAVE THE FOLLOWING CHARACTERISTICS:

- *AT 30% OF BANKFULL, THERE SHOULD BE RELATIVELY LITTLE BEDLOAD MOVEMENT*
- *AT 60% OF BANKFULL THERE SHOULD BE THE START OF MEASURABLE BEDLOAD MOVEMENT*
- *AT BANKFULL, THERE SHOULD BE MOVEMENT OF SUBSTRATE UP TO GRAVEL SIZE TO REJUVENATE RIFFLES, BUT THE LARGER SUBSTRATE SHOULD REMAIN STABLE.*

BASED ON THE PROPOSED CROSS SECTION, SLOPE, ROUGHNESS AND PROPOSED SUBSTRATE SIZE, THE FOLLOWING SEDIMENT LOAD WAS CALCULATED USING THE WILCOX AND CREW EQUATION.

SEDIMENT COMPETENCY AND CONVEYANCE ASSESSMENT

DISCHARGE	1 - 2 mm Kg/Min	2 - 4 mm Kg/Min	4 - 8 mm Kg/Min	8 - 16 mm Kg/Min	16 - 32 mm Kg/Min	32 - 64 mm Kg/Min	64 - 128 mm Kg/Min	TOTAL LOAD Kg/Min
30% BK (95 CFS)	0.70	1.11	0.86	4.86	4.24	1.42	0.07	13
60% BK (191 CFS)	4.20	7.26	6.24	39.51	41.37	23.26	4.76	126
BANKFULL (319 CFS)	10.08	17.99	15.99	105.30	116.77	75.98	30.66	372

THE ANALYSIS INDICATES THAT UNDER THE DESIGN CONDITIONS THE PROPOSED GRAVEL/COBBLE SUBSTRATE WOULD BEHAVE AS WOULD BE PREDICTED FOR A STABLE CHANNEL:

- *THE SAND AND PEA GRAVEL (2-8 MM) WOULD BE MOBILIZED DURING MOST STORM EVENTS, HELPING TO REMOVE FINES FROM THE RIFFLES.*
- *THE GRAVEL SUBSTRATE (8-64 MM) WOULD BECOME MOBILE UNDER STORM FLOWS BUT THE LOAD WOULD BE RELATIVELY LOW.*
- *THE COBBLE SUBSTRATE (>64 MM) WHICH REPRESENTS 20-40% OF THE SUBSTRATE WOULD BE SLIGHTLY MOBILE UNDER THE BANKFULL DISCHARGE*
- *THE GRADE CONTROL STONE UNDER THE RIFFLES (CLASS IA OR I RIPRAP) WOULD REMAIN STABLE DURING ALL STORM EVENTS PREVENTING INCISION.*
- *AT BANKFULL THE VOLUME OF BED LOAD WOULD RESULT IN ONLY <5 CF (372lg) OF STONE MOVING PER MINUTE THROUGH THE 24-FOOT-WIDE CHANNEL, AN INSUFFICIENT AMOUNT TO CAUSE AGGRADATION.*

2.5 DESIGN FEATURES AND INSTREAM STRUCTURES

THE DESIGN WILL INCORPORATE THE FOLLOWING FEATURES TO IMPROVE CHANNEL HABITAT AND FUNCTION:

- *RIFFLES WILL BE CONSTRUCTED BETWEEN MEANDERS USING IMPORTED STONE TO PROVIDE LONG-TERM STABILITY. THE EXISTING CHANNEL MATERIALS WILL BE SALVAGED WHERE POSSIBLE AND USED TO PROVIDE A COBBLE/GRAVEL LAYER ON THE RIFFLES.*
- *POOLS WILL BE CONSTRUCTED IN THE MEANDERS, TYPICALLY TWICE AS DEEP AS THE MAXIMUM RIFFLE DEPTH. EACH POOL WILL BE PROVIDED WITH WOODY MATERIAL FOR HABITAT ENHANCEMENT. FISH SAMPLING SHOWED THAT POOLS WITH WOOD HELD SUBSTANTIALLY MORE FISH THAN OPEN POOLS.*
- *DEPENDING ON ADDITIONAL MODELING RESULTS, THE OUTER MEANDER BENDS MAY BE STABILIZED WITH A STONE TOE OR WOOD TOE.*
- *TREES REMOVED FROM THE FLOODPLAIN DURING CONSTRUCTION WILL BE PLACED ALONG THE FLOODPLAIN TO PROVIDE HYDRAULIC ROUGHNESS AND REFUGE FOR FISH DURING HIGH FLOWS.*
- *THE HIGH ERODING VALLEY WALLS WILL BE PROTECTED FROM EROSION BY RELOCATION OF THE CHANNEL AND BY GRADING AND MATTING.*
- *LARGER STORMWATER OUTFALLS WILL BE RETROFITTED WITH ENERGY DISSIPATION BASINS.*
- *SMALLER STORMWATER OUTFALLS WILL BE RETROFITTED WITH MANHOLES TO DISSIPATE ENERGY AND TO REDIRECT FLOWS THROUGH OUTLET CHANNELS.*

3.0 FUNCTIONAL UPLIFT AND GOALS/OBJECTIVES

THE PROPOSED RESTORATION OF PIKES BRANCH WILL RESULT IN SIGNIFICANT FUNCTIONAL UPLIFT, INCLUDING HYDRAULIC, GEOMORPHIC, PHYSICOCHEMICAL, AND BIOLOGICAL PROPERTIES. THE REMOVAL OF VARIOUS FISH BLOCKAGES WILL IMPROVE PASSAGE, POTENTIALLY INCREASING THE DIVERSITY OF FISHES WITHIN THE STREAM. REALIGNMENT OF THE STREAM CHANNEL AND ADJUSTMENTS TO THE STREAM CHANNEL DIMENSIONS WILL REDUCE EROSION AND DECREASE SEDIMENT AND NUTRIENT LOADS. THE INCREASE IN FLOODPLAIN CONNECTION IMPROVES HYDROLOGY TO FLOODPLAIN WETLANDS AND REDUCES IN-CHANNEL HYDRAULIC STRESSES CURRENTLY CAUSING BANK EROSION.

PIKES BRANCH
FUNCTIONAL UPLIFT (GOALS AND OBJECTIVES) TABLE

LEVEL, CATEGORY & GOAL	PARAMETER & OBJECTIVE	MEASUREMENT METHOD	PERFORMANCE STANDARD			PRE RESTORATION CONDITION		POST RESTORATION CONDITION (DESIGN)	
			FUNCTIONING	AT-RISK	NOT FUNCTIONING	VALUE	RATING	VALUE	RATING
LEVEL 1 - HYDROLOGY									
	NOT APPLICABLE	NO CHANGES							
LEVEL 2 - HYDRAULICS									
IMPROVE FLOODPLAIN ACCESS	INCREASE ANNUAL FREQUENCE OF FLOODPLAIN ACCESS	CONFIRMED WITH STREAM GAGE OR PHOTO MONITORING	3+	1-2	<1	< 1	NOT FUNCTIONING	>3	FUNCTIONING
REDUCE HYDRAULIC STRESS	REDUCE VELOCITY AT BANKFULL	HEC-RAS MODEL	<4 FTS	4-6 FPS	>6 FPS	> 6 FT	NOT FUNCTIONING	< 4 fps	FUNCTIONING
LEVEL 3 - GEOMORPHOLOGY									
REDUCE BANK EROSION	REDUCE BANK EROSION	ESTIMATED WITH BEHI	LESS THAN MODERATE	MODERATE	HIGH- EXT	MOD-EXT	NOT FUNCTIONING	LOW-MOD	FUNCTIONING
REDUCE LATERAL INSTABILITY	REDUCE LATERAL EROSION RATES	PREDICTED WITH BEHI/NBS	<0.3 FT/YR	0.23-0.6 FT/YR	>0.6 FT/YR	0.4-0.9	NOT FUNCTIONING	<0.3 FT/YR	FUNCTIONING
INCREASE BEDFORM DIVERSITY	IMPROVE HABITAT BY PROMOTING A VARIETY OF DEPTHS AND FLOW VELOCITIES	% RIFFLE / % POOL	50/50	60/40	30/70	35/65	NOT FUNCTIONING	50/50	FUNCTIONING
LEVEL 4 - PHYSICOCHEMICAL									
REDUCE SEDIMENT LOADS	REDUCE TOTAL SUSPENDED SEDIMENT (TSS) ANNUAL LOAD	ANNUAL PREDICTED LOAD PER 1,000 LF	<50 TONS	50-175 TONS	>175 TONS	436 TONS	NOT FUNCTIONING	10 TONS	FUNCTIONING
REDUCE NUTRIENTS LOADS	REDUCE TOTAL PHOSPHORUS (TP) ANNUAL LOAD	ANNUAL PREDICTED LOAD PER 1,000 LF	<50 LBS	50-175 LBS	>175 LBS	458 LBS	NOT FUNCTIONING	42 LBS	FUNCTIONING
LEVEL 5 - BIOLOGY									
PROVIDE FISH PASSAGE	REMOVAL OF BLOCKAGES	FISHXING	NOT BLOCKED	PARTLY BLOCKED	PERMANENTLY BLOCKED	BLOCKED	NOT FUNCTIONING	NOT BLOCKED	FUNCTIONING

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PROJECT MANAGER TRACEY HARMON (804) 371-6834
SURVEYED BY, DATE GEORGE GIBSON, SEPT 2016, (703) 674-5790
DESIGN BY JOE CATERINO

EXISTING CONDITIONS - LOWER REACH

REVISED	STATE	STATE ROUTE	STATE PROJECT	SHEET NO
	VA.	611	00000-029-22356817	3

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

(A) - HEAD OF REACH

(B) - RIPRAP CAUSING FISH PASSAGE BLOCKAGE

(C) - HEADCUT BELOW CULVERT

(D) - FISH PASSAGE BLOCKAGE, SANITARY SEWER CROSSING

Worksheet 2-3. Field form for Level II stream classification (Rosgen, 1996; Rosgen and Silvey, 2005).

Stream:	**Pike Branch, Upper Reach - Riffle**	
Basin:	Drainage Area: **0** acres **0** mi^2	
Location:		
Twp.&Rge: ;	Sec.&Qtr.: ;	
Cross-Section Monuments (Lat./Long.):	**0 Lat / 0 Long**	Date: **06/07/17**
Observers:		Valley Type:

Bankfull WIDTH (W_{bkf}) WIDTH of the stream channel at bankfull stage elevation, in a riffle section.	**11.59**	ft
Bankfull DEPTH (d_{bkf}) Mean DEPTH of the stream channel cross-section, at bankfull stage elevation, in a riffle section ($d_{bkf} = A / W_{bkf}$).	**0.78**	ft
Bankfull X-Section AREA (A_{bkf}) AREA of the stream channel cross-section, at bankfull stage elevation, in a riffle section.	**9.08**	ft^2
Width/Depth Ratio (W_{bkf} / d_{bkf}) Bankfull WIDTH divided by bankfull mean DEPTH, in a riffle section.	**14.86**	ft/ft
Maximum DEPTH (d_{mbkf}) Maximum depth of the bankfull channel cross-section, or distance between the bankfull stage and Thalweg elevations, in a riffle section.	**1.23**	ft
WIDTH of Flood-Prone Area (W_{fpa}) Twice maximum DEPTH, or (2 x d_{mbkf}) = the stage/elevation at which flood-prone area WIDTH is determined in a riffle section.	**21.51**	ft
Entrenchment Ratio (ER) The ratio of flood-prone area WIDTH divided by bankfull channel WIDTH (W_{fpa} / W_{bkf}) (riffle section).	**1.86**	ft/ft
Channel Materials (Particle Size Index) D_{50} The D_{50} particle size index represents the mean diameter of channel materials, as sampled from the channel surface, between the bankfull stage and Thalweg elevations.	**9**	mm
Water Surface SLOPE (S) Channel slope = "rise over run" for a reach approximately 20–30 bankfull channel widths in length, with the "riffle-to-riffle" water surface slope representing the gradient at bankfull stage.	**0.01**	ft/ft
Channel SINUOSITY (k) Sinuosity is an index of channel pattern, determined from a ratio of stream length divided by valley length (SL / VL); or estimated from a ratio of valley slope divided by channel slope (VS / S).	**1.1**	
Stream Type	**B 4c**	(See **Figure 2-14**)

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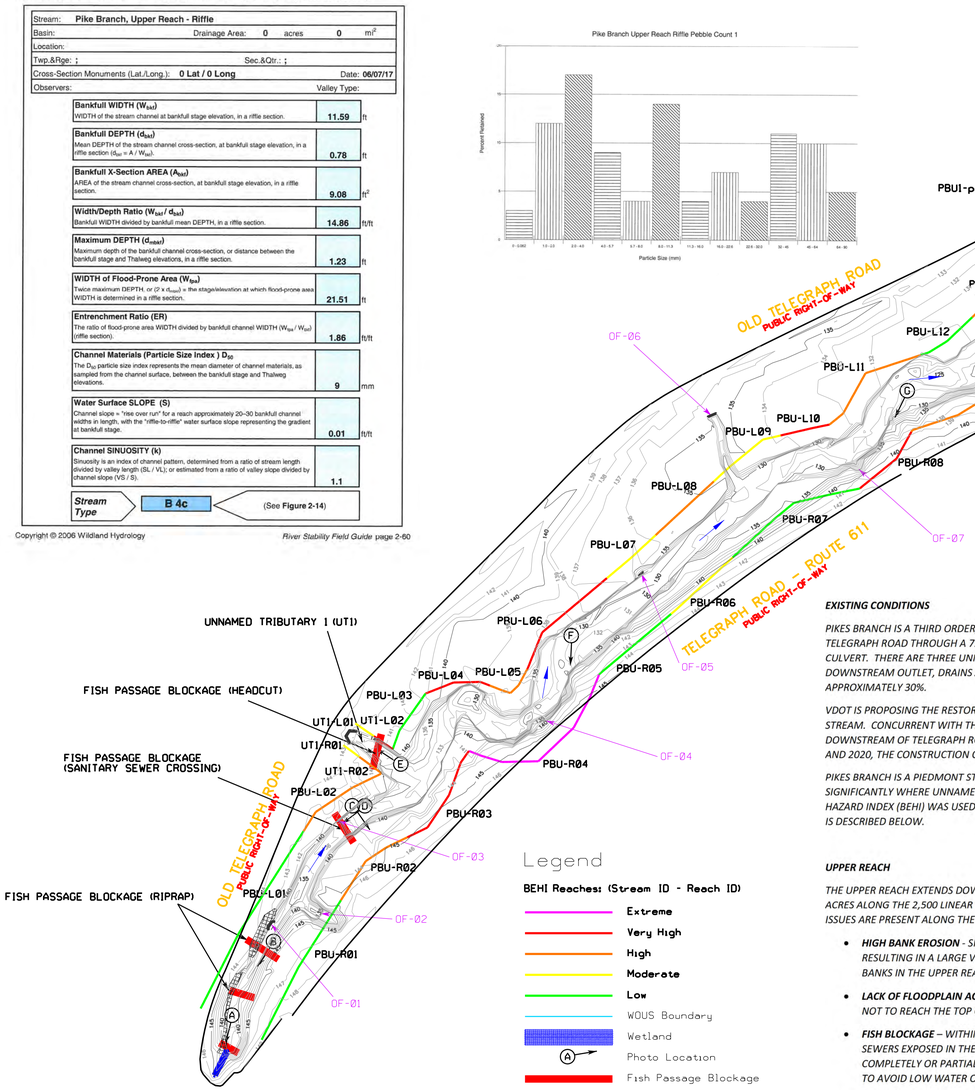


Legend

BEHI Reaches: (Stream ID - Reach ID)

- Extreme
- Very High
- High
- Moderate
- Low
- WOUS Boundary
- Wetland
- Photo Location
- Fish Passage Blockage
- Cross Section
- Riprap
- Flow Direction

NORTH

(K) - VERY HIGH BEHI: PBU-R16

(E) - HEADCUT BELOW CULVERT

(F) - EXTREME BEHI: PBU-R04

(H) - RIPRAP CAUSING FISH PASSAGE BLOCKAGE

(G) - VERY HIGH BEHI: PBU-R08

(J) - BANK COLLAPSE, DEBRIS AND RIPRAP CAUSING FISH PASSAGE BLOCKAGE

(I) - RIPRAP CAUSING FISH PASSAGE BLOCKAGE

(L) - CONCRETE RUBBLE CAUSING FISH PASSAGE BLOCKAGE

EXISTING CONDITIONS

PIKES BRANCH IS A THIRD ORDER, PERENNIAL TRIBUTARY TO CAMERON RUN, IN FAIRFAX COUNTY (020700100302, PL264). THE STREAM FLOWS UNDER OLD TELEGRAPH ROAD THROUGH A 72-INCH CULVERT, THEN FLOWS FOR 4,000 LF THROUGH VDOT PROPERTY BEFORE EXITING THROUGH A DOUBLE-BARRELED BOX CULVERT. THERE ARE THREE UNNAMED TRIBUTARIES FLOWING INTO THIS REACH AND NUMEROUS STORMWATER OUTFALLS. PIKES BRANCH, AT THE DOWNSTREAM OUTLET, DRAINS APPROXIMATELY 1.7 SQUARE MILES OF PRIMARILY DENSE RESIDENTIAL LAND, WITH AN IMPERVIOUS COVER OF APPROXIMATELY 30%.

VDOT IS PROPOSING THE RESTORATION OF PIKE BRANCH TO ADDRESS EXISTING DEGRADATION AND IMPACTS TO WATER QUALITY AND BIOLOGY OF THE STREAM. CONCURRENT WITH THE RESTORATION OF THIS REACH, FAIRFAX COUNTY IS DESIGNING THE RESTORATION OF THE REACH IMMEDIATELY DOWNSTREAM OF TELEGRAPH ROAD AS WELL AS THE UNNAMED TRIBUTARY #2 UPSTREAM OF TELEGRAPH ROAD WITHIN RIDGEVIEW PARK. BETWEEN 2018 AND 2020, THE CONSTRUCTION OF ALL THREE RESTORATION PROJECTS SHOULD COMPLETE.

PIKES BRANCH IS A PIEDMONT STREAM WITH LIMITED FLOODPLAIN ACCESS WITHIN A NARROW VALLEY. THE MAIN CHANNEL CHANGES DIMENSIONS SIGNIFICANTLY WHERE UNNAMED TRIBUTARY 2 AND 3 ENTER, DEFINING AN UPPER AND LOWER REACH. TO ESTIMATE BANK EROSION, THE BANK EROSION HAZARD INDEX (BEHI) WAS USED TO CATEGORIZE THE STREAM BANKS ALONG THE PROJECT AREA. THE CONDITION OF THE UPPER AND LOWER STREAM REACH IS DESCRIBED BELOW.

UPPER REACH

THE UPPER REACH EXTENDS DOWNSTREAM TO THE CONFLUENCE WITH UNNAMED TRIBUTARY #2. THE DRAINAGE AREA INCREASES FROM 160 ACRES TO 340 ACRES ALONG THE 2,500 LINEAR FEET OF CHANNEL. THIS REACH WOULD BE ASSIGNED TO THE ROSGEN CLASSIFICATION OF B4c. SIGNIFICANT ENVIRONMENTAL ISSUES ARE PRESENT ALONG THE UPPER REACH:

- ***HIGH BANK EROSION*** *- SIGNIFICANTLY ERODING BANKS ARE COMMON IN THE UPPER REACH. ERODING STREAM BANKS ARE TYPICALLY 5-15 FEET TALL, RESULTING IN A LARGE VOLUME OF SEDIMENT BEING DELIVERED DIRECTLY INTO THE STREAM ANNUALLY. APPROXIMATELY 3,000 LF (61%) OF THE BANKS IN THE UPPER REACH ARE RATED AS HIGH TO EXTREME, BASED ON A BANK EROSION EVALUATION (PHOTOS F, G AND K).*
- ***LACK OF FLOODPLAIN ACCESS*** *– THE UPPER REACH IS DEEPLY INCISED BELOW THE SURROUNDING LANDSCAPE. MOST LARGE STORMS ARE PREDICTED NOT TO REACH THE TOP OF THE BANK. THE LACK OF A WIDE ACTIVE FLOODPLAIN GREATLY INCREASES THE EROSION DURING LARGE STORM EVENTS.*
- ***FISH BLOCKAGE*** *– WITHIN THE REACH THERE ARE SEVERAL SIGNIFICANT FISH PASSAGE BLOCKAGES. THERE ARE TWO CONCRETE ENCASED SANITARY SEWERS EXPOSED IN THE CHANNEL (PHOTOS C AND P), WITH 2-FOOT VERTICAL DROPS BLOCKING FISH PASSAGE. THERE ARE AREAS OF THE CHANNEL COMPLETELY OR PARTIALLY BLOCKED BY RIPRAP OR DEBRIS. FISH POPULATIONS IN THE UPPER REACH CANNOT MOVE UPSTREAM OR DOWNSTREAM TO AVOID LOW WATER OR POOR WATER QUALITY CONDITIONS.*
- ***SEDIMENT SIZE*** *– THE UPPER REACH HAS >12% SANDS AND FINES, WHICH IS A SUFFICIENT LEVEL TO START TO DEGRADE AQUATIC HABITAT. THE PEBBLE COUNT DATA (SEE BAR CHART) SHOWS >12% SAND/FINES AND 25% PEA GRAVEL, BOTH WHICH ARE HIGHLY MOBILE UNDER STORM FLOWS. THE MOBILIZATION OF >37% OF THE SUBSTRATE LEADS TO UNSTABLE HABITAT AT HIGH FLOWS.*

SCALE	PROJECT	SHEET NO.
0 100' 200'	00000-029-22356817	3

$TIME$ST_MP$

DGN $REF001 $REF002 $REF003 $REF004 $REF005 $REF006
$DGNLEV $LEV001 $LEV002 $LEV003 $LEV004 $LEV005 $LEV006

PROJECT MANAGER TRACEY HARMON (804) 371-6834
SURVEYED BY, DATE GEORGE GIBSON, SEPT. 2016, (703) 674-5790
DESIGN BY JOE CATERINO

EXISTING CONDITIONS - UPPER REACH

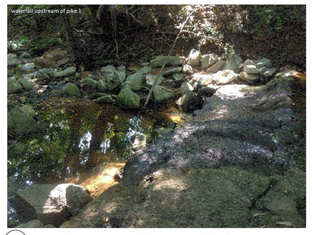
REVISED	STATE	STATE ROUTE	STATE PROJECT	SHEET NO
	VA.	611	00000-029-22356817	4

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

(M) - CONCRETE RUBBLE

(N) - GABION WALL FAILURE

(O) - FAILURE OF OUTFALL AND ASSOCIATED GABION WALL



(P) - FISH PASSAGE BLOCKAGE, SANITARY SEWER CROSSING

Worksheet 2-3. Field form for Level II stream classification (Rosgen, 1996; Rosgen and Silvey, 2005).

Stream:	**Pike Branch, Lower Reach - Riffle**	
Basin:	Drainage Area: **0** acres **0**	mi^2
Location:		
Twp.&Rge: ;	Sec.&Qtr.: ;	
Cross-Section Monuments (Lat./Long.):	**0 Lat / 0 Long**	Date: **06/07/17**
Observers:	Valley Type:	

Bankfull WIDTH (W_{bkf}) WIDTH of the stream channel at bankfull stage elevation, in a riffle section.	**25.79**	ft
Bankfull DEPTH (d_{bkf}) Mean DEPTH of the stream channel cross-section, at bankfull stage elevation, in a riffle section ($d_{bkf} = A / W_{bkf}$).	**1.73**	ft
Bankfull X-Section AREA (A_{bkf}) AREA of the stream channel cross-section, at bankfull stage elevation, in a riffle section.	**44.65**	ft^2
Width/Depth Ratio (W_{bkf} / d_{bkf}) Bankfull WIDTH divided by bankfull mean DEPTH, in a riffle section.	**14.91**	ft/ft
Maximum DEPTH (d_{mbkf}) Maximum depth of the bankfull channel cross-section, or distance between the bankfull stage and Thalweg elevations, in a riffle section.	**2.49**	ft
WIDTH of Flood-Prone Area (W_{fpa}) Twice maximum DEPTH, or (2 x d_{mbkf}) = the stage/elevation at which flood-prone area WIDTH is determined in a riffle section.	**45.83**	ft
Entrenchment Ratio (ER) The ratio of flood-prone area WIDTH divided by bankfull channel WIDTH (W_{fpa} / W_{bkf}) (riffle section).	**1.78**	ft/ft
Channel Materials (Particle Size Index) D_{50} The D_{50} particle size index represents the mean diameter of channel materials, as sampled from the channel surface, between the bankfull stage and Thalweg elevations.	**6**	mm
Water Surface SLOPE (S) Channel slope = "rise over run" for a reach approximately 20–30 bankfull channel widths in length, with the "riffle-to-riffle" water surface slope representing the gradient at bankfull stage.	**0.0095**	ft/ft
Channel SINUOSITY (k) Sinuosity is an index of channel pattern, determined from a ratio of stream length divided by valley length (SL / VL); or estimated from a ratio of valley slope divided by channel slope (VS / S).	**1**	

Stream Type **B 4c** (See Figure 2-14)

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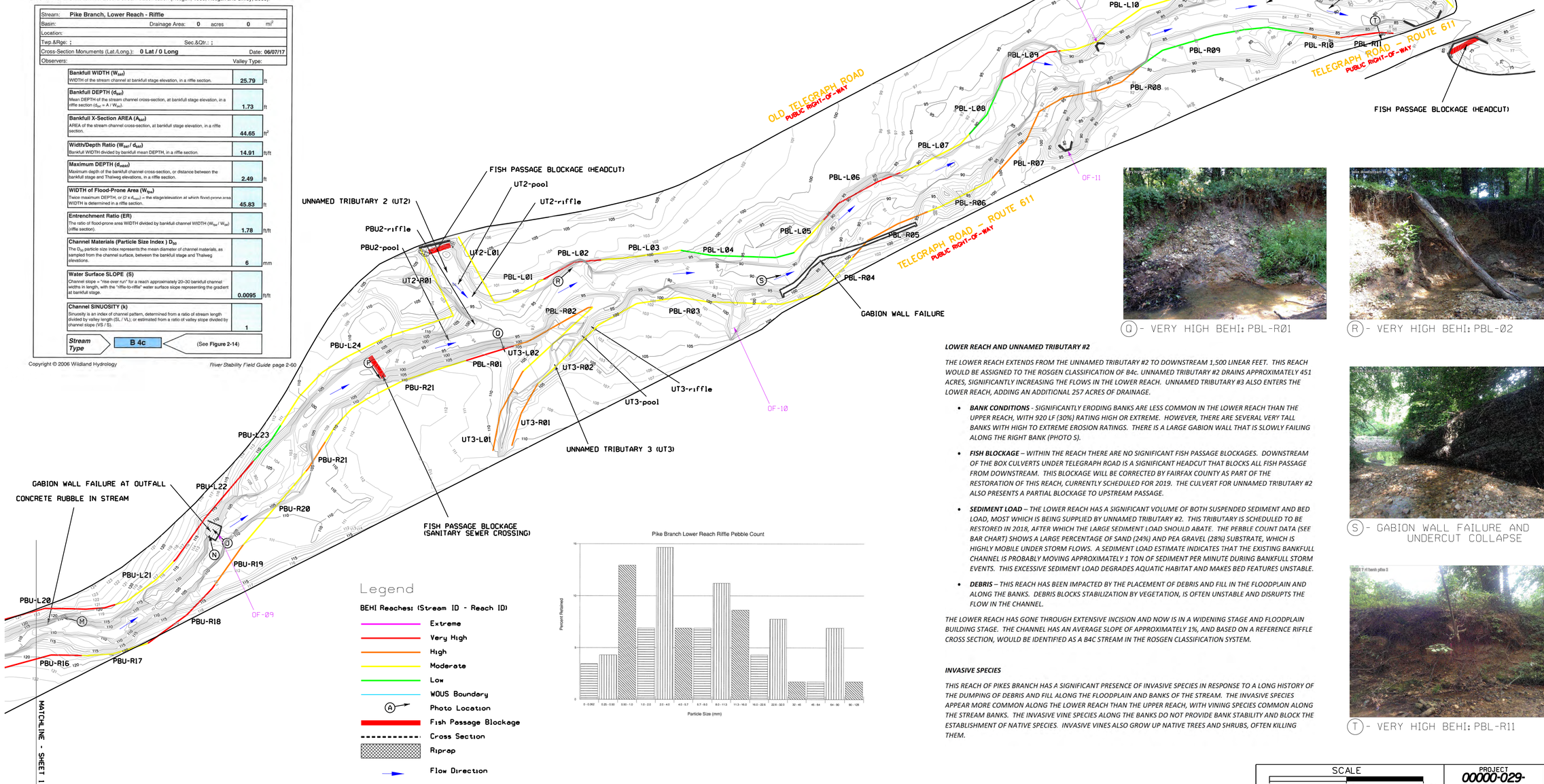


Legend

BEHI Reaches: (Stream ID - Reach ID)

- Extreme
- Very High
- High
- Moderate
- Low
- WOUS Boundary
- Photo Location
- Fish Passage Blockage
- Cross Section
- Riprap
- Flow Direction

(Q) - VERY HIGH BEHI: PBL-R01

(R) - VERY HIGH BEHI: PBL-02

LOWER REACH AND UNNAMED TRIBUTARY #2

THE LOWER REACH EXTENDS FROM THE UNNAMED TRIBUTARY #2 TO DOWNSTREAM 1,500 LINEAR FEET. THIS REACH WOULD BE ASSIGNED TO THE ROSGEN CLASSIFICATION OF B4c. UNNAMED TRIBUTARY #2 DRAINS APPROXIMATELY 451 ACRES, SIGNIFICANTLY INCREASING THE FLOWS IN THE LOWER REACH. UNNAMED TRIBUTARY #3 ALSO ENTERS THE LOWER REACH, ADDING AN ADDITIONAL 257 ACRES OF DRAINAGE.

- ***BANK CONDITIONS** - SIGNIFICANTLY ERODING BANKS ARE LESS COMMON IN THE LOWER REACH THAN THE UPPER REACH, WITH 920 LF (30%) RATING HIGH OR EXTREME. HOWEVER, THERE ARE SEVERAL VERY TALL BANKS WITH HIGH TO EXTREME EROSION RATINGS. THERE IS A LARGE GABION WALL THAT IS SLOWLY FAILING ALONG THE RIGHT BANK (PHOTO S).*
- ***FISH BLOCKAGE** – WITHIN THE REACH THERE ARE NO SIGNIFICANT FISH PASSAGE BLOCKAGES. DOWNSTREAM OF THE BOX CULVERTS UNDER TELEGRAPH ROAD IS A SIGNIFICANT HEADCUT THAT BLOCKS ALL FISH PASSAGE FROM DOWNSTREAM. THIS BLOCKAGE WILL BE CORRECTED BY FAIRFAX COUNTY AS PART OF THE RESTORATION OF THIS REACH, CURRENTLY SCHEDULED FOR 2019. THE CULVERT FOR UNNAMED TRIBUTARY #2 ALSO PRESENTS A PARTIAL BLOCKAGE TO UPSTREAM PASSAGE.*
- ***SEDIMENT LOAD** – THE LOWER REACH HAS A SIGNIFICANT VOLUME OF BOTH SUSPENDED SEDIMENT AND BED LOAD, MOST WHICH IS BEING SUPPLIED BY UNNAMED TRIBUTARY #2. THIS TRIBUTARY IS SCHEDULED TO BE RESTORED IN 2018, AFTER WHICH THE LARGE SEDIMENT LOAD SHOULD ABATE. THE PEBBLE COUNT DATA (SEE BAR CHART) SHOWS A LARGE PERCENTAGE OF SAND (24%) AND PEA GRAVEL (28%) SUBSTRATE, WHICH IS HIGHLY MOBILE UNDER STORM FLOWS. A SEDIMENT LOAD ESTIMATE INDICATES THAT THE EXISTING BANKFULL CHANNEL IS PROBABLY MOVING APPROXIMATELY 1 TON OF SEDIMENT PER MINUTE DURING BANKFULL STORM EVENTS. THIS EXCESSIVE SEDIMENT LOAD DEGRADES AQUATIC HABITAT AND MAKES BED FEATURES UNSTABLE.*
- ***DEBRIS** – THIS REACH HAS BEEN IMPACTED BY THE PLACEMENT OF DEBRIS AND FILL IN THE FLOODPLAIN AND ALONG THE BANKS. DEBRIS BLOCKS STABILIZATION BY VEGETATION, IS OFTEN UNSTABLE AND DISRUPTS THE FLOW IN THE CHANNEL.*

THE LOWER REACH HAS GONE THROUGH EXTENSIVE INCISION AND NOW IS IN A WIDENING STAGE AND FLOODPLAIN BUILDING STAGE. THE CHANNEL HAS AN AVERAGE SLOPE OF APPROXIMATELY 1%, AND BASED ON A REFERENCE RIFFLE CROSS SECTION, WOULD BE IDENTIFIED AS A B4C STREAM IN THE ROSGEN CLASSIFICATION SYSTEM.

INVASIVE SPECIES

THIS REACH OF PIKES BRANCH HAS A SIGNIFICANT PRESENCE OF INVASIVE SPECIES IN RESPONSE TO A LONG HISTORY OF THE DUMPING OF DEBRIS AND FILL ALONG THE FLOODPLAIN AND BANKS OF THE STREAM. THE INVASIVE SPECIES APPEAR MORE COMMON ALONG THE LOWER REACH THAN THE UPPER REACH, WITH VINING SPECIES COMMON ALONG THE STREAM BANKS. THE INVASIVE VINE SPECIES ALONG THE BANKS DO NOT PROVIDE BANK STABILITY AND BLOCK THE ESTABLISHMENT OF NATIVE SPECIES. INVASIVE VINES ALSO GROW UP NATIVE TREES AND SHRUBS, OFTEN KILLING THEM.

(S) - GABION WALL FAILURE AND UNDERCUT COLLAPSE

(T) - VERY HIGH BEHI: PBL-R11

SCALE	PROJECT	SHEET NO.
0 100' 200'	00000-029-22356817	4

$APPLEST/MLT$

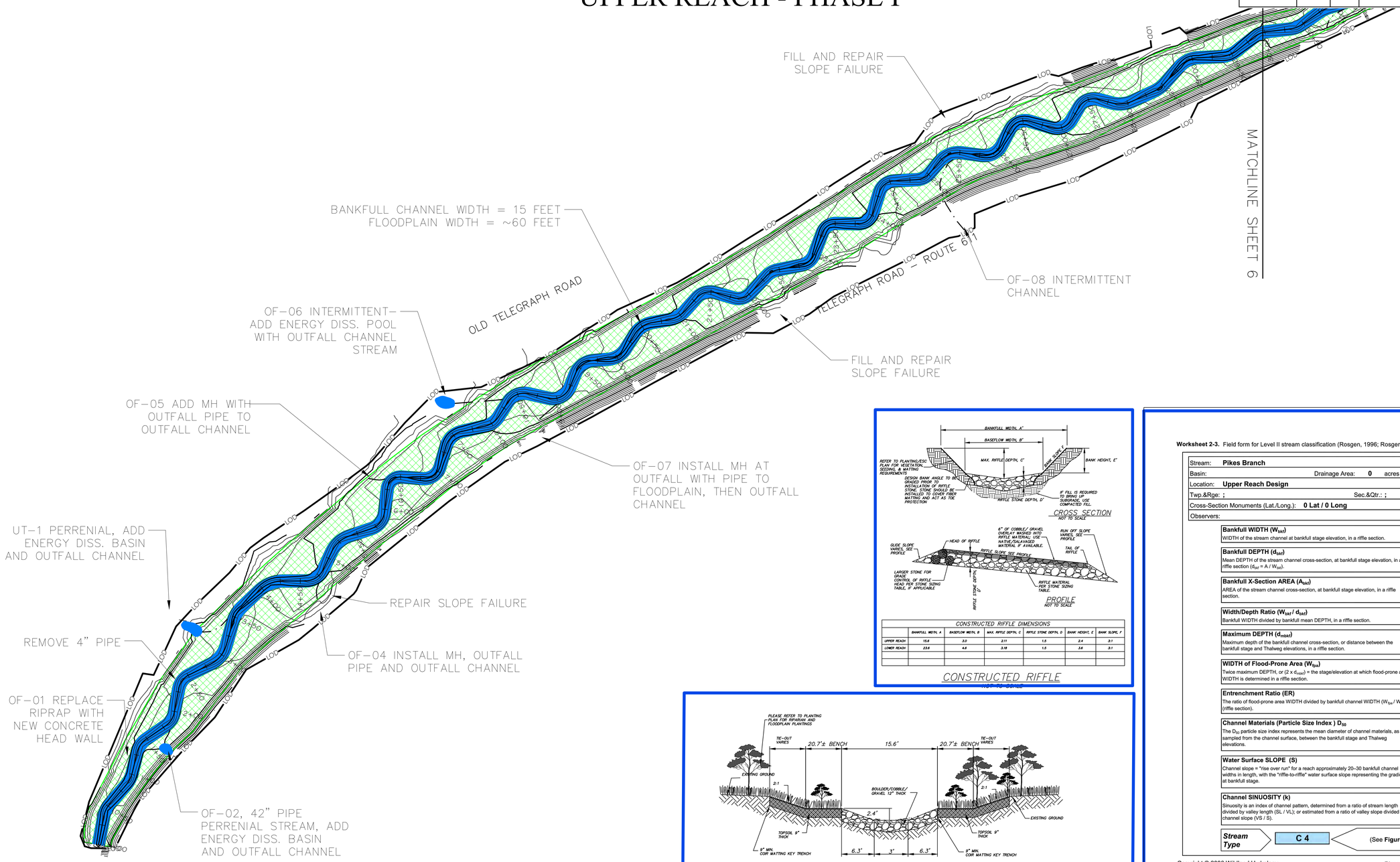
DGN $REF001 $REF002 $REF003 $REF004 $REF005 $REF006
$DGNLEV $LEV001 $LEV002 $LEV003 $LEV004 $LEV005 $LEV006

PROJECT MANAGER_TRACEY_HARMON_(804)_371-6834_____
SURVEYED BY, DATE GEORGE_GIBSON, SEPT_2016 (703) 674-5790_
IMPLEMENTATION DESIGN BY, DATE_JOE_CATERINO, NOV 2017 (804)_729-9113_

PIKES BRANCH CONCEPTUAL STREAM PLAN

UPPER REACH - PHASE I

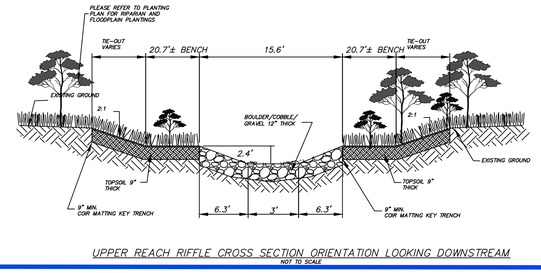
REVISED	STATE	ROUTE	STATE PROJECT	SHEET NO.
	VA.		00000-029-22356817	5



CONSTRUCTED RIFFLE DIMENSIONS

	BANKFULL WIDTH, A	BASEFLOW WIDTH, B	MAX. RIFFLE DEPTH, C	RIFFLE STONE DEPTH, D	BANK HEIGHT, E	BANK SLOPE, F
UPPER REACH	15.6	3.0	2.11	1.5	2.4	3:1
LOWER REACH	23.6	4.6	3.18	1.5	3.6	3:1

CONSTRUCTED RIFFLE
NOT TO SCALE



UPPER REACH RIFFLE CROSS SECTION ORIENTATION LOOKING DOWNSTREAM
NOT TO SCALE

Worksheet 2-3. Field form for Level II stream classification (Rosgen, 1996; Rosgen and Silvey, 2005).

Stream:	**Pikes Branch**			
Basin:		Drainage Area:	**0** acres	**0** mi^2
Location:	**Upper Reach Design**			
Twp.&Rge:	**;**		Sec.&Qtr.:	**;**
Cross-Section Monuments (Lat./Long.):	**0 Lat / 0 Long**			Date: **02/01/18**
Observers:				Valley Type:

Bankfull WIDTH (W_{bkf}) WIDTH of the stream channel at bankfull stage elevation, in a riffle section.	**15.6**	ft
Bankfull DEPTH (d_{bkf}) Mean DEPTH of the stream channel cross-section, at bankfull stage elevation, in a riffle section ($d_{bkf} = A / W_{bkf}$).	**1**	ft
Bankfull X-Section AREA (A_{bkf}) AREA of the stream channel cross-section, at bankfull stage elevation, in a riffle section.	**20.3**	ft^2
Width/Depth Ratio (W_{bkf} / d_{bkf}) Bankfull WIDTH divided by bankfull mean DEPTH, in a riffle section.	**15.6**	ft/ft
Maximum DEPTH (d_{mbkf}) Maximum depth of the bankfull channel cross-section, or distance between the bankfull stage and Thalweg elevations, in a riffle section.	**2.37**	ft
WIDTH of Flood-Prone Area (W_{fpa}) Twice maximum DEPTH, or (2 x d_{mbkf}) = the stage/elevation at which flood-prone area WIDTH is determined in a riffle section.	**65.72**	ft
Entrenchment Ratio (ER) The ratio of flood-prone area WIDTH divided by bankfull channel WIDTH (W_{fpa} / W_{bkf}) (riffle section).	**4.21**	ft/ft
Channel Materials (Particle Size Index) D_{50} The D_{50} particle size index represents the mean diameter of channel materials, as sampled from the channel surface, between the bankfull stage and Thalweg elevations.	**45**	mm
Water Surface SLOPE (S) Channel slope = "rise over run" for a reach approximately 20–30 bankfull channel widths in length, with the "riffle-to-riffle" water surface slope representing the gradient at bankfull stage.	**0.0154**	ft/ft
Channel SINUOSITY (k) Sinuosity is an index of channel pattern, determined from a ratio of stream length divided by valley length (SL / VL); or estimated from a ratio of valley slope divided by channel slope (VS / S).	**1.2**	
Stream Type	**C 4** (See **Figure 2-14**)	

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GRAPHIC SCALE: 1" = 60'
0' 60' 120'

PROJECT	SHEET NO.
00000-029-22356817	5

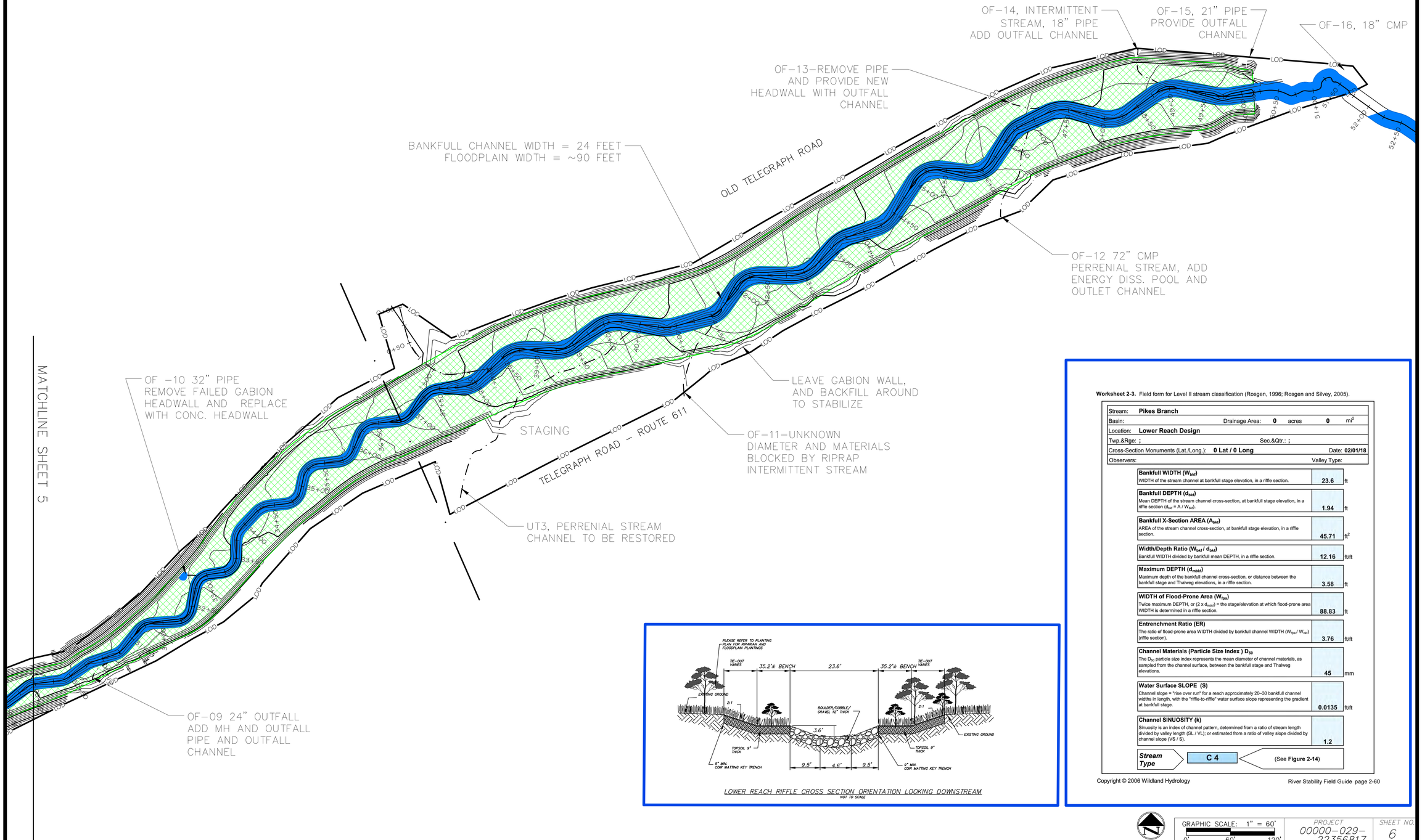
$TIME$STAMP$

DGN $REF001 $REF002 $REF003 $REF004 $REF005 $REF006
$DGNLEV $LEV001 $LEV002 $LEV003 $LEV004 $LEV005 $LEV006

PROJECT MANAGER_TRACEY_HARMON_(804)_371-6834_____
SURVEYED BY, DATE GEORGE_GIBSON, SEPT_2016_(703)_674-5790_
IMPLEMENTATION DESIGN BY, DATE_JOE_CATERINO,_NOV_2017_(804)_729-9113_

PIKES BRANCH CONCEPTUAL STREAM PLAN
LOWER REACH - PHASE II

REVISED	STATE	ROUTE	STATE PROJECT	SHEET NO.
	VA.		00000-029-22356817	6



LOWER REACH RIFFLE CROSS SECTION ORIENTATION LOOKING DOWNSTREAM
NOT TO SCALE

Worksheet 2-3. Field form for Level II stream classification (Rosgen, 1996; Rosgen and Silvey, 2005).

Stream:	**Pikes Branch**			
Basin:	Drainage Area:	**0** acres	**0**	mi^2
Location:	**Lower Reach Design**			
Twp.&Rge:	**;**	Sec.&Qtr.: **;**		
Cross-Section Monuments (Lat./Long.):	**0 Lat / 0 Long**		Date: **02/01/18**	
Observers:			Valley Type:	

Bankfull WIDTH (W_{bkf}) WIDTH of the stream channel at bankfull stage elevation, in a riffle section.	**23.6**	ft
Bankfull DEPTH (d_{bkf}) Mean DEPTH of the stream channel cross-section, at bankfull stage elevation, in a riffle section ($d_{bkf} = A / W_{bkf}$).	**1.94**	ft
Bankfull X-Section AREA (A_{bkf}) AREA of the stream channel cross-section, at bankfull stage elevation, in a riffle section.	**45.71**	ft^2
Width/Depth Ratio (W_{bkf} / d_{bkf}) Bankfull WIDTH divided by bankfull mean DEPTH, in a riffle section.	**12.16**	ft/ft
Maximum DEPTH (d_{mbkf}) Maximum depth of the bankfull channel cross-section, or distance between the bankfull stage and Thalweg elevations, in a riffle section.	**3.58**	ft
WIDTH of Flood-Prone Area (W_{fpa}) Twice maximum DEPTH, or (2 x d_{mbkf}) = the stage/elevation at which flood-prone area WIDTH is determined in a riffle section.	**88.83**	ft
Entrenchment Ratio (ER) The ratio of flood-prone area WIDTH divided by bankfull channel WIDTH (W_{fpa} / W_{bkf}) (riffle section).	**3.76**	ft/ft
Channel Materials (Particle Size Index) D_{50} The D_{50} particle size index represents the mean diameter of channel materials, as sampled from the channel surface, between the bankfull stage and Thalweg elevations.	**45**	mm
Water Surface SLOPE (S) Channel slope = "rise over run" for a reach approximately 20–30 bankfull channel widths in length, with the "riffle-to-riffle" water surface slope representing the gradient at bankfull stage.	**0.0135**	ft/ft
Channel SINUOSITY (k) Sinuosity is an index of channel pattern, determined from a ratio of stream length divided by valley length (SL / VL); or estimated from a ratio of valley slope divided by channel slope (VS / S).	**1.2**	
Stream Type	**C 4**	(See **Figure 2-14**)

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GRAPHIC SCALE: 1" = 60'
0' 60' 120'

PROJECT 00000-029-22356817 SHEET NO. 6

$TIME$STAMP$

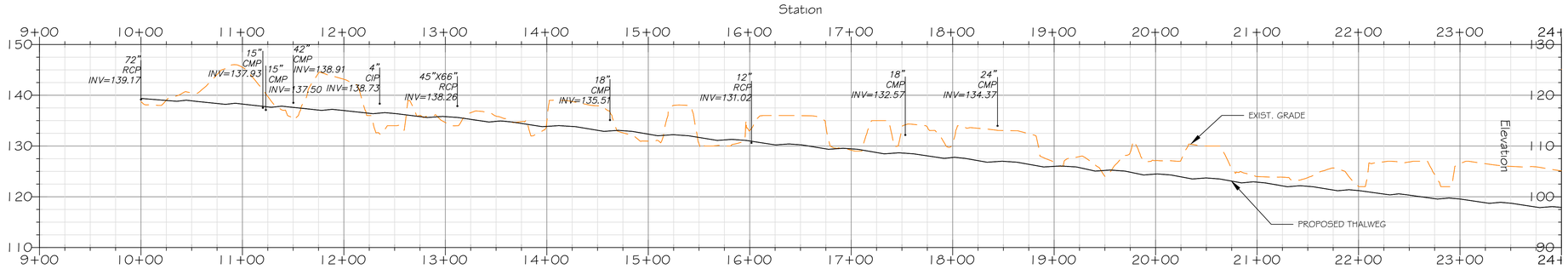
DGN $REF001 $REF002 $REF003 $REF004 $REF005 $REF006
$DGNLEV $LEV001 $LEV002 $LEV003 $LEV004 $LEV005 $LEV006

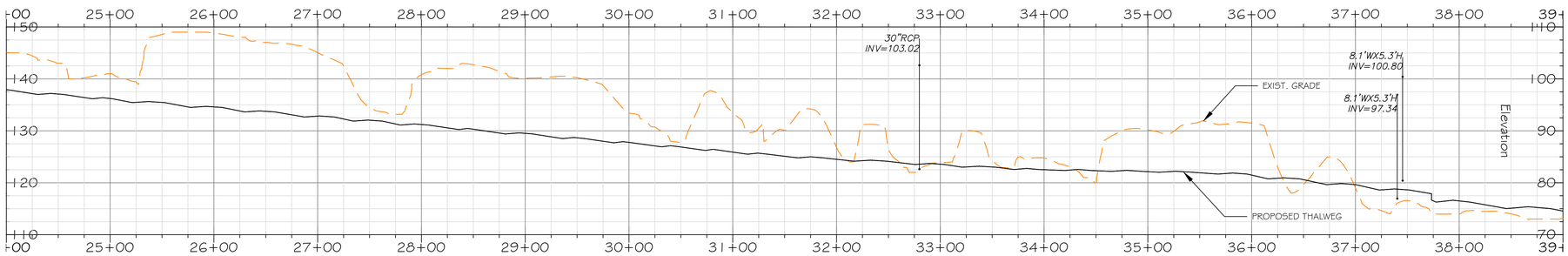
PROJECT MANAGER TRACEY HARMON (804) 371-6834
SURVEYED BY, DATE GEORGE GIBSON, SEPT 2016 (703) 674-5790
IMPLEMENTATION DESIGN BY, DATE JOE CATERINO, NOV 2017 (804) 729-9113

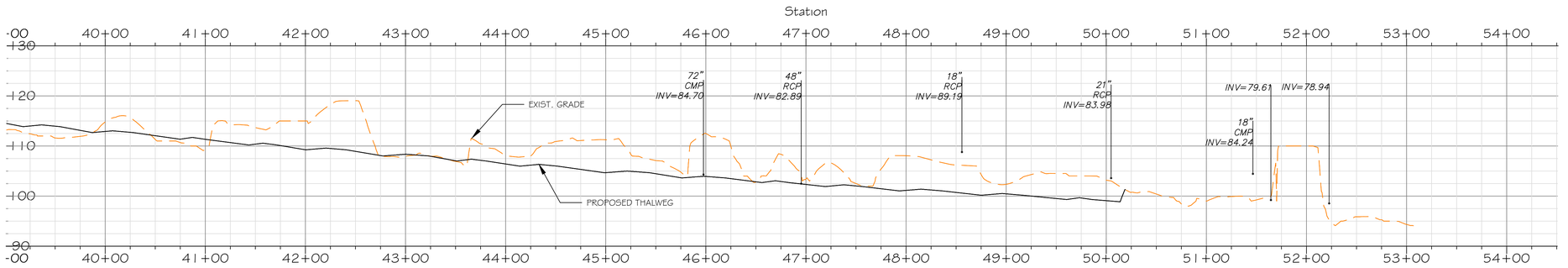
PIKES BRANCH PROFILE

REVISED	STATE	STATE ROUTE	PROJECT	SHEET NO.
	VA.		00000-029-22356817	7

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







$TIME$STAMP$

GRAPHIC SCALE: 1" = 60'
0' 60' 120'

PROJECT	SHEET NO.
00000-029-22356817	7

Cell Revised 12/11/12

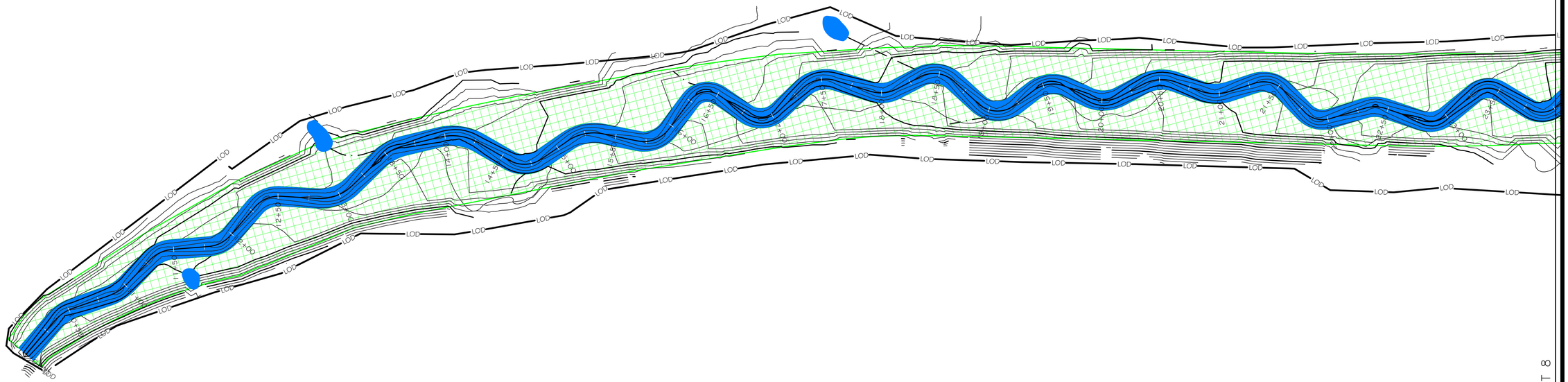
DGN $REF001 $REF002 $REF003 $REF004 $REF005 $REF006
$DGNLEV $LEV001 $LEV002 $LEV003 $LEV004 $LEV005 $LEV006

PROJECT MANAGER_TRACEY HARMON (804) 371-6834
SURVEYED BY, DATE GEORGE GIBSON, SEPT 2016 (703) 674-5790
IMPLEMENTATION DESIGN BY, DATE JOE CATERINO, NOV 2017 (804) 729-9113

PLANTING PLAN, DETAILS & SCHEDULE

REVISED	STATE	ROUTE	STATE PROJECT	SHEET NO.
	VA.		00000-029-22356817	8

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



MATCHLINE SHEET 8

LEGEND:

FLOODPLAIN PLANTING (1.56 AC.)

NOTE:
AREAS OUTSIDE OF PROPOSED FLOODPLAIN AND WITHIN LOD TO BE UPLAND PLANTING (.92 AC.)

GRAPHIC SCALE: 1" = 40'
0' 40' 80'

PROJECT 00000-029-22356817 SHEET NO. 8

$TIME$STAMP$

DGN $REF001 $REF002 $REF003 $REF004 $REF005 $REF006
$DGNLEV $LEV001 $LEV002 $LEV003 $LEV004 $LEV005 $LEV006

PROJECT MANAGER_TRACEY HARMON (804) 371-6834
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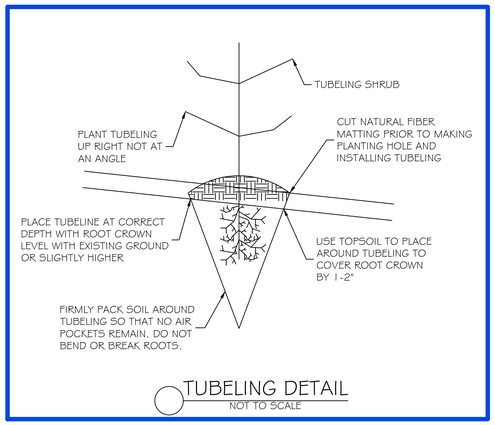
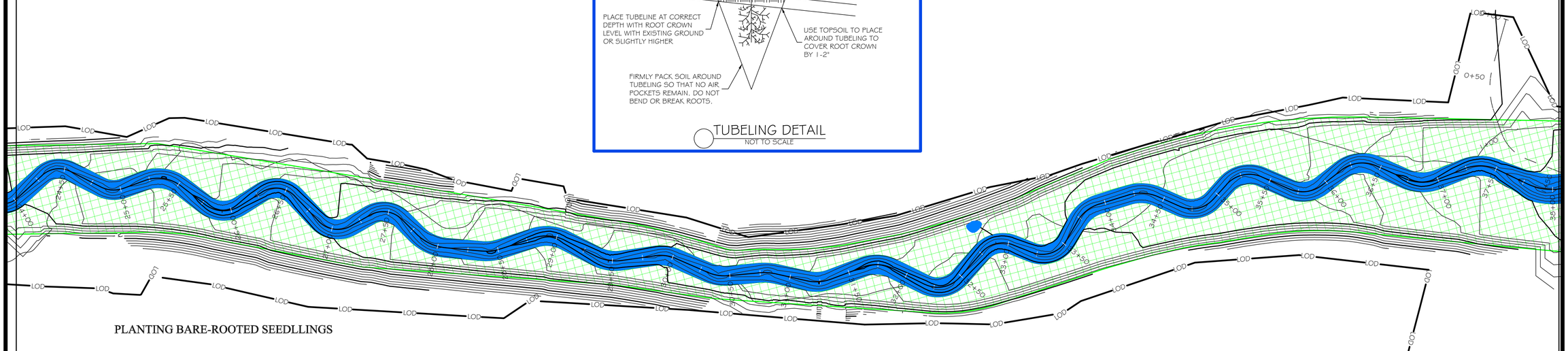
PLANTING PLAN, DETAILS AND SCHEDULE

REVISED	STATE	ROUTE	PROJECT	SHEET NO.
	VA.		00000-029-22356817	9

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



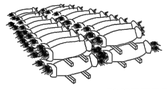
TUBELING DETAIL
NOT TO SCALE



MATCHLINE SHEET 7

MATCHLINE SHEET 9

PLANTING BARE-ROOTED SEEDLLINGS



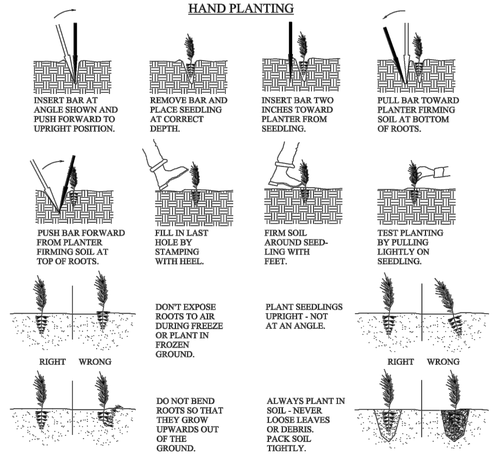
CARE OF SEEDLINGS UNTIL PLANTED

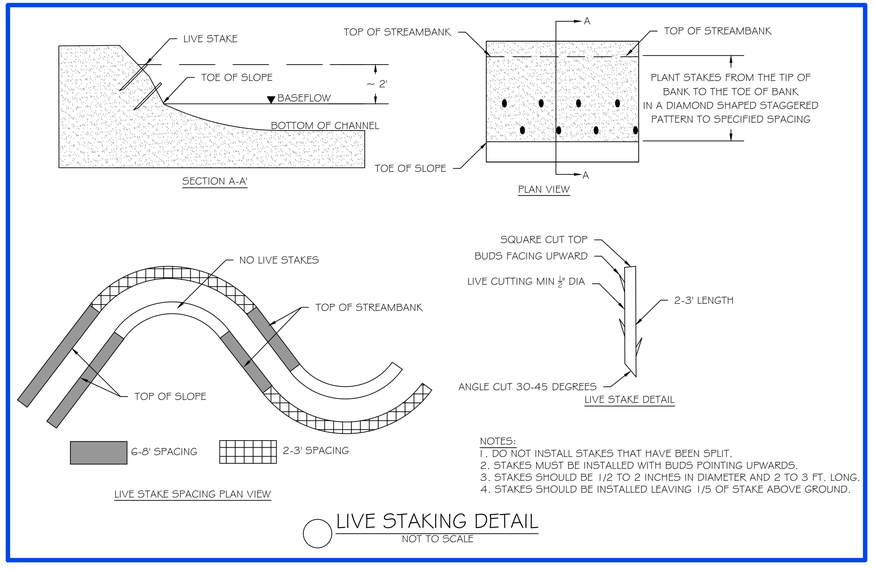
SEEDLINGS SHOULD BE PLANTED IMMEDIATELY. IF IT IS NECESSARY TO STORE MOSS PACKED SEEDLINGS FOR MORE THAN 2 WEEKS, ONE PINT OF WATER PER PKG. SHOULD BE ADDED. IF CLAY-TREATED, DO NOT ADD WATER TO PKG. PACKAGES MUST BE SEPERATED TO PROVIDE VENTILATION TO PREVENT "HEATING". SEPARATE PACKAGES WITH WOOD STRIPS AND STORE OUT OF THE WIND IN A SHADED, COOL (NOT FREEZING) LOCATION.

CARE OF SEEDLINGS DURING PLANTING

WHEN PLANTING, ROOTS MUST BE KEPT MOIST UNTIL TREES ARE IN THE GROUND. DO NOT CARRY SEEDLINGS IN YOUR HAND EXPOSED TO THE AIR AND SUN. KEEP MOSS-PACKED SEEDLINGS IN A CONTAINER PACKED WITH WET MOSS OR FILLED WITH THICK MUDDY WATER. COVER CLAY-TREATED SEEDLINGS WITH WET BURLAP ONLY.

HAND PLANTING





NOTES:
1. DO NOT INSTALL STAKES THAT HAVE BEEN SPLIT.
2. STAKES MUST BE INSTALLED WITH BUDS POINTING UPWARDS.
3. STAKES SHOULD BE 1/2 TO 2 INCHES IN DIAMETER AND 2 TO 3 FT. LONG.
4. STAKES SHOULD BE INSTALLED LEAVING 1/5 OF STAKE ABOVE GROUND.

LIVE STAKING DETAIL
NOT TO SCALE

LEGEND:

FLOODPLAIN PLANTING (1.66 AC.)

NOTE:
AREAS OUTSIDE OF PROPOSED FLOODPLAIN AND WITHIN LOD TO BE UPLAND PLANTING (1.39 AC.)

GRAPHIC SCALE: 1" = 40'
0' 40' 80'

PROJECT 00000-029-22356817

SHEET NO. 9

$TIME$ $STAMP$

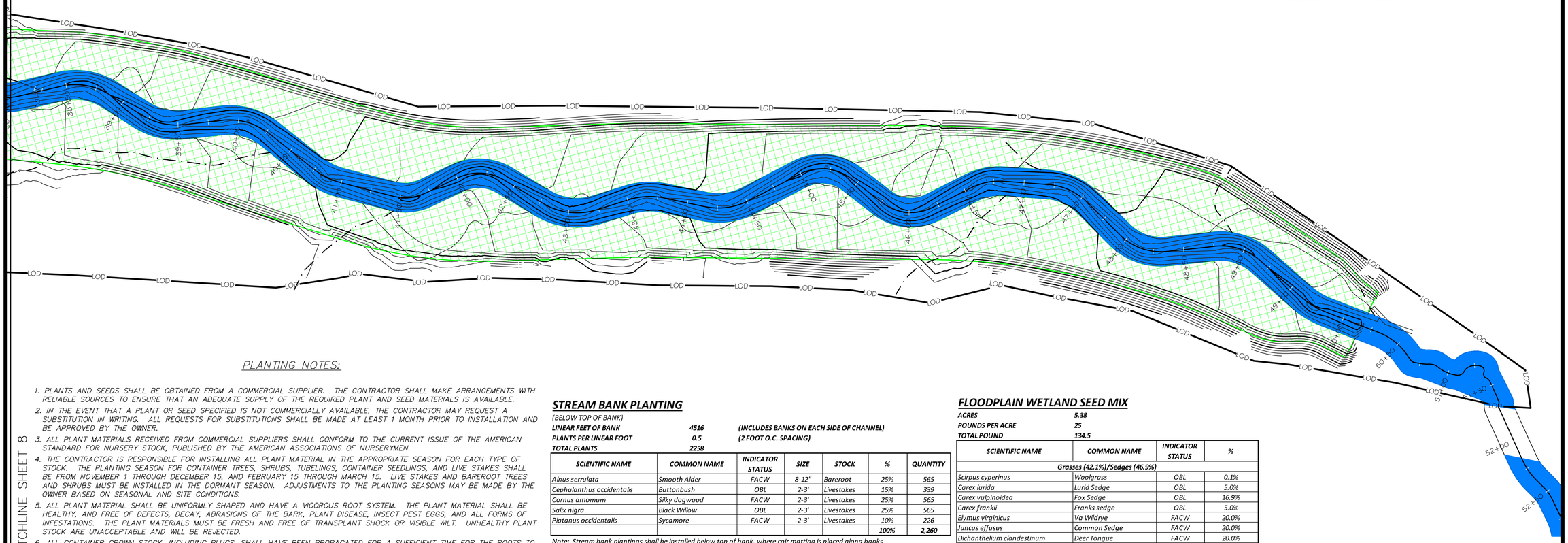
DGN $REF001 $REF002 $REF003 $REF004 $REF005 $REF006
$DGNLEV $LEV001 $LEV002 $LEV003 $LEV004 $LEV005 $LEV006

PROJECT MANAGER TRACEY HARMON (804) 371-6834
SURVEYED BY, DATE GEORGE GIBSON, SEPT 2016 (703) 674-5790
IMPLEMENTATION DESIGN BY, DATE JOE CATERINO, NOV 2017 (804) 729-9113

PLANTING PLAN, DETAILS AND SCHEDULE

REVISED	STATE	ROUTE	PROJECT	SHEET NO.
	VA.		00000-029-22356817	10

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



PLANTING NOTES:

1. PLANTS AND SEEDS SHALL BE OBTAINED FROM A COMMERCIAL SUPPLIER. THE CONTRACTOR SHALL MAKE ARRANGEMENTS WITH RELIABLE SOURCES TO ENSURE THAT AN ADEQUATE SUPPLY OF THE REQUIRED PLANT AND SEED MATERIALS IS AVAILABLE.
2. IN THE EVENT THAT A PLANT OR SEED SPECIFIED IS NOT COMMERCIALLY AVAILABLE, THE CONTRACTOR MAY REQUEST A SUBSTITUTION IN WRITING. ALL REQUESTS FOR SUBSTITUTIONS SHALL BE MADE AT LEAST 1 MONTH PRIOR TO INSTALLATION AND BE APPROVED BY THE OWNER.
3. ALL PLANT MATERIALS RECEIVED FROM COMMERCIAL SUPPLIERS SHALL CONFORM TO THE CURRENT ISSUE OF THE AMERICAN STANDARD FOR NURSERY STOCK, PUBLISHED BY THE AMERICAN ASSOCIATIONS OF NURSERYMEN.
4. THE CONTRACTOR IS RESPONSIBLE FOR INSTALLING ALL PLANT MATERIAL IN THE APPROPRIATE SEASON FOR EACH TYPE OF STOCK. THE PLANTING SEASON FOR CONTAINER TREES, SHRUBS, TUBELINGS, CONTAINER SEEDLINGS, AND LIVE STAKES SHALL BE FROM NOVEMBER 1 THROUGH DECEMBER 15, AND FEBRUARY 15 THROUGH MARCH 15. LIVE STAKES AND BAREROOT TREES AND SHRUBS MUST BE INSTALLED IN THE DORMANT SEASON. ADJUSTMENTS TO THE PLANTING SEASONS MAY BE MADE BY THE OWNER BASED ON SEASONAL AND SITE CONDITIONS.
5. ALL PLANT MATERIAL SHALL BE UNIFORMLY SHAPED AND HAVE A VIGOROUS ROOT SYSTEM. THE PLANT MATERIAL SHALL BE HEALTHY, AND FREE OF DEFECTS, DECAY, ABRASIONS OF THE BARK, PLANT DISEASE, INSECT PEST EGGS, AND ALL FORMS OF INFESTATIONS. THE PLANT MATERIALS MUST BE FRESH AND FREE OF TRANSPLANT SHOCK OR VISIBLE WILT. UNHEALTHY PLANT STOCK ARE UNACCEPTABLE AND WILL BE REJECTED.
6. ALL CONTAINER GROWN STOCK, INCLUDING PLUGS, SHALL HAVE BEEN PROPAGATED FOR A SUFFICIENT TIME FOR THE ROOTS TO HAVE DEVELOPED SUFFICIENTLY TO HOLD THE SOILS TOGETHER WHEN REMOVED FROM THE CONTAINER. CONTAINER STOCK WITH POORLY DEVELOPED ROOTS ARE UNACCEPTABLE AND WILL BE REJECTED.
7. NO SEEDING OR PLANTING SHALL OCCUR WHEN THE SOIL IS FROZEN. NO SEEDING SHALL OCCUR WHEN THE SITE IS FLOODED. PLANTING SHALL NOT BE ALLOWED IF THE SITE IS FLOODED.
8. THE CONTRACTOR SHALL NOTIFY THE OWNER A MINIMUM OF 48 HOURS PRIOR TO THE COMMENCING OF PLANTING OR SEEDING OPERATIONS.
9. THE FINAL LOCATION OF PLANT MATERIAL, AS WELL AS LOCATION OF PLANTING ZONES, WILL BE SUBJECT TO THE APPROVAL OF THE OWNER. THE CONTRACTOR WILL BE RESPONSIBLE FOR THE REPLANTING OR RESEEDING ANY PLANT MATERIAL INSTALLED WITHOUT APPROVAL OF THE OWNER.
10. EACH CONTAINER PLANT SHALL BE FERTILIZED WITH 20-10-5 CONTROLLED RELEASE TABLETS. FORMULATIONS VARY CONSIDERABLY BY MANUFACTURER, AND OTHER FORMULATIONS ARE ACCEPTABLE, PROVIDED THE TABLETS ARE NOT WATER-SOLUBLE. THE TABLETS SHALL BE BURIED NEAR THE PLANT'S ROOT SYSTEM. THE PLANT STOCK SHALL BE FERTILIZED AT THE FOLLOWING RATES:

STOCK	TABLETS
PLUGS AND QUARTS	ONE 5 GRAM TABLET
BAREROOT, TUBELINGS AND SEEDLINGS	ONE 10 GRAM TABLET
#1 CONTAINER	ONE 21 GRAM TABLETS
#5 CONTAINER	TWO 21 GRAM TABLETS

11. DURING PLANTING THE CONTRACTOR SHALL WATER EACH PLANT WITH THE FOLLOWING MINIMUM QUANTITIES OF WATER, UNLESS OWNER DETERMINES THERE IS SUFFICIENT SOIL MOISTURE ON SITE:

TREES	1 GALLON OF WATER
SHRUBS	1 GALLON OF WATER
PLUGS	1 PINT OF WATER

12. TO ENSURE FASTER STABILIZATION OF SEEDED AREAS WITHIN RIPARIAN BUFFER USE A TEMPORARY SEED AS OUTLINED BELOW AS A SUPPLEMENT TO THE SPECIFIED PERMANENT SEED MIXES, NO LIME OR FERTILIZER IS TO BE ADDED AT THE TIME OF SEEDING.

SEED	SEEDING DATES	SEEDING RATES
RYE	JAN-MAY & AUG-DEC	60 LB/AC
GERMAN MILLET	MAY-AUG	20 LB/AC

13. TOPSOIL SHALL BE SALVAGED FROM THE RESTORATION AREA, A 2" LAYER SHALL BE PLACED PRIOR TO SEEDING IN ALL DISTURBED AREAS.

MATCHLINE SHEET 8

STREAM BANK PLANTING

(BELOW TOP OF BANK)

LINEAR FEET OF BANK	**4516**	**(INCLUDES BANKS ON EACH SIDE OF CHANNEL)**
PLANTS PER LINEAR FOOT	**0.5**	**(2 FOOT O.C. SPACING)**
TOTAL PLANTS	**2258**	

SCIENTIFIC NAME	COMMON NAME	INDICATOR STATUS	SIZE	STOCK	%	QUANTITY
Alnus serrulata	Smooth Alder	FACW	8-12"	Bareroot	25%	565
Cephalanthus occidentalis	Buttonbush	OBL	2-3'	Livestakes	15%	339
Cornus amomum	Silky dogwood	FACW	2-3'	Livestakes	25%	565
Salix nigra	Black Willow	OBL	2-3'	Livestakes	25%	565
Platanus occidentalis	Sycamore	FACW	2-3'	Livestakes	10%	226
					100%	**2,260**

Note: Stream bank plantings shall be installed below top of bank, where coir matting is placed along banks

UPLAND PLANTING (TRIBUTARY)

ACRES	**3.59**
PLANTS PER ACRE	**600**
TOTAL PLANTS	**2,154**

SCIENTIFIC NAME	COMMON NAME	INDICATOR STATUS	SIZE	STOCK	%	QUANTITY
CANOPY (80%)						
Fagus grandifolia	American beech	FACU	8-12"	Bareroot	10%	215
Acer rubrum	Red maple	FAC	8-12"	Bareroot	10%	215
Liriodendron tulipifera	Tulip poplar	FACU	8-12"	Bareroot	15%	323
Pinus taeda	Loblolly pine	FAC	8-12"	Bareroot	5%	108
Quercus montana	Chestnut oak	UPL	8-12"	Bareroot	10%	215
Quercus alba	White oak	FACU	8-12"	Bareroot	15%	323
Quercus rubra	Northern red oak	FACU	8-12"	Bareroot	15%	323
UNDERSTORY/SHRUB (20%)						
Cercis canadensis	Eastern redbud	UPL	8-12"	Bareroot	5%	108
Carpinus caroliniana	Ironwood	FAC	8-12"	Bareroot	7.5%	162
Hamamelis virginiana	American witch-hazel	FACU	8-12"	Bareroot	7.5%	162
					100%	**2,154**

FLOODPLAIN WETLAND SEED MIX

ACRES	**5.38**
POUNDS PER ACRE	**25**
TOTAL POUND	**134.5**

SCIENTIFIC NAME	COMMON NAME	INDICATOR STATUS	%
Grasses (42.1%)/Sedges (46.9%)			
Scirpus cyperinus	Woolgrass	OBL	0.1%
Carex lurida	Lurid Sedge	OBL	5.0%
Carex vulpinoidea	Fox Sedge	OBL	16.9%
Carex frankii	Franks sedge	OBL	5.0%
Elymus virginicus	Va Wildrye	FACW	20.0%
Juncus effusus	Common Sedge	FACW	20.0%
Dichanthelium clandestinum	Deer Tongue	FACW	20.0%
Cinna arundinacea	Wood reedgrass	FACW	2.0%
Forbs (11%)			
Helianthus angustifolius	Swamp Sunflower	FACW	1.0%
Persicaria pensylvanicum	PA Smartweed	FACW	5.0%
Bidens aristosa	Showy Tickseed (NC)	FACW	5.0%
			100.0%

UPLAND SEED MIX

ACRES	**3.59**
POUNDS PER ACRE	**25**
TOTAL POUND	**89.75**

SCIENTIFIC NAME	COMMON NAME	INDICATOR STATUS	%
Grasses(89.5%)			
Agrostis perennans	Autumn Bentgrass	FACU	5.0%
Andropogon virginicus	Broomsedge	FACU	5.0%
Chasmanthium latifolium	River Oats	FACU	15.0%
Elymus virginicus	VA Wildrye	FACW	15.0%
Dichanthelium clandestinum	Deertongue	FACW	14.5%
Schizachyrium scoparium	Little Bluestem	FACU	25.0%
Tridens flavus	Purpletop	FACU	10.0%
Forbs (10.5%)			
Rubeckia hirta	Black Eyed Susan	FACU	0.5%
Helianthus helianthoides	OxEye Sunflower	NI	2.0%
Cichorium intybus	Blue Chickory	NI	1.0%
Coreopsis lanclolata	Longleaf Coreopsis	FACU	1.0%
Chamaecrista fasciculata	Partridge Pea	FACU	3.0%
Bidens aristosa	Showy Tickseed (NC)	FACW	3.0%
			100.0%

LEGEND:

FLOODPLAIN PLANTING (2.16 AC.)

NOTE:
AREAS OUTSIDE OF PROPOSED FLOODPLAIN AND WITHIN LOD TO BE UPLAND PLANTING (1.28 AC.)

GRAPHIC SCALE: 1" = 40'
0' 40' 80'

PROJECT 00000-029-22356817

SHEET NO. 10

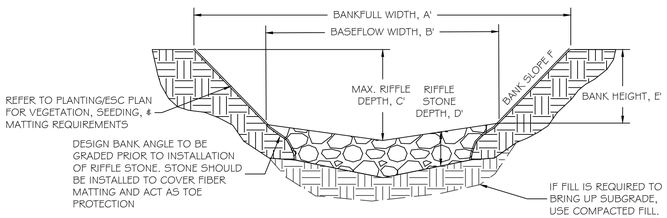
$TIME$ $STAMP$

DGN $REF001 $REF002 $REF003 $REF004 $REF005 $REF006
$DGNLEV $LEV001 $LEV002 $LEV003 $LEV004 $LEV005 $LEV006

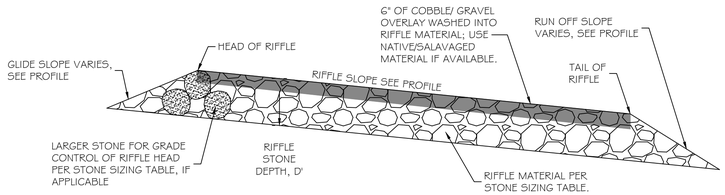
PROJECT MANAGER_TRACEY HARMON (804) 371-6834 _____
SURVEYED BY, DATE GEORGE GIBSON, SEPT 2016 (703) 674-5790 _____
IMPLEMENTATION DESIGN BY, DATE JOE CATERINO, NOV 2017 (804) 729-9113

STREAM STRUCTURE DETAILS

REVISED	STATE	ROUTE	PROJECT	SHEET NO.
	VA.		00000-029-22356817	11



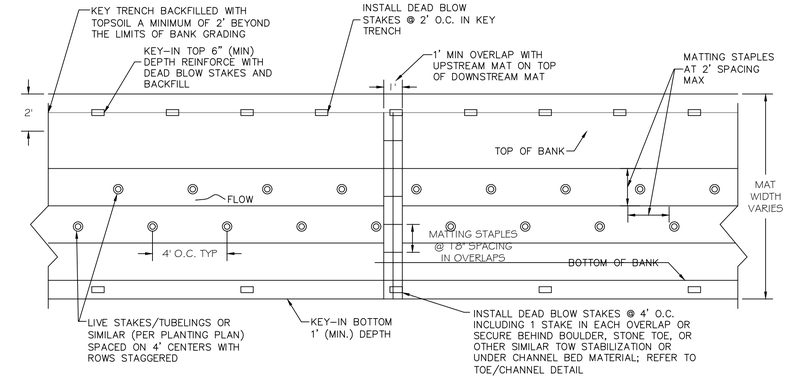
CROSS SECTION
NOT TO SCALE



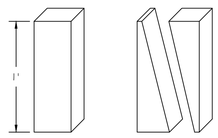
PROFILE
NOT TO SCALE

CONSTRUCTED RIFFLE DIMENSIONS						
	BANKFULL WIDTH, A	BASEFLOW WIDTH, B	MAX. RIFFLE DEPTH, C	RIFFLE STONE DEPTH, D	BANK HEIGHT, E	BANK SLOPE, F
REACH X						

1 CONSTRUCTED RIFFLE
NOT TO SCALE

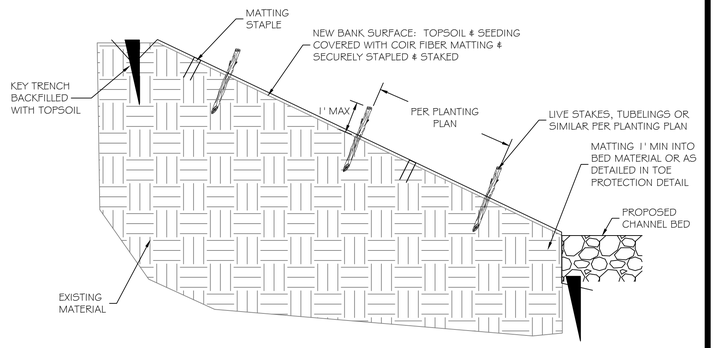


2 COIR FIBER MATTING DETAIL IN-CHANNEL INSTALLATION
NOT TO SCALE

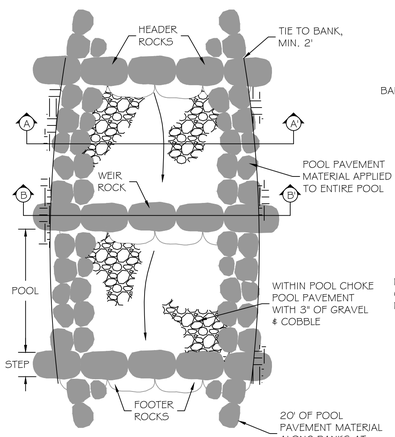


SAW A 2X4 DIAGONALLY TO PRODUCE (2) DEAD BLOW STAKES

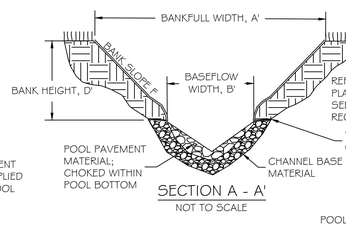
3 DEAD BLOW STAKE
NOT TO SCALE



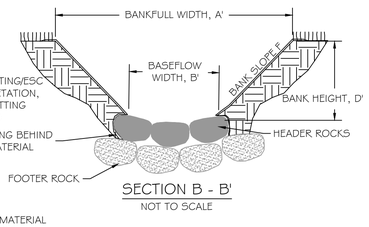
4 COIR FIBER MATTING WITH LIVE STAKES
NOT TO SCALE



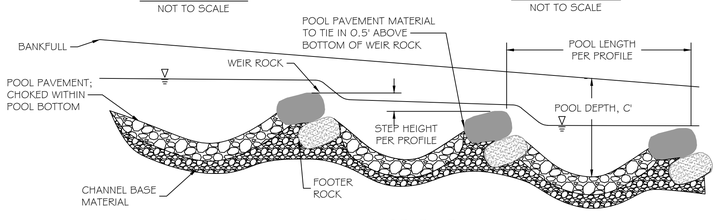
PLAN VIEW
NOT TO SCALE



SECTION A - A'
NOT TO SCALE



SECTION B - B'
NOT TO SCALE

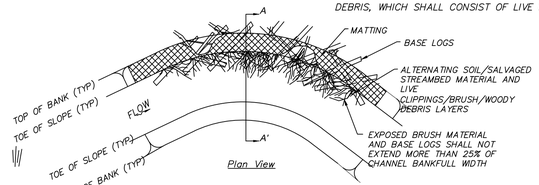


PROFILE VIEW
NOT TO SCALE

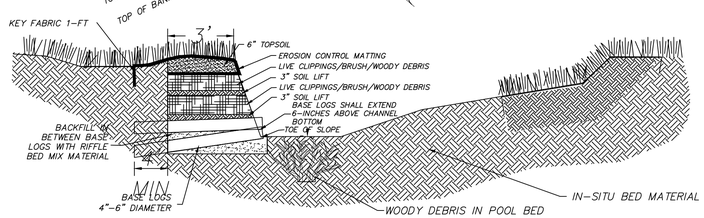
STEP POOL DETAILS					
	BANKFULL WIDTH, A	BASEFLOW WIDTH, B	POOL DEPTH, C	BANK HEIGHT, D	BANK SLOPE, F
REACH #	X'	X'	X'	X'	X:X
ALL STONE SIZING PER STONE SIZING TABLE.					

5 STEP POOL
NOT TO SCALE

NOTES:
1. OVEREXCAVATE 3' OUTSIDE OF TOP OF BANK (BANKFULL).
2. INSTALL BASE LOGS IN A CRISS CROSS PATTERN, DRIVING THEM INTO THE EXISTING BANK A MINIMUM OF 4'. BASE LOGS SHALL BE AN AVERAGE 6" DIAMETER. BACKFILL AROUND BASE LOGS WITH RIFFLE BED MIX.
3. INSTALL A LAYER OF SOIL MATERIAL OBTAINED FROM EXCAVATION OPERATION ON TOP OF THE BASE LOGS.
4. LIGHTLY SPREAD AND TAMP SOIL MATERIAL TO FILL VOIDS BETWEEN BASE LOGS. AVOID HEAVY COMPACTION TO PREVENT DAMAGE TO THE BASE LOGS. FINISHED LAYER OF SOIL SHALL BE 3-INCHES THICK.
5. INSTALL A LAYER OF LIVE CLIPPINGS/ BRUSH/ WOODY DEBRIS, WHICH SHALL CONSIST OF LIVE LIVE CLIPPINGS (75%) AND BRANCHES/ROOTS (25%) DERIVED FROM THE CLEARING OPERATION. LIGHTLY COMPACT THE LIVE CLIPPINGS/BRUSH/WOODY DEBRIS LAYER.
6. LIVE CLIPPINGS SHALL BE PREPARED FROM LIVE PLANT MATERIAL FREE OF INSECTS AND DISEASES. THE PLANTS SHALL CONSIST OF WILLOW, DOGWOOD, AND ALDER.
7. LIVE CLIPPINGS/BRUSH SHALL BE ALIGNED SO STEMS ARE ROUGHLY PARALLEL AND INSTALLED POINTING SLIGHTLY UPSTREAM. FINISHED LIVE CLIPPINGS/BRUSH LAYER SHALL BE 3-INCHES THICK.
8. INSTALL ALTERNATING SOIL MATERIAL AND LIVE CLIPPINGS/BRUSH/WOODY DEBRIS LAYERS TO WITHIN 6-INCHES OF THE PROPOSED FINISHED GRADE.
9. INSTALL EROSION CONTROL MATTING OVER THE TOP LAYER OF BRUSH WITH AN AMPLE AMOUNT OF MATTING OVERHANGING TO WRAP OVER THE TOPSOIL LAYER ONCE IT IS PLACED.
10. INSTALL TOPSOIL OVER FINAL LIVE CLIPPINGS/BRUSH/WOODY LAYER TO ACHIEVE FINISHED GRADE.
11. PREPARE SEEDBED, APPLY SEED, AND WRAP EROSION CONTROL MATTING OVER THE FINISHED TOPSOIL AND KEY INTO EXISTING BANK.



Plan View



Section A-A'

6 BRUSH TOE BANK STABILIZATION (BTBS)
NOT TO SCALE

	PROJECT	SHEET NO.
	00000-029-22356817	11

$TIME$$STAMP$

DGN $REF001 $REF002 $REF003 $REF004 $REF005 $REF006
$DGNLEV $LEV001 $LEV002 $LEV003 $LEV004 $LEV005 $LEV006

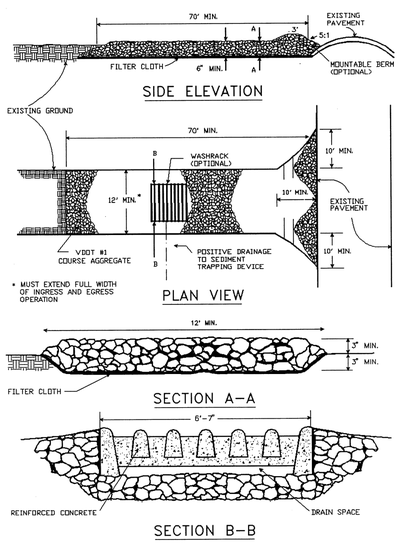
PROJECT MANAGER TRACEY HARMON (804) 371-6834 _ _ _ _
SURVEYED BY, DATE GEORGE GIBSON, SEPT 2016 (703) 674-5790
IMPLEMENTATION DESIGN BY, DATE JOE CATERINO, NOV 2017 (804) 729-9113

EROSION & SEDIMENT CONTROL DETAILS

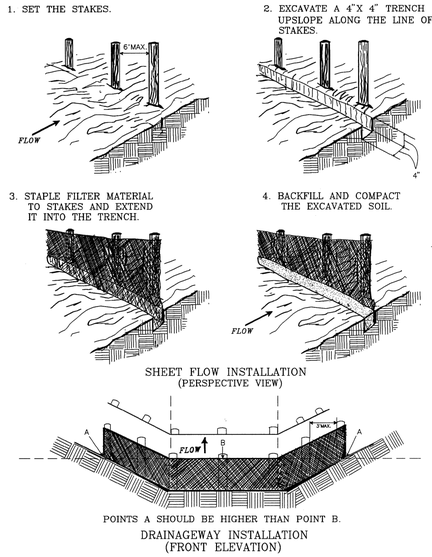
REVISED	STATE	ROUTE	STATE PROJECT	SHEET NO.
	VA.		00000-029-22356817	12

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

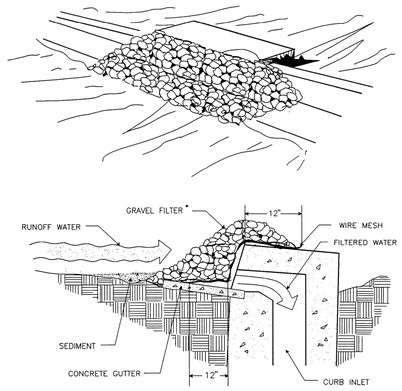
STONE CONSTRUCTION ENTRANCE



CONSTRUCTION OF A SILT FENCE (WITHOUT WIRE SUPPORT)



GRAVEL CURB INLET SEDIMENT FILTER

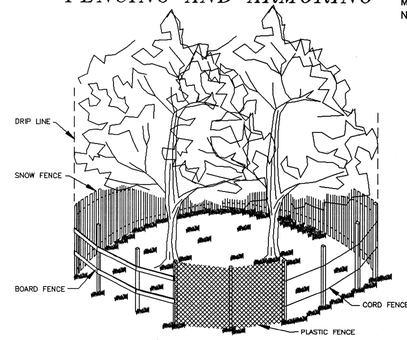


SPECIFIC APPLICATION

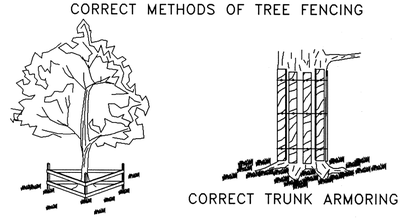
THIS METHOD OF INLET PROTECTION IS APPLICABLE AT CURB INLETS WHERE PONDING IN FRONT OF THE STRUCTURE IS NOT LIKELY TO CAUSE INCONVENIENCE OR DAMAGE TO ADJACENT STRUCTURES AND UNPROTECTED AREAS.

* GRAVEL SHALL BE VDOT #3, #357 OR 5 COARSE AGGREGATE.

FENCING AND ARMORING



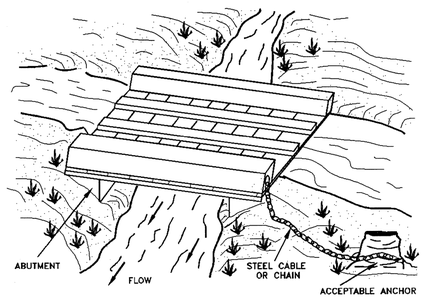
CORRECT METHODS OF TREE FENCING

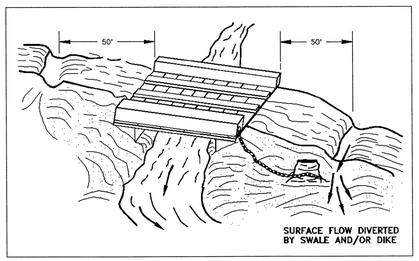


CORRECT TRUNK ARMORING

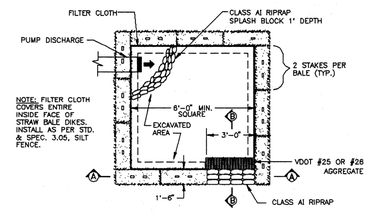
TRIANGULAR BOARD FENCE

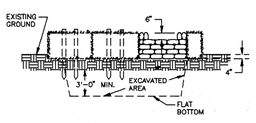
TEMPORARY BRIDGE CROSSING

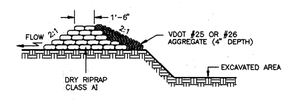




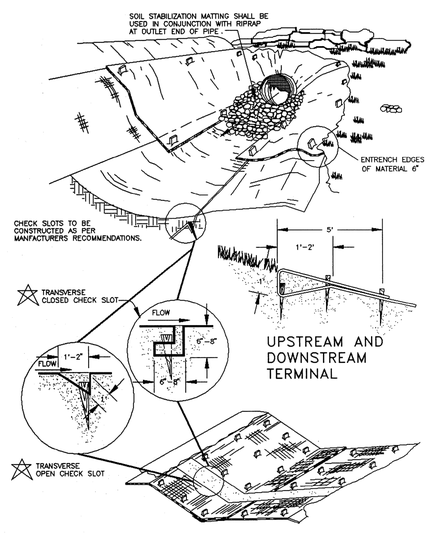
STRAW BALE/SILT FENCE PIT



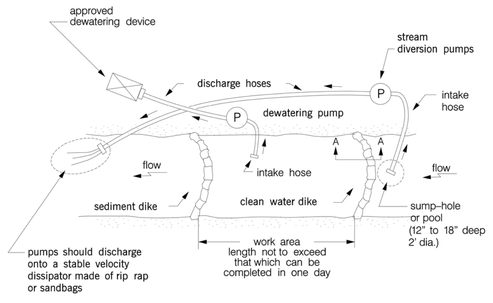




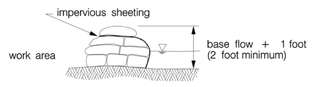
TYPICAL TREATMENT-2 SOIL STABILIZATION MATTING INSTALLATION



PLAN VIEW



SECTION A-A



$TIME$STAMP$

	PROJECT	SHEET NO.
	00000-029-22356817	12

Cell Revised 12/11/12

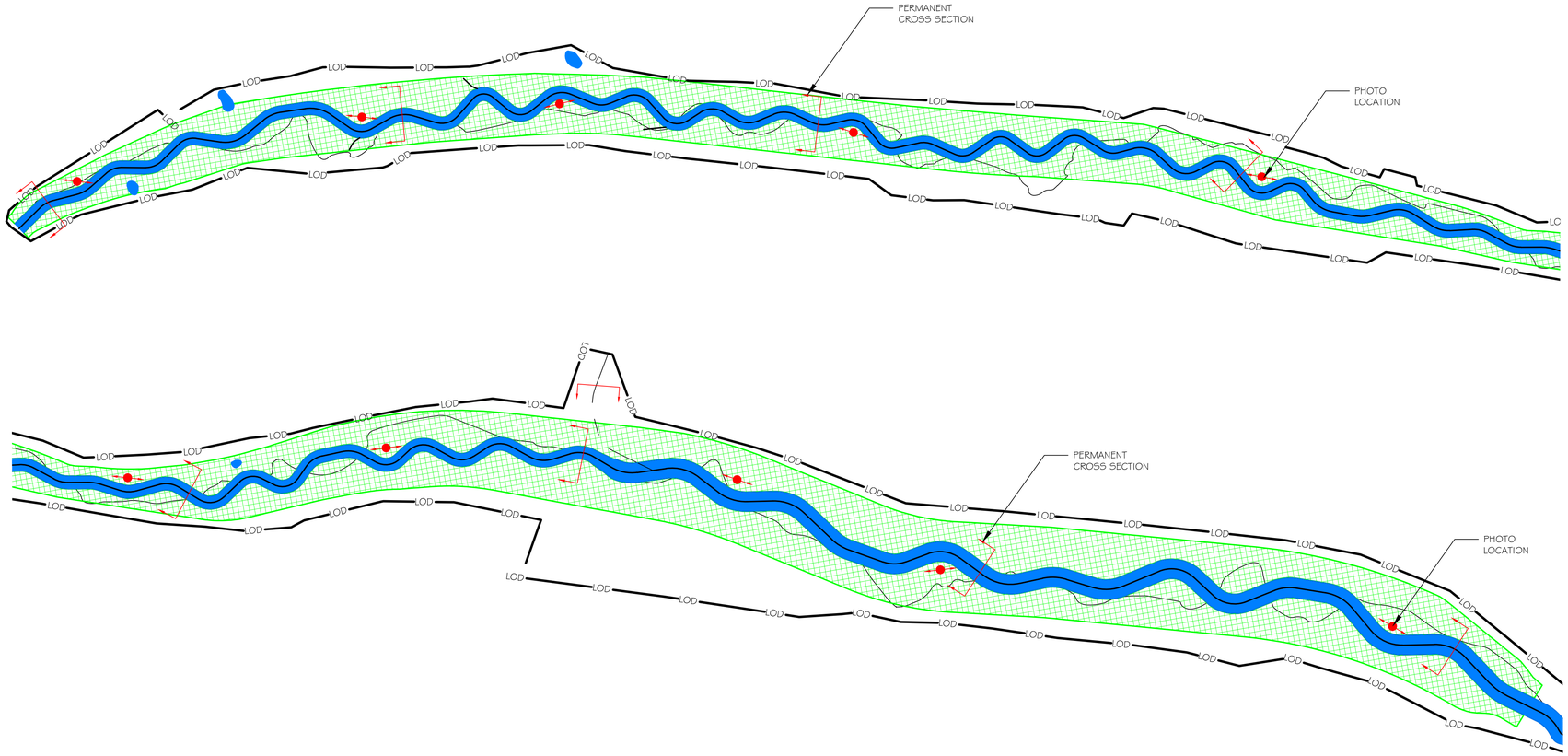
DGN $REF001 $REF002 $REF003 $REF004 $REF005 $REF006
$DGNLEV $LEV001 $LEV002 $LEV003 $LEV004 $LEV005 $LEV006

PROJECT MANAGER_TRACEY HARMON (804) 371-6834 _____
SURVEYED BY, DATE GEORGE GIBSON, SEPT 2016 (703) 674-5790 _____
IMPLEMENTATION DESIGN BY, DATE JOE CATERINO, NOV 2017 (804) 729-9113

MONITORING AND MAINTENANCE PLAN

REVISED	STATE	STATE ROUTE	PROJECT	SHEET NO.
	VA.		00000-029-22356817	13

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



POST-CONSTRUCTION MONITORING AND MAINTENANCE PLAN

AS-BUILT REPORT

A POST-CONSTRUCTION AS-BUILT SURVEY AND FUNCTION-BASED ASSESSMENT SHALL BE SUBMITTED TO THE USACE WITHIN 90 DAYS OF PROJECT COMPLETION. THE AS-BUILT SURVEY SUBMITTAL SHALL DEMONSTRATE THAT DESIGN OBJECTIVES HAVE BEEN ACHIEVED AND INCLUDE:

- *PLAN VIEW OF AS-BUILT THALWEG ON PROPOSED DESIGN*
- *LONGITUDINAL PROFILE*
- *TEN (10) PERMANENT CROSS-SECTIONS, WHICH IS APPROXIMATELY 1 CROSS-SECTION PER 500 LF OF RESTORATION*
- *LOCATION OF PLANTED RIPARIAN BUFFER VEGETATION*
- *REPRESENTATIVE PHOTOGRAPHS*
- *A DISCUSSION OF THE SURVEYED AS-BUILT CONDITIONS COMPARED TO THE PROJECT DESIGN.*

ANNUAL MONITORING PLAN

ANNUAL MONITORING SHALL BE CONDUCTED FOR THREE YEARS AFTER CONSTRUCTION (OR UNTIL TWO SEQUENTIAL REPORTS INDICATE THAT THE CHANNEL IS STABLE AND THE SITE HAS MEET OVERALL RESTORATION GOALS) TO COLLECT DATA DEMONSTRATING THE PROJECT'S FUNCTIONAL UPLIFT WHEN COMPARED WITH BASELINE VALUES. A REPORT SUMMARIZING AND CONTAINING ALL NECESSARY DATA SHALL BE SUBMITTED TO THE USACE AND DEQ WITHIN 90 DAYS OF THE ANNUAL MONITORING EVENT.

THE ANNUAL INSPECTION SHALL INCLUDE QUANTIFIABLE MEASUREMENTS OF APPROPRIATE, PROJECT SPECIFIC PARAMETERS BASED ON PROJECT GOALS AND DESIGN OBJECTIVES TO ASSESS AQUATIC RESOURCE FUNCTIONAL LIFT AS COMPARED TO THE BASELINE. A NARRATIVE DISCUSSION SUMMARIZING THE PROJECT PERFORMANCE SHALL ALSO BE INCLUDED. THE FOLLOWING DATA WILL BE COLLECTED TO SUPPORT RESTORATION OBJECTIVES:

PHOTOGRAPHIC DOCUMENTATION

A SET OF GEO-REFERENCED, GROUND-LEVEL PHOTOGRAPHS WITH VISUAL DESCRIPTIONS SHALL BE TAKEN DURING ANNUAL MONITORING EVENTS. THE VISUAL DESCRIPTIONS CAN GENERALLY INCLUDE, BUT ARE NOT LIMITED TO:

- *DOMINANT VEGETATION SPECIES IDENTIFICATION*
- *HERBACEOUS PLANT COVERAGE ASSESSMENT*
- *WOODY PLANT SURVIVAL RATE*
- *INVASIVE SPECIES PRESENT*
- *CONDITION OF IN-STREAM STRUCTURES*
- *EXCESSIVE SEDIMENTATION OR EROSION.*

ADDITIONALLY, PHOTOGRAPHS OF INDICATORS OF OUT OF BANK FLOW STAGE SHALL BE TAKEN OF THE CHANNEL AND FLOODPLAIN BENCH (E.G. SEDIMENT DEPOSITION, DEBRIS LINES, OR BENT VEGETATION).

MAINTENANCE PLAN

$TIME$$STAMP$

GRAPHIC SCALE: 1" = 80'
0' 80' 160'

PROJECT 00000-029-22356817 | SHEET NO. 13