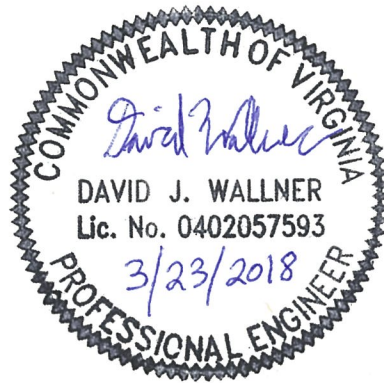


By virtue of this seal and signature, all supporting documents included in this package are accurate and support the design presented herein.



MS-19 STORMWATER MANAGEMENT. PROPERTIES AND WATERWAYS DOWNSTREAM FROM DEVELOPMENT SITES SHALL BE PROTECTED FROM SEDIMENT DEPOSITION, EROSION AND DAMAGE DUE TO INCREASES IN VOLUME, VELOCITY AND PEAK FLOW RATE OF STORMWATER RUNOFF FOR THE STATED FREQUENCY STORM OF 24-HOUR DURATION IN ACCORDANCE WITH THE FOLLOWING STANDARDS AND CRITERIA. STREAM RESTORATION AND RELOCATION PROJECTS THAT INCORPORATE NATURAL CHANNEL DESIGN CONCEPTS ARE NOT MAN-MADE CHANNELS AND SHALL BE EXEMPT FROM ANY FLOW RATE CAPACITY AND VELOCITY REQUIREMENTS FOR NATURAL OR MAN-MADE CHANNELS:

- a. CONCENTRATED STORMWATER RUNOFF LEAVING A DEVELOPMENT SITE SHALL BE DISCHARGED DIRECTLY INTO AN ADEQUATE NATURAL OR MAN-MADE RECEIVING CHANNEL, PIPE OR STORM SEWER SYSTEM. FOR THOSE SITES WHERE RUNOFF IS DISCHARGED INTO A PIPE OR PIPE SYSTEM, DOWNSTREAM STABILITY ANALYSES AT THE OUTFALL OF THE PIPE OR PIPE SYSTEM SHALL BE PERFORMED.
- b. ADEQUACY OF ALL CHANNELS AND PIPES SHALL BE VERIFIED IN THE FOLLOWING MANNER:
1. THE APPLICANT SHALL DEMONSTRATE THAT THE TOTAL DRAINAGE AREA TO THE POINT OF ANALYSIS WITHIN THE CHANNEL IS ONE HUNDRED TIMES GREATER THAN THE CONTRIBUTING DRAINAGE AREA OF THE PROJECT IN QUESTION; OR
 2. (A) NATURAL CHANNELS SHALL BE ANALYZED BY THE USE OF A TWO-YEAR STORM TO VERIFY THAT STORMWATER WILL NOT OVERTOP CHANNEL BANKS NOR CAUSE EROSION OF CHANNEL BED OR BANKS.
(b) ALL PREVIOUSLY CONSTRUCTED MAN-MADE CHANNELS SHALL BE ANALYZED BY THE USE OF A 10-YEAR STORM TO VERIFY THAT STORMWATER WILL NOT OVERTOP ITS BANKS AND BY THE USE OF A TWO-YEAR STORM TO DEMONSTRATE THAT STORMWATER WILL NOT CAUSE EROSION OF CHANNEL BED OR BANKS; AND
(c) PIPES AND STORM SEWER SYSTEMS SHALL BE ANALYZED BY THE USE OF A 10-YEAR STORM TO VERIFY THAT STORMWATER WILL BE CONTAINED WITHIN THE PIPE OR SYSTEM.
- c. IF EXISTING NATURAL RECEIVING CHANNELS OR PREVIOUSLY CONSTRUCTED MAN-MADE CHANNELS OR PIPES ARE NOT ADEQUATE, THE APPLICANT SHALL:
1. IMPROVE THE CHANNELS TO A CONDITION WHERE A 10-YEAR STORM WILL NOT OVERTOP THE BANKS AND A TWO-YEAR STORM WILL NOT CAUSE EROSION TO THE CHANNEL, THE BED, OR THE BANKS; OR
 2. IMPROVE THE PIPE OR PIPE SYSTEM TO A CONDITION WHERE THE 10-YEAR STORM IS CONTAINED WITHIN THE APPURTENANCES;
 3. DEVELOP A SITE DESIGN THAT WILL NOT CAUSE THE PRE-DEVELOPMENT PEAK RUNOFF RATE FROM A TWO-YEAR STORM TO INCREASE WHEN RUNOFF OUTFALLS INTO A NATURAL CHANNEL OR WILL NOT CAUSE THE PRE-DEVELOPMENT PEAK RUNOFF RATE FROM A 10-YEAR STORM TO INCREASE WHEN RUNOFF OUTFALLS INTO A MAN-MADE CHANNEL; OR
 4. PROVIDE A COMBINATION OF CHANNEL IMPROVEMENT, STORMWATER DETENTION OR OTHER MEASURES WHICH IS SATISFACTORY TO THE VESCP AUTHORITY TO PREVENT DOWNSTREAM EROSION.
- d. THE APPLICANT SHALL PROVIDE EVIDENCE OF PERMISSION TO MAKE THE IMPROVEMENTS.
- e. ALL HYDROLOGIC ANALYSES SHALL BE BASED ON THE EXISTING WATERSHED CHARACTERISTICS AND THE ULTIMATE DEVELOPMENT CONDITION OF THE SUBJECT PROJECT.
- f. IF THE APPLICANT CHOOSES AN OPTION THAT INCLUDES STORMWATER DETENTION, HE SHALL OBTAIN APPROVAL FROM THE VESCP OF A PLAN FOR MAINTENANCE OF THE DETENTION FACILITIES. THE PLAN SHALL SET FORTH THE MAINTENANCE REQUIREMENTS OF THE FACILITY AND THE PERSON RESPONSIBLE FOR PERFORMING THE MAINTENANCE.
- g. OUTFALL FROM A DETENTION FACILITY SHALL BE DISCHARGED TO A RECEIVING CHANNEL, AND ENERGY DISSIPATORS SHALL BE PLACED AT THE OUTFALL OF ALL DETENTION FACILITIES AS NECESSARY TO PROVIDE A STABILIZED TRANSITION FROM THE FACILITY TO THE RECEIVING CHANNEL.
- h. ALL ON-SITE CHANNELS MUST BE VERIFIED TO BE ADEQUATE.
- i. INCREASED VOLUMES OF SHEET FLOWS THAT MAY CAUSE EROSION OR SEDIMENTATION ON ADJACENT PROPERTY SHALL BE DIVERTED TO A STABLE OUTLET, ADEQUATE CHANNEL, PIPE OR PIPE SYSTEM, OR TO A DETENTION FACILITY.
- j. IN APPLYING THESE STORMWATER MANAGEMENT CRITERIA, INDIVIDUAL LOTS OR PARCELS IN A RESIDENTIAL, COMMERCIAL OR INDUSTRIAL DEVELOPMENT SHALL NOT BE CONSIDERED TO BE SEPARATE DEVELOPMENT PROJECTS. INSTEAD, THE DEVELOPMENT, AS A WHOLE, SHALL BE CONSIDERED TO BE A SINGLE DEVELOPMENT PROJECT. HYDROLOGIC PARAMETERS THAT REFLECT THE ULTIMATE DEVELOPMENT CONDITION SHALL BE USED IN ALL ENGINEERING CALCULATIONS.
- k. ALL MEASURES USED TO PROTECT PROPERTIES AND WATERWAYS SHALL BE EMPLOYED IN A MANNER WHICH MINIMIZES IMPACTS ON THE PHYSICAL, CHEMICAL AND BIOLOGICAL INTEGRITY OF RIVERS, STREAMS AND OTHER WATERS OF THE STATE.
- l. ANY PLAN APPROVED PRIOR TO JULY 1, 2014, THAT PROVIDES FOR STORMWATER MANAGEMENT THAT ADDRESSES ANY FLOW RATE CAPACITY AND VELOCITY REQUIREMENTS FOR NATURAL OR MAN-MADE CHANNELS SHALL SATISFY THE FLOW RATE CAPACITY AND VELOCITY REQUIREMENTS FOR NATURAL OR MAN-MADE CHANNELS IF THE PRACTICES ARE DESIGNED TO (I) DETAIN THE WATER QUALITY VOLUME AND TO RELEASE IT OVER 48 HOURS; (II) DETAIN AND RELEASE OVER A 24-HOUR PERIOD THE EXPECTED RAINFALL RESULTING FROM THE ONE YEAR, 24-HOUR STORM; AND (III) REDUCE THE ALLOWABLE PEAK FLOW RATE RESULTING FROM THE 1.5, 2, AND 10-YEAR, 24-HOUR STORMS TO A LEVEL THAT IS LESS THAN OR EQUAL TO THE PEAK FLOW RATE FROM THE SITE ASSUMING IT WAS IN A GOOD FORESTED CONDITION, ACHIEVED THROUGH MULTIPLICATION OF THE FORESTED PEAK FLOW RATE BY A REDUCTION FACTOR THAT IS EQUAL TO THE RUNOFF VOLUME FROM THE SITE WHEN IT WAS IN A GOOD FORESTED CONDITION DIVIDED BY THE RUNOFF VOLUME FROM THE SITE IN ITS PROPOSED CONDITION, AND SHALL BE EXEMPT FROM ANY FLOW RATE CAPACITY AND VELOCITY REQUIREMENTS FOR NATURAL OR MAN-MADE CHANNELS AS DEFINED IN ANY REGULATIONS PROMULGATED PURSUANT TO § 62.1-44.15:54 OR 62.1-44.15:65 OF THE ACT.
- m. FOR PLANS APPROVED ON AND AFTER JULY 1, 2014, THE FLOW RATE CAPACITY AND VELOCITY REQUIREMENTS OF § 62.1-44.15:52 A OF THE ACT AND THIS SUBSECTION SHALL BE SATISFIED BY COMPLIANCE WITH WATER QUALITY REQUIREMENTS IN THE STORMWATER MANAGEMENT ACT (§ 62.1-44.15:24 ET SEQ. OF THE CODE OF VIRGINIA) AND ATTENDANT REGULATIONS, UNLESS SUCH LAND-DISTURBING ACTIVITIES ARE IN ACCORDANCE WITH 9VAC25-870-48 OF THE VIRGINIA STORMWATER MANAGEMENT PROGRAM (VSMP) REGULATION OR ARE EXEMPT PURSUANT TO SUBDIVISION C 7 OF § 62.1-44.15:34 OF THE ACT.
- n. COMPLIANCE WITH THE WATER QUANTITY MINIMUM STANDARDS SET OUT IN 9VAC25-870-66 OF THE VIRGINIA STORMWATER MANAGEMENT PROGRAM (VSMP) REGULATION SHALL BE DEEMED TO SATISFY THE REQUIREMENTS OF THIS SUBDIVISION 19.

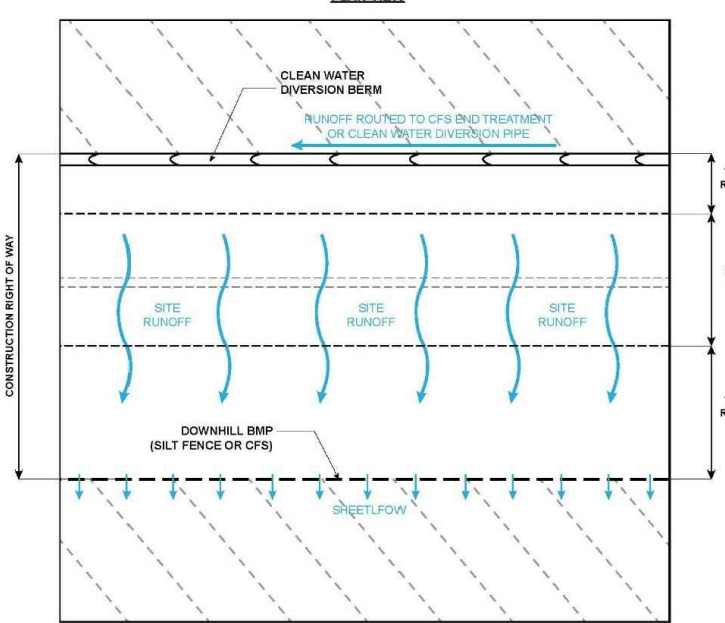
15. MS-19 COMPLIANCE DURING CONSTRUCTION:

A. INTRODUCTION

THE PRIMARY INTENT OF MS-19 IS TO ENSURE THAT DOWN GRADIENT PROPERTIES ARE PROTECTED FROM ADVERSE IMPACTS RESULTING FROM INCREASES IN STORMWATER RUNOFF FROM DEVELOPMENT ACTIVITIES. IN ACCORDANCE WITH 9VAC25-870-66, WATER QUANTITY, COMPLIANCE WITH THE WATER QUALITY REQUIREMENTS CONTAINED IN THAT SECTION SATISFIES THE REQUIREMENTS OF M.S. 19:

“COMPLIANCE WITH THE MINIMUM STANDARDS SET OUT IN THIS SECTION SHALL BE DEEMED TO SATISFY THE REQUIREMENTS OF SUBDIVISION 19 OF 9VAC25-840-40 (MINIMUM STANDARDS; VIRGINIA EROSION AND SEDIMENT CONTROL REGULATIONS).”

THERE ARE TWO PRIMARY FLOW REGIMES ASSOCIATED WITH THE CONSTRUCTION PHASE OF THE PROJECT THAT WILL NEED TO BE ASSESSED FOR COMPLIANCE WITH MS-19. THESE INCLUDE FLOWS GENERATED DIRECTLY WITHIN THE DISTURBED PROJECT AREA THAT ARE CONTROLLED BY PERIMETER CONTROLS CONSISTING OF COMPOST FILTER SOCKS (CFS) OR SILT FENCE, AS WELL AS FLOWS ROUTED AROUND THE PROJECT AREA VIA CLEAN WATER DIVERSIONS (THROUGH EITHER A CFS END TREATMENT RELEASE FOR SITUATIONS WHERE CLEAN WATER DOES NOT CROSS THE ROW, OR THROUGH A CLEAN WATER DIVERSION PIPE WITH A STILLING BASIN WHEN A PARTICULAR LOCATION REQUIRES CLEAN WATER TO BE DIVERTED THROUGH THE ROW). THE FOLLOWING FIGURE DEPICTS THE DIRECT RUNOFF SCENARIOS, FOR MORE SPECIFICS ON THE CLEAN WATER DIVERSION SCENARIOS, SEE DETAILS MVP-ES0, MVP-ES0.1, MVP-ES1, AND MVP-ES1.1.



REGARDLESS OF THE SPECIFIC LOCATION AND/OR FLOW REGIME, ALL EROSION AND SEDIMENT CONTROL MEASURES INCLUDED IN THE DESIGN PLANS FOR THE PROJECT HAVE BEEN DEVELOPED AND DESIGNED TO BE IN FULL COMPLIANCE WITH STATE REQUIREMENTS, AS CONTAINED IN THE VIRGINIA EROSION AND SEDIMENT CONTROL HANDBOOK (VESCH), AS WELL AS THE APPROVED *PROJECT SPECIFIC STANDARDS AND SPECIFICATIONS*. AS A RESULT, ALL IMPLEMENTED PRACTICES (CLEAN WATER DIVERSION, SILT FENCE, CFS, SOIL STABILIZATION, TEMPORARY WATER BARS, ETC.) WILL MEET ALL STATE REQUIREMENTS. IN ALL INSTANCES OF OFFSITE STORMWATER FLOW DURING THE CONSTRUCTION PHASE OF THE PROJECT, COMPLIANCE WITH MS-19 IS PROVIDED THROUGH THE PROVISION OF SHEETFLOW BELOW THE RESPECTIVE EROSION AND SEDIMENT CONTROL PRACTICES ALONG THE PERIMETER (CFS, SILT FENCE, OR CLEAN WATER DIVERSION END TREATMENTS). A DESCRIPTION OF THE FLOW REGIME FOR BOTH THE CLEAN WATER DIVERSIONS AND DIRECT RUNOFF FROM DISTURBED AREAS OF THE PROJECT IS PROVIDED BELOW, FOLLOWED BY AN ANALYSIS THAT DEMONSTRATES THAT FLOW FROM THE PROPOSED PRACTICES WILL PROVIDE FOR NON-EROSIVE SHEET FLOW AND IS THEREFORE IN FULL COMPLIANCE WITH MS-19.

B. RUNOFF FROM PROJECT SITE

PROPERLY DESIGNED AND IMPLEMENTED EROSION AND SEDIMENT CONTROLS IN THE FORM OF SOIL STABILIZATION, TEMPORARY WATER BARS WITH STILLING BASINS THAT FLOW TO CFS, STAND-ALONE CFS, AND/OR SILT FENCE WILL ENSURE DISTURBED AREAS WITHIN THE PROJECT SITE ARE PROTECTED IN ACCORDANCE WITH VESCH SPECIFICATIONS. PERIMETER CONTROLS (CFS AND/OR SILT FENCE, DEPENDING ON THE SPECIFIC LOCATION) WILL FILTER RUNOFF AND PROVIDE SHEETFLOW TO DOWNGRADIENT AREAS IN A NON-EROSIVE MANNER. THIS WILL RESULT IN RUNOFF FROM THE PROJECT SITE MEETING MS-19 REQUIREMENTS.

1. SHEETFLOW DISCHARGES

THE RELEVANT STANDARD REFERRED TO IN 9VAC25-870-66 IS IN SECTION D THAT CONTAINS THE REQUIREMENTS WHEN DISCHARGING STORMWATER IN THE FORM OF SHEETFLOW:

“D. INCREASED VOLUMES OF SHEET FLOW RESULTING FROM Pervious OR DISCONNECTED IMPervious AREAS, OR FROM PHYSICAL SPREADING OF CONCENTRATED FLOW THROUGH LEVEL SPREADERS, MUST BE IDENTIFIED AND EVALUATED FOR POTENTIAL IMPACTS ON DOWN-GRADIENT PROPERTIES OR RESOURCES. INCREASED VOLUMES OF SHEET FLOW THAT WILL CAUSE OR CONTRIBUTE TO EROSION, SEDIMENTATION, OR FLOODING OF DOWN GRADIENT PROPERTIES OR RESOURCES SHALL BE DIVERTED TO A STORMWATER MANAGEMENT FACILITY OR A STORMWATER CONVEYANCE SYSTEM THAT CONVEYS THE RUNOFF WITHOUT CAUSING DOWN-GRADIENT EROSION, SEDIMENTATION, OR FLOODING. IF ALL RUNOFF FROM THE SITE IS SHEET FLOW AND THE CONDITIONS OF THIS SUBSECTION ARE MET, NO FURTHER WATER QUANTITY CONTROLS ARE REQUIRED.”

SHEETFLOW DOWN GRADIENT OF THE ROW DURING THE CONSTRUCTION PHASE WILL BE PROVIDED BY PERIMETER CONTROLS THAT HAVE BEEN DESIGNED IN ACCORDANCE WITH THE APPROVED *PROJECT SPECIFIC STANDARDS AND SPECIFICATIONS*, AS WELL AS THE RELEVANT SPECIFICATIONS CONTAINED IN THE VESCH (AS NOTED ABOVE). EACH PRACTICE (SILT FENCE AND CFS) HAS BEEN SELECTED BASED ON THE SITE SPECIFIC CONDITIONS TO MAKE CERTAIN THAT THEY WILL FUNCTION PROPERLY AND AS INTENDED. CONFIRMATION THAT SHEETFLOW WILL BE PROVIDED DOWNGRADIENT OF EACH PRACTICE IS PROVIDE BELOW.

a) SILT FENCE

BY DEFINITION, SILT FENCE IS A FILTERING PRACTICE THAT HAS A STATED PERMEABILITY OF 0.3 GAL/MIN/SF (VESCH TABLE 3-05-A). ASSUMING A MAXIMUM PONDING DEPTH OF 24-IN, THIS WILL RESULT IN A FLOW RATE THROUGH THE FENCING OF 0.6 GAL/MIN/ LF OF FENCING. CONVERTING, THIS EQUATES TO APPROXIMATELY 0.00134 CFS/ LF (448.83 GPM = 1 CFS). THIS FLOW RATE CAN BE INSERTED INTO MANNING'S EQUATION TO SOLVE FOR THE CORRESPONDING DEPTH OF FLOW:

$$Q = (1.49/N) A R^{2/3} S^{1/2}$$

WHERE:

$$Q = \text{OVERLAND FLOW RATE, CFS}$$

$$A = \text{CROSS-SECTIONAL FLOW AREA PER LF OF FENCE (I.E. DEPTH X 1), FT}^2$$

$$N = \text{MANNING'S COEFFICIENT.}$$

THIS PARAMETER WAS ASSUMED TO BE 0.24 FOR SHEETFLOW IN “DENSE GRASSES” (TR-55, TABLE 3-1). AREAS BELOW THE END TREATMENTS WILL BE SEEDED WITH A NATIVE GRASSES AND WOODY SPECIES, SO THE “DENSE GRASSES” N VALUE WAS DEEMED TO BE THE MOST APPROPRIATE VS THE “SHORT PRAIRIE GRASS” (N = 0.15) OR “BERMUDA GRASS” (N = 0.41) ALTERNATIVES).

$$R = \text{HYDRAULIC RADIUS, FT.}$$

THIS TERM IS DEFINED AS THE CROSS-SECTIONAL FLOW AREA DIVIDED BY THE WETTED PERIMETER. HOWEVER, FOR SHALLOW, WIDE FLOW THIS CAN BE ASSUMED TO BE EQUAL TO THE FLOW DEPTH. TO ILLUSTRATE, ASSUME A FLOW DEPTH OF 0.10 FT OVER A LENGTH OF 10 FT:

$$\begin{aligned} R &= A / WP \\ &= (0.1 \text{ FT} * 10 \text{ FT}) / (0.1 \text{ FT} + 10 \text{ FT} + 0.1 \text{ FT}) \\ &= 1.0 \text{ FT}^2 / 10.2 \text{ FT} \\ &= 0.098 \text{ FT} \end{aligned}$$

$$\text{DEPTH} = 0.10 \text{ FT IS A VALID ASSUMPTION}$$

$$S = \text{DOWN-GRADIENT OVERLAND SLOPE, FT/FT.}$$

ASSUMING AN OVERLAND SLOPE OF 0.5 FT/FT AND AN “N” VALUE OF 0.24 (MEADOW), RESULTS IS A NOMINAL FLOW DEPTH OF 0.0078 FT:

$$0.00134 = (1.49/0.24) (\text{DEPTH X 1}) \text{ DEPTH}^{2/3} 0.5^{1/2}$$

REARRANGING,

$$\text{DEPTH}^{5/3} = 0.000305$$

$$\text{DEPTH} = 0.0078 \text{ FT}$$

THIS FLOW DEPTH CAN THEN BE USED TO COMPUTE THE VELOCITY IN ACCORDANCE WITH:

$$\begin{aligned} V &= Q/A \\ &= 0.00134 / 0.0078 \\ &= 0.17 \text{ FPS} \end{aligned}$$

THIS VALUE IS AN ORDER OF MAGNITUDE LOWER THAN THE CONSERVATIVELY ASSUMED ALLOWABLE VELOCITY OF 2 FPS (BARE EARTH). THIS RESULT IS NOT UNEXPECTED AS THE PURPOSE OF SILT FENCE IS TO SLOWLY FILTER STORMWATER RUNOFF.

b) CFS

THE OTHER PERIMETER CONTROL THAT WILL BE IMPLEMENTED, DEPENDING ON THE SPECIFIC LOCATION, WILL BE CFS. THE COMPOST FILTER SOCKS ARE RATED BY THE AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO) IN THE DOCUMENT “*FILTER BERMS AND FILTER SOCKS: STANDARD SPECIFICATIONS FOR COMPOST FOR EROSION/SEDIMENT CONTROL*” TO PASS A RANGE OF FLOWS, FROM 4 TO OVER 10 GPM/LF (TABLE 2). A PRODUCT SPECIFIC CITATION OBTAINED FROM FILTREXX® STIPULATES A FLOW THROUGH RATE OF 22.5 GAL/MIN/LF FOR A 24-IN DIAMETER CFS (THE EFFECTIVE SIZE THAT WILL BE USED FOR THIS PROJECT). IN ORDER TO ENSURE A SHEETFLOW DEPTH OF NOT MORE THAN 0.10 FT BELOW THE CFS, AN EVEN HIGHER FLOW RATE OF 43 GPM WAS ASSUMED (VERY CONSERVATIVE).

ASSUMING A WORST CASE OF 43 GPM, THIS EQUATES TO A FLOW RATE OF 0.095 CFS/LF. USING MANNING'S EQUATION TO SOLVE FOR THE DEPTH OF FLOW USING THE SAME ASSUMPTIONS AND METHODOLOGY NOTED ABOVE RESULTS IN AN OVERLAND FLOW DEPTH OF 0.10 FT:

$$0.095 = (1.49/0.24) (\text{DEPTH X 1}) \text{ DEPTH}^{2/3} 0.5^{1/2}$$

REARRANGING,

$$\text{DEPTH}^{5/3} = 0.022 \text{ FT}$$

$$\text{DEPTH} = 0.10 \text{ FT}$$

THIS FLOW DEPTH CAN THEN BE USED TO COMPUTE THE VELOCITY IN ACCORDANCE WITH:

$$\begin{aligned} V &= Q/A \\ &= 0.095 / 0.10 \\ &= 0.95 \text{ FPS} \end{aligned}$$

THUS, THE CFS WILL ALSO PROVIDE SHEETFLOW IN A NON-EROSIVE MANNER THAT WILL NOT IMPACT DOWN GRADIENT PROPERTIES. AS A RESULT, SHEETFLOW DOWNGRADIENT FROM THE CFS PERIMETER CONTROL IMMEDIATELY FOLLOWING CONSTRUCTION IS ALSO IN FULL COMPLIANCE WITH M.S. 19.

c) FLOODING

BECAUSE SHEETFLOW HAS BEEN DEMONSTRATED FOR DOWNGRADIENT FLOWS DURING THE CONSTRUCTION PROCESS, COMPLIANCE WITH THE FLOODING PROVISION OF THE REGULATIONS (9VAC25-870-66 C. FLOOD PROTECTION) IS NOT REQUIRED. HOWEVER, THE SHEETFLOW PROVISION CITED IN THIS NARRATIVE DOES REQUIRE THAT “FLOODING” OF DOWNGRADIENT PROPERTIES OR RESOURCES” DOES NOT OCCUR. THE DEFINITION OF “FLOODING” PROVIDED IN THE REGULATIONS IS:

“FLOODING” MEANS A VOLUME OF WATER THAT IS TOO GREAT TO BE CONFINED WITHIN THE BANKS OR WALLS OF A STREAM, WATER BODY, OR CONVEYANCE SYSTEM AND THAT OVERFLOWS ONTO ADJACENT LANDS, THEREBY CAUSING OR THREATENING DAMAGE.”

IN THIS INSTANCE, THERE ARE NO CONVEYANCES (I.E. SHEETFLOW), THEREFORE THE APPLICABLE PORTION OF THE DEFINITION IS RELATED TO OVERLAND FLOW THAT CAUSES OR THREATENS TO CAUSE DAMAGE. THIS ANALYSIS HAS DEMONSTRATED THAT THE SHEETFLOW FROM EITHER THE SILT FENCE OR CFS IS NON-EROSIVE. THEREFORE, THE TEMPORARY, NOMINAL INCREASES IN DOWN GRADIENT FLOW RATES THAT MAY OCCUR IN SOME SITUATIONS (NOTE - IN MANY INSTANCES THE FLOW RATES WILL ACTUALLY BE REDUCED AS A RESULT OF PONDING BEHIND THE SILT FENCE AND/OR CFS) WILL NOT RESULT IN DAMAGE AND THEREFORE COMPLIES WITH THE REQUIREMENTS OF MS-19.

C. CLEAN WATER DIVERSIONS

CLEAN WATER DIVERSIONS WILL BE INSTALLED IN ACCORDANCE WITH VESCH STD & SPEC 3.09 (DIVERSION DIKES) AND PROJECT DETAILS MVP-ES0.1 (CLEAN WATER DIVERSION WITH END RELEASE) AND MVP-ES0 (CLEAN WATER DIVERSION WITH CLEAN WATER PIPE) TO ROUTE CLEAN STORMWATER AROUND THE PROJECT WORK AREA.

1. CLEAN WATER DIVERSION WITH END RELEASE (MVP-ES0.1)

THE END TREATMENTS ARE COMPRISED OF CFS (DETAIL MVP-ES3) THAT HAVE BEEN PROPERLY DESIGNED TO FILTER RUNOFF PRIOR TO BEING DISCHARGED OFF SITE. THE STORAGE/PEAK FLOW ATTENUATION PROVIDED BY THE ROCK CHECK DAMS SPACED ACROSS THE CLEAN WATER DIVERSION, IN COMBINATION WITH THE PROPOSED CLEAN WATER DIVERSION CFS END TREATMENT, ENSURE A NON-EROSIVE SHEETFLOW DISCHARGE AS DEMONSTRATED PREVIOUSLY IN SECTION B(1)(B). FURTHER DISCUSSION OF THE METHODOLOGY/APPROACH, ASSUMPTIONS, AND THE RESULTING CFS END TREATMENT DESIGN ARE PROVIDED BELOW.

a) 10-YEAR PEAK FLOW CALCULATIONS

PEAK FLOW CALCULATIONS WERE COMPLETED FOR THE 10-YEAR STORM EVENT USING THE RATIONAL METHOD:

$$Q = C I A$$

WHERE:

$$Q = \text{OVERLAND FLOW RATE, CFS}$$

$$C = \text{RUNOFF COEFFICIENT}$$

ASSUMED C=0.21 FOR “WOODED” LAND USE CONDITION IN HSG D SOILS WITH 6%+ SLOPES PER VA SWM HANDBOOK VOLUME II, TABLE 4-5B TO BE CONSERVATIVE.

$$I = \text{RAINFALL INTENSITY (10 YR STORM)}$$

RAINFALL INTENSITIES CORRESPONDING TO TRAVEL TIMES FOR SLOPES RANGING FROM 10-40% WERE USED TO CALCULATE A RANGE OF PEAK FLOWS REPRESENTATIVE OF THE VARIABLE SLOPES ACROSS THE PIPELINE. THE TRAVEL TIME FOR EACH SLOPE CONDITION WAS CALCULATED IN ACCORDANCE WITH TR-55 ASSUMING A TOTAL FLOW LENGTH OF 600 FT (100 FT SHEETFLOW AND 500 FT SHALLOW CONCENTRATED FLOW) AND A SHEETFLOW MANNING'S N-VALUE OF 0.24 FOR “DENSE GRASSES” (TR-55, TABLE 3-1) TO BE CONSERVATIVE; RAINFALL INTENSITIES CORRESPONDING TO THE CALCULATED TRAVEL TIMES WERE DEVELOPED USING THE 2015 VDOT DRAINAGE MANUAL, APPENDIX 6C-1 “B, D AND E FACTORS - APPLICATION” USING THE FACTORS FOR PITTSYLVANIA COUNTY TO BE CONSERVATIVE. A SUMMARY TABLE WITH THE CALCULATED TRAVEL TIME AND RAINFALL INTENSITY FOR EACH SLOPE CONDITION IS PROVIDED BELOW:

SLOPE (%)	TRAVEL TIME (MIN)	10-YEAR RAINFALL INTENSITY (IN/HR)
10	9	5.52
20	6	6.29
30	5	6.61
40	5	6.61

$$A = \text{DRAINAGE AREA, AC}$$

ASSUMED A = 5 AC, WHICH IS THE MAXIMUM ALLOWABLE DRAINAGE AREA FOR TEMPORARY DIVERSION DIKES PER VESCH STD & SPEC 3.09.

A SUMMARY WITH THE CALCULATED 10-YEAR PEAK FLOW FOR EACH SLOPE CONDITION IS PROVIDED BELOW:

SLOPE (%)	10-YEAR PEAK FLOW (CFS)
10	5.8
20	6.6
30	6.94
40	6.94

b) CLEAN WATER DIVERSION MODELING APPROACH AND ASSUMPTIONS

CALCULATIONS TO DETERMINE THE PEAK FLOW ATTENUATION PROVIDED BY THE ROCK CHECK DAMS SPACED ACROSS THE CLEAN WATER DIVERSION WERE COMPLETED USING THE *HYDRAFLOW HYDROGRAPHS* EXTENSION FOR *AUTOCAD CIVIL 3D*. TO MODEL THE STORAGE/PEAK FLOW ATTENUATION PROVIDED BY THE ROCK CHECK DAMS SPACED ACROSS THE CLEAN WATER DIVERSION, A DIVERSION LENGTH OF 550 FT WAS ASSUMED FOR THE CONTRIBUTING 5 AC DRAINAGE AREA BASED ON A REVIEW OF PROPOSED DIVERSION LENGTHS AND THEIR CORRESPONDING DRAINAGE AREAS. A LINEAR REGRESSION ANALYSIS WAS COMPLETED FOR AN EXAMPLE SECTION OF THE PIPELINE (SPREAD 8, ESCP SHEETS 12.02 THROUGH 12.10) BY PLOTTING THE DIVERSION LENGTH VERSUS THE CORRESPONDING DRAINAGE AREA, AND THE FOLLOWING DATA POINTS WERE EXCLUDED FROM THE ANALYSIS TO ENSURE A CONSERVATIVE DIVERSION LENGTH ESTIMATION:

- OBVIOUS OUTLIERS (E.G., LARGE DRAINAGE AREAS CORRESPONDING TO DRAINAGE FEATURES)
- DATA POINTS THAT ARE TIED TO SECTIONS OF THE PIPELINE THAT RUN RIDGELINE SINCE THOSE DATA POINTS FAVORABLY (I.E., NON-CONSERVATIVELY) SKEW THE LINEAR REGRESSION ANALYSIS

THE DATA THAT WAS USED TO PERFORM THE LINEAR REGRESSION ANALYSIS, ALONG WITH THE RESULTING EQUATION THAT WAS USED TO ESTIMATE THE DIVERSION LENGTH CORRESPONDING TO A 5 AC DRAINAGE AREA, IS PROVIDED IN THE SUMMARY TABLE BELOW:

PLAN SHEET NO.	DIVERSION ID	DIVERSION LENGTH (FT)	DIVERSION DRAINAGE AREA (AC)	COMMENTS
12.02	1	498	4	
	2	74	0.1	
	3	407	3.1	
	4	121	2.7	
	5	83	1.5	
	6	112	1.3	
12.02	7	78	18.3	DRAINAGE AREA TIED TO A DRAINAGE FEATURE, AND IS OMITTED FROM ANALYSIS
	8	96	0.1	DRAINAGE AREA NEAR RIDGE AND IS OMITTED FROM ANALYSIS
12.03	1	234	1.2	
	2	262	1.6	
	3	500	3.2	
12.04	1	377	1.3	
	2	81	0.2	
	3	604	1	DRAINAGE AREA NEAR RIDGE AND IS OMITTED FROM ANALYSIS
	4	160	0.5	DRAINAGE AREA NEAR RIDGE AND IS OMITTED FROM ANALYSIS
	5	402	0.8	DRAINAGE AREA NEAR RIDGE AND IS OMITTED FROM ANALYSIS
				DRAINAGE AREA NEAR RIDGE AND IS OMITTED FROM ANALYSIS
12.05	1	347	0.3	DRAINAGE AREA NEAR RIDGE AND IS OMITTED FROM ANALYSIS
	2	214	0.6	
12.06	1	37	0.1	
	2	167	0.8	
12.06	3	351	4.9	DRAINAGE AREA TIED TO A DRAINAGE FEATURE, AND IS OMITTED FROM ANALYSIS
	4	88	0.1	DRAINAGE AREA NEAR RIDGE AND IS OMITTED FROM ANALYSIS
	5	127	0.2	DRAINAGE AREA LIMITED BY E&S PERIMETER CONTROLS AND IS OMITTED FROM ANALYSIS
	6	425	0.8	DRAINAGE AREA LIMITED BY E&S PERIMETER CONTROLS AND IS OMITTED FROM ANALYSIS
12.07	1	250	0.6	
	2	49	0.1	
	3	155	0.3	
	5	93	0.3	
	6	209	0.4	
	7	21	0.1	
12.08	2	307	0.3	DRAINAGE AREA NEAR RIDGE AND IS OMITTED FROM ANALYSIS
	1	126	0.1	
12.09	2	284	1.6	
	4	492	1	DRAINAGE AREA NEAR RIDGE AND IS OMITTED FROM ANALYSIS
	5	477	0.4	DRAINAGE AREA NEAR RIDGE AND IS OMITTED FROM ANALYSIS
12.1	1	292	2	
	2	191	1.4	
	3	234	1.6	
	4	148	0.1	DRAINAGE AREA NEAR RIDGE AND IS OMITTED FROM ANALYSIS
	5	695	1.4	DRAINAGE AREA NEAR RIDGE AND IS OMITTED FROM ANALYSIS
RESULTING LINEAR REGRESSION EQUATION: Y = 96.439X + 86.264				
R² = 0.6217				
FOR A 5 AC DRAINAGE AREA (X=5), THE DIVERSION LENGTH IS ESTIMATED AS 568 FT. A DIVERSION LENGTH OF 550 FT WAS ASSUMED FOR THE ANALYSIS.				

OTHER ASSUMPTIONS PERTAINING TO THE CLEAN WATER DIVERSION AND ROCK CHECK DAMS ARE AS FOLLOWS:

- CLEAN WATER DIVERSION GEOMETRY IS TRAPEZOIDAL WITH THE FOLLOWING DIMENSIONS:
 - 8 FT BOTTOM WIDTH
 - 2H:1V SIDE SLOPES
 - TOTAL DEPTH OF 1.5 FT (I.E., HEIGHT OF TEMPORARY DIVERSION PER VESCH STD & SPEC 3.09)
- ROCK CHECK DAMS HAVE A HEIGHT OF 1 FT, WHICH IS BELOW TOP-OF-DIVERSION AND THE MAXIMUM HEIGHT OF 3 FT PER VESCH STD & SPEC 3.20.
- ROCK CHECK DAMS HAVE A TOP WIDTH OF 12 FT (I.E., [8 FT BOTTOM WIDTH] + [2*[2H:1V*1 FT]])

A DEPTH-STORAGE CURVE FOR THE CLEAN WATER DIVERSION WITH CHECK DAMS WAS DEVELOPED USING THE FOLLOWING EQUATION FROM *SECTION 6.4.8* OF THE PENNSYLVANIA BEST MANAGEMENT PRACTICES (BMP) MANUAL:

$$V = [0.5*L*D*(WT + WB)/2]*N$$

WHERE:

$$V = \text{STORAGE VOLUME, CF}$$

$$L = \text{LENGTH OF DIVERSION IMPOUNDMENT AREA PER CHECK DAM, FT}$$

$$L = 550 \text{ FT}/N \text{ WHERE } 550 \text{ FT IS THE ASSUMED DIVERSION LENGTH AND "N" IS THE NUMBER OF CHECK DAMS SPACED ALONG THE DIVERSION}$$

$$D = \text{DEPTH OF CHECK DAM, FT}$$

$$\text{ASSUMED D} = 1 \text{ FT}$$

$$WT = \text{TOP WIDTH OF CHECK DAM, FT}$$

$$WT = WB + (2*[2H:1V*1 \text{ FT}]) = 8 \text{ FT} + (2*2 \text{ FT}) = 12 \text{ FT}$$

$$WB = \text{BOTTOM WIDTH OF CHECK DAM, FT}$$

$$\text{ASSUMED WB} = 8 \text{ FT}$$

$$N = \text{NUMBER OF CHECK DAMS, WHERE "D" IS THE DEPTH OF THE CHECK DAM (1 FT) AND "S" IS THE SLOPE CONDITION IN FT/FT.}$$

THE CALCULATED DEPTH-STORAGE CURVE FOR EACH SLOPE CONDITION IS PROVIDED IN THE TABLE BELOW. NOTE THAT THE STORAGE VOLUME BEHIND EACH ROCK CHECK DAM VARIES BASED ON THE SLOPE CONDITION, BUT THE TOTAL STORAGE VOLUME WITHIN THE DIVERSION REMAINS THE SAME SINCE THE SAME DIVERSION LENGTH AND GEOMETRY IS ASSUMED FOR ALL SLOPE CONDITIONS. THE REDUCED STORAGE BEHIND EACH CHECK DAM FOR STEEPER SLOPES IS ACCOUNTED FOR BY AN INCREASED NUMBER OF CHECK DAMS, AS DESCRIBED ABOVE.

CLEAN WATER DIVERSION DEPTH-STORAGE DATA			
SLOPE (%)	DEPTH (FT)	STORAGE VOLUME IN DIVERSION BEHIND EACH CHECK DAM (CF)	TOTAL STORAGE VOLUME WITHIN DIVERSION (CF)
10	0	0	0
	0.5	25	1,375
	1	50	2,750
	1.5	75	4,125
	2	100	5,500
20	0	0	0
	0.5	13	1,375
	1	25	2,750
	1.5	38	4,125
	2	50	5,500
30	0	0	0
	0.5	8.3	1,375
	1	17	2,750
	1.5	25	4,125
	2	33	5,500
40	0	0	0
	0.5	6.3	1,375
	1	13	2,750
	1.5	19	4,125
	2	25	5,500

c) COMPOST FILTER SOCK END TREATMENT MODELING APPROACH AND ASSUMPTIONS

DISCHARGE FROM THE CLEAN WATER DIVERSION IS ROUTED TO A CFS END TREATMENT. CALCULATIONS TO DETERMINE THE ADDITIONAL PEAK FLOW ATTENUATION PROVIDED BY THE PROPOSED CFS END TREATMENT WERE ALSO COMPLETED WITHIN *HYDRAFLOW HYDROGRAPHS*. TO MODEL THE STORAGE/PEAK FLOW ATTENUATION PROVIDED BY THE CFS END TREATMENT, A DEPTH-STORAGE CURVE WAS DEVELOPED FOR EACH SLOPE CONDITION (10-40%) ASSUMING "WEDGE" STORAGE BEHIND THE LENGTH OF THE END TREATMENT USING THE FOLLOWING EQUATION:

$$V = [0.5*(D*S/1/S)*D]*L$$

WHERE:

$$V = \text{STORAGE VOLUME, CF}$$

$$D = \text{PONDING DEPTH BEHIND CFS END TREATMENT, FT}$$

$$\text{FOR 24-IN DIAMETER CFS END TREATMENT (OR EQUIVALENT, SUCH AS 12-IN TRIPLE STACK), THE MAXIMUM PONDING DEPTH (D) IS 2 FT}$$

$$S = \text{SLOPE, FT/FT}$$

$$L = \text{LENGTH OF CFS END TREATMENT, FT}$$

$$\text{ASSUMED L} = 10 \text{ FT}$$

THE CALCULATED DEPTH-STORAGE CURVE FOR EACH SLOPE CONDITION IS PROVIDED IN THE TABLE BELOW:

CFS END TREATMENT DEPTH-STORAGE DATA		
SLOPE (%)	DEPTH (FT)	PONDING VOLUME, V (CF)
10	0	0
	1	50
	2	200
	3	450
	0	0
20	1	25
	2	100
	3	225
	0	0
	1	17
30	2	67
	3	150
	0	0
40	1	13
	2	50
	3	113

CFS IS AN APPROVED E&S CONTROL FOR THE PROJECT (SEE DETAIL MVP-ES3) AND IS CLASSIFIED AS "FLOW-THROUGH" TECHNOLOGY. THEREFORE, IN ADDITION TO DEFINING THE WEIR OUTLET AT THE TOP OF THE END TREATMENT, A DEPTH-DISCHARGE CURVE WAS DEVELOPED TO ACCOUNT FOR FLOW THROUGH THE CFS AT A RATE OF 0.095 CFS/LF (OR 43 GPM/LF, AS DISCUSSED IN *SECTION B.1.B*) ABOVE).

d) COMPOST FILTER SOCK END TREATMENT DESIGN

BASED ON THE CALCULATIONS AND ASSUMPTIONS NOTED IN *SECTIONS C.1.A) THROUGH C.1.C)* ABOVE, IT WAS DETERMINED THAT FLOW FROM THE CLEAN WATER DIVERSION WILL NOT OVERTOP A 10 FT LONG, 24-IN DIAMETER CFS END TREATMENT (OR EQUIVALENT, SUCH AS 12 IN. TRIPLE STACK), WITH A WORST CASE MAXIMUM DEPTH OF 1.32 FT FOR THE 10 % SLOPE CONDITION. NOTE THAT A 12 FT TOP OF CHECK DAM WIDTH IS NEEDED IN ORDER TO ENSURE THAT THE CFS END TREATMENT DOES NOT OVERTOP, SO 16 FT OF THE TEMPORARY ROW (I.E., 12 FT + [2H:1V*0.5 FT] + [2H:1V*1.5 FT] = 16 FT) WILL BE OCCUPIED BY THE CLEAN WATER DIVERSIONS.

THEREFORE, SINCE NO OVERTOPPING WILL OCCUR AND AS DEMONSTRATED PREVIOUSLY IN *SECTION B.1.B)*, THE CFS WILL PRODUCE SHEETFLOW IN A NON-EROSIVE MANNER THAT WILL NOT IMPACT DOWN GRADIENT PROPERTIES.

1. CLEAN WATER DIVERSION WITH CLEAN WATER PIPE (MVP-ES50)

CLEAN WATER DIVERSIONS CAN ALSO DISCHARGE VIA TEMPORARY SLOPE DRAINS PER DETAIL MVP-ES50 AS AN ALTERNATIVE TO USING CFS END TREATMENTS WHEN CONDITIONS ARE MORE APPROPRIATE; ALL TEMPORARY SLOPE DRAINS WILL DISCHARGE TO A PLUNGE POOL OUTLET (SEE DETAILS MVP-ES51 AND MVP-ES51.1). CALCULATIONS CORRESPONDING TO THESE PROJECT DETAILS (SPECIFICALLY, THE SIZING OF THE TEMPORARY SLOPE DRAINS AND PLUNGE POOL OUTLET) WERE SUBMITTED WITH THE FOLLOWING DEVIATION REQUESTS AND APPROVED BY THE DEQ:

- REQUEST 24-IN SLOPE DRAIN PIPE SIZE FOR CLEAN WATER DIVERSIONS
- REQUEST CLEAN WATER PIPE PLUNGE POOL OUTLET DESIGN

D. SUMMARY

SINCE IT HAS BEEN DEMONSTRATED THAT UNDER THE MOST CONSERVATIVE ASSUMPTIONS THAT SHEETFLOW DOWN GRADIENT OF THE PERIMETER CONTROLS, AS WELL AS FROM THE END TREATMENTS ASSOCIATED WITH THE CLEAN WATER DIVERSION SCENARIOS, DURING AND IMMEDIATELY FOLLOWING CONSTRUCTION WILL NOT "*CAUSE OR CONTRIBUTE TO EROSION, SEDIMENTATION, OR FLOODING OF DOWN GRADIENT PROPERTIES*", THE CONSTRUCTION PHASE OF THE PROJECT WILL BE IN FULL COMPLIANCE WITH MS-19.

16. BEST MANAGEMENT PRACTICES INSTALLATION AND REMOVAL NOTES:

TEMPORARY AND PERMANENT BMPS WILL BE USED DURING CONSTRUCTION ACTIVITIES TO AVOID AND/OR MINIMIZE ADVERSE ENVIRONMENTAL EFFECTS OF CONSTRUCTION ACTIVITIES.

THE FOLLOWING ARE GENERAL BMP INSTALLATION NOTES FOR PIPELINE CONSTRUCTION ACTIVITIES.

- A STONE CONSTRUCTION ENTRANCE, SHOWN ON DETAIL SHEET, SHALL BE PROVIDED AT ALL LOCATIONS WHERE CONSTRUCTION TRAFFIC WILL BE ACCESSING A PAVED ROAD DIRECTLY FROM A DISTURBED AREA.
- TEMPORARY SEDIMENT BARRIERS, INCLUDING APPROPRIATELY SIZED SILT FENCE OR COMPOST FILTER SOCK WILL BE PLACED AROUND SOIL STOCKPILES, AS NEEDED.
- COMPOST FILTER SOCK WILL BE PLACED AROUND WETLANDS AND WATERBODIES IN AND ADJACENT TO THE WORK AREA PRIOR TO ANY TRENCHING ACTIVITIES. COMPOST FILTER SOCK HAS BEEN SIZED PER MVP-ES3 AND THE SIZE IS SPECIFIED ON THE PLAN SETS UTILIZING THE LINE TYPES CONTAINED IN THE LEGEND ON EACH SHEET.
- STOCKPILE SLOPES WILL BE 2:1 OR FLATTER, AND STOCKPILES WILL NOT EXCEED 35 FEET IN HEIGHT.
- TEMPORARY STREAM CROSSINGS SHALL BE INSTALLED AS INDICATED ON THE E&S PLAN SHEETS AND AS PER THE E&S DETAIL SHEETS.
- EXCAVATED TRENCH SPOIL MATERIAL WILL BE USED FOR TEMPORARY RIGHT OF WAY DIVERSIONS AS SHOWN IN THE DETAIL AT THE LOCATIONS INDICATED ON THE PLAN SHEETS.
- WATERBARS WILL BE INSTALLED IMMEDIATELY AFTER INITIAL DISTURBANCE OF THE SOIL IN ACCORDANCE WITH THE SPACING AND SIZING REQUIREMENTS SHOWN ON PLAN AND DETAIL SHEET. WATERBARS WILL BE CONSTRUCTED OF SOIL TO REDUCE RUNOFF VELOCITY AND DIVERT WATER OFF THE PIPELINE ROW.
- TRENCH DEWATERING, IF NEEDED, WILL BE CONDUCTED USING A PUMP AND HOSE. WATER WILL BE RELEASED INTO A FILTER BAG THAT WILL BE LOCATED IN A WELL-VEGETATED UPLAND AREA.
- TRENCH BREAKERS WILL BE INSTALLED ON SLOPES ADJACENT TO STREAMS, WETLANDS, AND ROAD CROSSINGS TO PREVENT SUBSURFACE EROSION. TRENCH BREAKERS WILL BE INSTALLED AS SHOWN ON THE DETAILS.
- THE WORK AREA WILL BE BACKFILLED FOLLOWING PIPELINE INSTALLATION OR OTHER EXCAVATION WORK. IN AREAS WHERE TOPSOIL HAS BEEN SEGREGATED, THE SUBSOIL WILL BE REPLACED FIRST, AND THEN THE TOPSOIL WILL BE SPREAD OVER THE AREA FROM WHICH IT WAS REMOVED. DISTURBED AREAS WILL BE RESTORED TO THEIR ORIGINAL TOPOGRAPHIC CONTOURS.
- THE PERMANENT WATERBARS WILL BE CONSTRUCTED WITH A FIVE PERCENT (MAXIMUM) OUTSLOPE TO DIVERT SURFACE FLOW TO A WELL VEGETATED STABLE AREA.
- IMMEDIATELY FOLLOWING BACKFILLING ALL DISTURBED AREAS WILL BE GRADED IN PREPARATION FOR SEEDING AND MULCHING. THE CONSTRUCTION SITE SHOULD BE STABILIZED AS SOON AS POSSIBLE AFTER COMPLETION. ESTABLISHMENT OF FINAL COVER MUST BE INITIATED NO LATER THAN 7 DAYS AFTER REACHING FINAL GRADE. REFER TO TABLES ON THIS SHEET FOR TEMPORARY AND PERMANENT SEEDING SPECIFICATIONS.
- FOR 3:1 OR STEEPER SLOPES THE DISTURBED AREA WILL HAVE EROSION CONTROL BLANKETING INSTALLED AS INDICATED ON DETAIL SHEET.
- TEMPORARY SEDIMENT BARRIERS WILL BE MAINTAINED UNTIL VEGETATION HAS BECOME ESTABLISHED WITH A GROUND COVER THAT IS UNIFORM, MATURE ENOUGH TO SURVIVE AND WILL INHIBIT EROSION. ONCE THIS COVERAGE HAS BEEN OBTAINED, APPROPRIATE CONTROLS WILL BE REMOVED FROM THE WORK AREA. AREAS DISTURBED DURING THE REMOVAL OF THE EROSION CONTROLS WILL BE STABILIZED IMMEDIATELY.

- ALL WASTE MATERIAL WILL BE TRANSPORTED OFFSITE FOR RECYCLING AND/OR DISPOSAL AT A FACILITY APPROVED TO RECEIVE THE MATERIAL.
- IN NON-AGRICULTURAL AREAS THE VISUAL SURVEY SHALL BE COMPARED TO THE DENSITY AND COVER OF ADJACENT UNDISTURBED LANDS. IN AGRICULTURAL AREAS, THE VISUAL SURVEY SHALL BE COMPARED TO THE ADJACENT UNDISTURBED PORTIONS OF THE SAME FIELD, UNLESS THE EASEMENT AGREEMENT SPECIFIES OTHERWISE.
- WETLANDS ALONG THE PROPOSED PIPELINE ARE EXPECTED TO EXHIBIT VARYING DEGREES OF SATURATION AND WATER ELEVATION, REQUIRING A VARIETY OF PLANT SPECIES TO BE RE-ESTABLISHED. IN UNSATURATED WETLANDS, MOST VEGETATION WILL BE REPLACED BY SEEDING. SATURATED WETLANDS WILL TYPICALLY BE ALLOWED TO RE-VEGETATE NATURALLY. WETLAND REVEGETATION WILL BE CONSIDERED SUCCESSFUL WHEN THE COVER OF HERBACEOUS AND/OR WOODY SPECIES IS AT LEAST 80 PERCENT OF THE TYPE, DENSITY, AND DISTRIBUTION OF THE VEGETATION IN ADJACENT WETLAND AREAS THAT WERE NOT DISTURBED BY CONSTRUCTION. REVEGETATION EFFORTS WILL CONTINUE UNTIL WETLAND REVEGETATION IS SUCCESSFUL.

ADDED DETAILS FOR ROADS AND PADS		ADDRESS VADEQ COMMENTS		ADDRESS VADEQ COMMENTS		ADDRESS VADEQ COMMENTS		ADDRESS VADEQ COMMENTS		DESCRIPTION:	
NO.:	DATE:	DWNL:	CHGD.:	APPD.:							
7	01/31/18	KAL	RE	DW							
6	01/26/18	KAL	RE	DW							
5	01/08/18	KAL	RE	DW							
4	11/28/17	KAL	RE	DW							
3	11/01/17	KAL	RE	DW							
2	08/18/17	KAL	RE	DW							

REVISIONS:

Mountain Valley Pipeline EROSION AND SEDIMENT CONTROL PLANS MOUNTAIN VALLEY PIPELINE PROJECT – H600 LINE		MOUNTAIN VALLEY PIPELINE, LLC 555 SOUTHPOINTE BOULEVARD, SUITE 200 CANONSBURG, PA 15317	
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TETRA TECH complex world CLEAR SOLUTIONS™	
661 ANDERSEN DRIVE FOSTER PLAZA 7 PITTSBURGH, PA 15220	

GENERAL DETAILS SET	
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COMMONWEALTH OF PENNSYLVANIA DAVID J. WALLNER Lic. No. 0402057593 Professional Engineer	
DRAWN BY: KAL	
CHECKED BY: HT	
APPROVED BY: RE	
DATE: 11/28/2017	
SCALE: AS SHOWN	
NARRATIVE 3 OF 4	

GENERAL CONSTRUCTION SEQUENCE

THE FOLLOWING IS A GENERAL SEQUENCE FOR EARTHMOVING ACTIVITIES ASSOCIATED WITH CONSTRUCTION OF THE PIPELINE.

1. INSTALL TEMPORARY EROSION AND SEDIMENT CONTROLS PRIOR TO EARTH DISTURBANCE. REFER TO BEST MANAGEMENT PRACTICES (BMP) INSTALLATION AND REMOVAL NOTES. APPROPRIATE BMPs SHOULD BE PLACED AROUND SENSITIVE AREAS PRIOR TO EARTH DISTURBANCE. STONE CONSTRUCTION ENTRANCES (SCE) ARE TO BE PROVIDED AT ALL LOCATIONS WHERE ACCESS ROADS AND PIPELINES WILL BE ACCESSING OR CROSSING A PUBLIC ROADWAY. NOTE THAT SILT FENCE, COMPOST FILTER SOCK AND SUPER SILT FENCE IS BEING INSTALLED AS PART OF A "SYSTEM" OF EROSION CONTROL BMPs INCLUDING CLEAN WATER DIVERSIONS, WATERBARS AND BONDED FIBER MATRIX. THIS BMP SYSTEM APPROACH ALLOWS MVP TO MANAGE SLOPE LENGTH LIMITATIONS OF SUPER SILT BY INTRODUCING SLOPE BREAKS AND ADDITIONAL SURFACE EROSION PROTECTION.
2. INSTALL TEMPORARY E&S CONTROLS FOR STREAM CROSSINGS AT LOCATIONS SHOWN ON THE E&S PLAN SHEETS. NO EARTH DISTURBANCE ACTIVITIES WITHIN 50 FEET OF STREAM CHANNELS WILL BE PERFORMED UNTIL MATERIALS NEEDED TO COMPLETE THE CROSSING ARE AT THE NEAREST AVAILABLE LOCATION.
3. GENERAL CLEARING AND GRUBBING OF THE TREES AND BRUSH ALONG THE RIGHT-OF-WAY (ROW) FOR PIPELINE TRENCHING MAY COMMENCE TO THE WIDTH SPECIFIED IN THE AGREEMENT OR CONSTRUCTION ALIGNMENT SHEETS, WHICHEVER IS LESS. SMALLER DEBRIS, SUCH AS SHRUBS OR LIMBS, ARE TO BE CHIPPED AND UTILIZED ON-SITE AS PART OF THE SOIL STABILIZATION. WHERE CHIPPED MATERIAL IS USED AS MULCH, SPREAD AT A RATE NOT TO EXCEED 1 TON/ACRE. UNLESS OTHERWISE DIRECTED BY THE LANDOWNER, LOGS WILL EITHER BE HAULED OFF-SITE OR GIVEN TO THE LANDOWNER UPON THEIR REQUEST; STUMPS AND/OR LOGS WILL BE GROUND, CHIPPED, WINDROWED, OR HAULED OFF-SITE.
4. INSTALL CLEAN WATER DIVERSIONS AND CLEAN WATER DIVERSION PIPES IN ACCORDANCE WITH VESCH STD & SPEC 3.09 AND MVP-ES50 AND MCP-ES50.1. IN ADDITION, INSTALL OUTLET STRUCTURES FOR CLEAN WATER PIPES IN ACCORDANCE WITH MVP-ES51 AND MVP-ES51.1. FOLLOWING INSTALLATION OF CLEAN WATER DIVERSION BERMS STABILIZE THE UPHILL SIDE OF THE BERM USING TEMPORARY SEED, EROSION CONTROL MATTING OR BONDED FIBER MATRIX. FINALLY INSTALL ROCK CHECK DAMS IN ACCORDANCE WITH VESCH STD & SPEC 3.20 EXCEPT THAT COMPOST FILTER SOCK OR NATIVE ROCK (SIZED APPROPRIATELY PER VESCH STD & SPEC 3.20) EXCAVATED DURING GRADING WILL BE USED FOR CONSTRUCTION.
5. INSTALL TEMPORARY AND PERMANENT RIGHT-OF-WAY DIVERSIONS/WATERBARS IMMEDIATELY AFTER INITIAL DISTURBANCE OF THE SOIL IN ACCORDANCE WITH THE WATERBAR SPACING AND SIZING REQUIREMENTS SHOWN ON THE PLAN AND DETAIL SHEETS (SEE DETAILS VADEQ STD & SPEC 3.11 AND MVP-17). RIGHT-OF-WAY DIVERSIONS/WATERBARS WILL BE CONSTRUCTED OF SOIL, AND USED TO REDUCE RUNOFF VELOCITY AND DIVERT WATER OFF THE PIPELINE ROW. WATERBARS WILL BE INSTALLED WITH SUMP FILTERS (DETAIL MVP-ES42) AT THE DISCHARGE END.
6. EXCAVATE PIPELINE TRENCH AND BEGIN GRADING OF PROPOSED METER AND RECTIFIER ANODE BED SITES. THE PROPOSED CONSTRUCTION ROW AND EXTRA WORKSPACES ARE TO BE USED AS A WORK AREA FOR TRENCH EXCAVATION, EQUIPMENT MOVEMENT AND THE TEMPORARY STORAGE OF SOIL STOCKPILES, AS NEEDED. EQUIPMENT, SOIL STOCKPILES, AND OTHER MATERIALS ARE TO REMAIN UPSLOPE OF BMPs DURING CONSTRUCTION ACTIVITIES. REFER TO BMP INSTALLATION AND REMOVAL SEQUENCE FOR THE BMPs TO BE USED FOR PROTECTION DURING TRENCH EXCAVATION AND AROUND TEMPORARY SOIL STOCKPILES. STOCKPILES AND NON-WORK AREA SLOPES WILL BE STABILIZED THROUGH AN APPLICATION OF EITHER MULCH (ORGANIC, EROSION CONTROL BLANKET OR BONDED FIBER MATRIX) OR TEMPORARY SEED. TOPSOIL WILL BE SEGREGATED IN ALL AREAS OF THE PROJECT INCLUDING PASTURELAND, UPLAND FORESTED AREAS, RESIDENTIAL AREAS, MEADOWLANDS, WETLANDS WITHOUT STANDING WATER OR SATURATED SOIL, AREAS REQUESTED BY THE LANDOWNER, OR WHERE DIRECTED BY THE E.I.
7. PIPELINE SECTIONS WILL BE TRANSPORTED TO THE WORK AREA AND STRUNG ALONG THE WORKING SIDE OF THE ROW PARALLEL TO THE TRENCH LINE. WELDING CAN OCCUR IN OR OUT OF THE TRENCH. THE PIPELINE WILL BE BENT TO CONFORM TO THE TRENCH CONTOUR, ALIGNED WELDED AND PLACED ON TEMPORARY SUPPORTS ALONGSIDE THE TRENCH. WELDS WILL BE VISUALLY AND RADIO-GRAPHICALLY INSPECTED AND REPAIRED AS NECESSARY. THE PIPE SECTION WILL BE LOWERED INTO THE TRENCH AND PLACED ON PADDING PER MVP CONSTRUCTION STANDARDS. ANY WITNESS ENCOUNTERED DURING CONSTRUCTION WORK WILL BE DEWATERED BY USING PUMPS, HOSES, AND PUMPED BAGS (DETAIL MVP-ES2), AND WILL BE DISCHARGED TO A WELL VEGETATED, UPLAND AREA.
8. STREAM PIPELINE CROSSING CONSTRUCTION METHODS WILL BE INSTALLED AT LOCATIONS SHOWN ON THE E&S PLAN SHEETS AND AS SPECIFIED ON DETAIL SHEET. STREAM BANK STABILIZATION WILL BE INSTALLED IMMEDIATELY FOLLOWING COMPLETION OF PIPELINE STREAM CROSSING INSTALLATION AS SHOWN ON THE DETAIL SHEET.
9. INSTALL TRENCH BREAKERS AT LOCATIONS SHOWN ON THE DRAWINGS OR AS DIRECTED BY MVP AND AS SPECIFIED ON THE DETAIL SHEET (DETAIL MVP-20).
10. THE TRENCH WILL SUBSEQUENTLY BE BACKFILLED WITH SUITABLE EXCAVATED MATERIAL. THE BACKFILL MATERIAL WILL BE SLIGHTLY CROWNED IN UPLAND AREAS TO ALLOW FOR SETTLEMENT THAT MAY OCCUR. CROWNING THE SOIL SLIGHTLY OVER THE PIPELINE WILL HELP PREVENT FUTURE STORM WATER-RELATED PROBLEMS FROM SETTLING OF THE BACKFILLED AREA. NO CROWNING OF SOILS WILL TAKE PLACE IN WETLANDS, STREAMS, OR FLOOD PLAINS. THE SUBSOIL WILL BE REPLACED FIRST, AND THEN THE TOPSOIL WILL BE SPREAD OVER THE AREA FROM WHICH IT WAS REMOVED. DISTURBED AREAS WILL BE RESTORED TO THEIR APPROXIMATE ORIGINAL TOPOGRAPHIC CONTOURS.
11. STABILIZE EXPOSED AND UNWORKED SOILS BY APPLICATION OF EFFECTIVE BMPs THAT PROTECT THE SOIL FROM THE EROSIIVE FORCES OF RAINDROPS, FLOWING WATER, AND WIND. PERMANENT OR TEMPORARY SOIL STABILIZATION SHALL BE APPLIED TO DENUDED AREAS WITHIN SEVEN DAYS AFTER FINAL GRADE IS REACHED ON ANY PORTION OF THE SITE. WHERE A DENUDED AREA WILL REMAIN IDLE FOR MORE THAN 7 CALENDAR DAYS, TEMPORARY SEEDING (MVP-ES3.10) WILL BE APPLIED TO THE ROUGH GRADED AREA. PERMANENT STABILIZATION SHALL BE APPLIED TO AREAS THAT ARE TO BE LEFT DORMANT FOR MORE THAN ONE YEAR.
12. ANY EXCESS EXCAVATED MATERIALS REMAINING AFTER THE TRENCH HAS BEEN BACKFILLED WILL BE DISPOSED OF WITHIN THE EXISTING ROW IN AN UPLAND AREA OUTSIDE OF THE 100-YEAR FLOOD PLAIN. MATERIAL WILL BE SPREAD IN A THIN LAYER AND TIED INTO EXISTING CONTOURS TO CREATE POSITIVE DRAINAGE FOR STORMWATER RUNOFF. IF EXCESS MATERIAL IS DETERMINED TO BE AFM, TREATMENT OF THE EXCESS SPOIL WILL BE COMPLETED IN ACCORDANCE WITH THE ACID FORMING MATERIAL.
13. CONSTRUCT PERMANENT RIGHT-OF-WAY DIVERSION/WATERBARS AFTER COMPLETION OF GRADING IN ACCORDANCE WITH THE WATERBAR SPACING AND SIZING REQUIREMENTS SHOWN ON PLAN AND DETAIL SHEETS (DETAIL MVP-17).
14. PRIOR TO SEEDING MVP WILL DISC AREAS TO A DEPTH OF 4-6" TO FACILITATE REVEGETATION. DISCING WILL BE PERFORMED ON SUBSOILS TO A DEPTH OF 4-6" AND AGAIN FOLLOWING TOPSOIL.
15. REVEGETATE DISTURBED AREA PER THE TABLES ON DETAILS MVP-ES11.1 TO 11.9 AND MVP-ES12.1 TO 12.4 ON THIS SHEET OR PER LANDOWNER REQUEST. FOR 3:1 OR STEEPER SLOPES THE DISTURBED AREA WILL HAVE EROSION CONTROL FABRIC (BLANKETING, HYDROSEEDING, FLEX TERRA, OR APPROVED EQUAL) INSTALLED AS SHOWN ON DETAIL SHEET (DETAILS VA STD & SPEC 3.36, MVP-ES40 AND MVP ES-40.1).
16. RE-ESTABLISH APPROPRIATE DRAINAGE IN EXISTING ROAD CHANNELS PRIOR TO SEEDING AND MULCHING.

DAY IF THE STORM EVENT OCCURS WHEN THERE ARE
B. INTERNAL WATERSHEDS

- AT LEAST ONCE EVERY FOUR BUSINESS DAYS, OR
 - AT LEAST ONCE EVERY 5 BUSINESS DAYS AND NO LATER THAN 48 HOURS FOLLOWING A MEASURABLE STORM EVENT (OR ON THE NEXT BUSINESS DAY IF THE STORM EVENT OCCURS WHEN THERE ARE MORE THAN 48 HOURS BETWEEN BUSINESS DAYS).
- TEMPORARY BMP'S WILL BE REMOVED UPON ACHIEVING VEGETATIVE STABILIZATION, WHICH IS DEFINED AS "A GROUND COVER IS ACHIEVED THAT IS UNIFORM, MATURE ENOUGH TO SURVIVE AND WILL INHIBIT EROSION". DISTURBED AREAS NOT ATTAINING AN ACCEPTABLE VEGETATIVE COVER SHALL BE RESEED AS NEEDED UNTIL THE ENDPOINT IS ACHIEVED.
8. ALL POLLUTANTS, INCLUDING WASTE MATERIALS AND DEMOLITION DEBRIS THAT OCCUR ON SITE DURING CONSTRUCTION SHALL BE HANDLED AND LEGALLY DISPOSED OF IN A MANNER THAT DOES NOT CAUSE CONTAMINATION OF SURFACE WATERS. WOODY DEBRIS MAY BE CHIPPED AND SPREAD ON-SITE.
- FOR STREAM CROSSINGS, REFER TO THE FOLLOWING STEPS:
1. INSTALL TEMPORARY EQUIPMENT BRIDGE, BYPASS HOSE, FLUME, PUMP, OR COFFERDAM AS DESCRIBED IN STREAM CROSSING DETAILS AROUND THE WORK AREA.
 2. DEWATER WORK AREA UTILIZING PUMP WATER FILTER BAGS. WHERE POSSIBLE, EXCAVATION WILL BE FROM THE TOP OF THE STREAM BANK.
 3. INSTALL TRENCH PLUGS, PIPE, AND BACKFILL.
 4. STABILIZE CHANNEL EXCAVATION AND STREAM BANKS PRIOR TO REDIRECTING STREAM FLOW.
 5. REMOVE BYPASS HOSE, FLUME, PUMP, AND TEMPORARY DAM AS NEEDED.

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APPROVED BY:	RE:
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SECRET	NO SHOW	REVISION
NARRATIVE 4 OF 4		

ETRA TECH CAD FILE PATH: X:\CADD\Pittsburgh\EQI\7157 - MVP\00 - General\E&S\Narratives\NARRATIVES\SPREAD 9\7157ES0000NARRATIVE-4(S9).dwa PLOTTED ON: 2/27/2018 8:21 AM PLOTTED BY: Rickabough, Grea PLOT FILE: ENVIRONMENTAL COLOR.ctb

F WORKING WITHIN A WETLAND AREA, FOLLOW THE GENERALIZED CONSTRUCTION SEQUENCE BELOW:

1. INSTALL EITHER SUPER SILT FENCE, ORANGE CONSTRUCTION FENCE, OR COMPOST FILTER SOCKS ALONG THE PERIMETERS OF THE SITE AS SHOWN ON THE CONSTRUCTION DRAWINGS.
2. MATS, PADS, OR SIMILAR DEVICES WILL BE USED DURING THE CROSSINGS OF WETLANDS. ORIGINAL GRADES THROUGH WETLANDS MUST BE RESTORED AFTER TRENCHING AND BACKFILLING. ANY EXCESS FILL MATERIALS MUST BE REMOVED FROM THE WETLAND AND NOT SPREAD WITHIN WETLANDS.
3. SOIL EXCAVATED FROM WETLAND AREAS WILL BE CAREFULLY REMOVED WITH THE ROOTS INTACT. THIS SOIL WILL BE PLACED IN A SEPARATE STOCKPILE TO BE REUSED DURING THE WETLAND SURFACE RESTITUTION.
4. DEWATER WORK AREA UTILIZING PUMPED WATER FILTER BAGS.
5. INSTALL PIPE.
6. INSTALL TRENCH PLUGS IN WETLAND AREAS TO PREVENT THE TRENCH FROM DRAINING THE WETLAND OR CHANGING ITS HYDROLOGY.
7. BACKFILL PIPE TRENCH. BACKFILL THE TOP 12-INCHES OF THE EXCAVATED TRENCH WITH THE STOCKPILED WETLAND SOIL TO MATCH ORIGINAL SURFACE GRADES.
8. COMPACT BACKFILL AND GRADE THE SURFACE OF THE TRENCH AREA TO ALLOW FOR POSITIVE DRAINAGE TO SOIL E&SCS AND TO PREPARE DISTURBED AREAS FOR PERMANENT TRENCH RESTORATION.
9. MAINTAIN ALL E&SCS DEVICES UNTIL SITE WORK IS COMPLETE AND A GROUND COVER IS ACHIEVED THAT IS UNIFORM AND MATURE ENOUGH TO SURVIVE AND INHIBIT EROSION.
10. REMOVE ALL SOIL AND E&SC MEASURES UPON ESTABLISHMENT OF A GROUND COVER THAT IS UNIFORM AND MATURE ENOUGH TO SURVIVE AND INHIBIT EROSION. RE-GRADE AND REVEGETATE AREAS DISTURBED DURING THE REMOVAL OF THE SOIL E&SCS.

BMP MAINTENANCE

- TEMPORARY AND PERMANENT EROSION AND SEDIMENT CONTROL BMPs SHALL BE MAINTAINED AND REPAIRED AS NEEDED TO ASSURE CONTINUED PERFORMANCE OF THEIR INTENDED FUNCTION. MAINTENANCE AND REPAIR SHALL BE CONDUCTED IN ACCORDANCE WITH THE APPROVED STANDARDS AND SPECIFICATIONS.
- IN NON-AGRICULTURAL AREAS THE VISUAL SURVEY SHALL BE COMPARED TO THE DENSITY AND COVER OF ADJACENT UNDISTURBED LANDS. IN AGRICULTURAL AREAS, THE VISUAL SURVEY SHALL BE COMPARED TO THE ADJACENT UNDISTURBED PORTIONS OF THE SAME FIELD, UNLESS THE EASEMENT AGREEMENT SPECIFIES OTHERWISE.
- WETLANDS ALONG THE PROPOSED PIPELINE ARE EXPECTED TO EXHIBIT VARYING DEGREES OF SATURATION AND WATER ELEVATION, REQUIRING A VARIETY OF PLANT SPECIES TO BE RE-ESTABLISHED. IN UNSATURATED WETLANDS, MOST VEGETATION WILL BE REPLACED BY SEEDING. SATURATED WETLANDS WILL TYPICALLY BE ALLOWED TO RE-VEGETATE NATURALLY. WETLAND REVEGETATION WILL BE CONSIDERED SUCCESSFUL WHEN THE COVER OF HERBACEOUS SPECIES IS AT LEAST 80 PERCENT OF THE TYPE, DENSITY, AND DISTRIBUTION OF THE VEGETATION IN ADJACENT WETLAND AREAS THAT WERE NOT DISTURBED BY CONSTRUCTION. REVEGETATION EFFORTS WILL CONTINUE UNTIL WETLAND REVEGETATION IS SUCCESSFUL.
- CONDUCTING INSPECTIONS OF TEMPORARY ESC CONTROLS AND SWM BMPs AT LEAST ONCE EVERY FOUR BUSINESS DAYS.

TEMPORARY BMPS WILL BE REMOVED UPON ACHIEVING VEGETATIVE STABILIZATION, WHICH IS DEFINED AS "A GROUND COVER IS ACHIEVED THAT IS UNIFORM, MATURE ENOUGH TO SURVIVE AND WILL INHIBIT EROSION". DISTURBED AREAS NOT ATTAINING AN ACCEPTABLE VEGETATIVE COVER SHALL BE RESEED AS NEEDED UNTIL THE ENDPOINT IS ACHIEVED.

- TEMPORARY EROSION AND SEDIMENT CONTROL BMPs SHOULD BE REMOVED WITHIN 30 DAYS AFTER FINAL SITE STABILIZATION IS ACHIEVED OR AFTER THE TEMPORARY BMPs ARE NO LONGER NEEDED. TRAPPED SEDIMENT SHALL BE REMOVED OR STABILIZED ON SITE. DISTURBED SOIL RESULTING FROM REMOVAL OF BMPs OR VEGETATION SHALL BE PERMANENTLY STABILIZED.

KARST FEATURES

MVP'S KARST HAZARDS ASSESSMENT (KHA) AND KARST MITIGATION PLAN (KMP) ARE CONSISTENT WITH APPLICABLE SECTIONS OF THE VIRGINIA DEPARTMENT OF CONSERVATION AND RECREATION (DCR) TECHNICAL BULLETIN NO. 2, HYDROLOGIC MODELING AND DESIGN IN KARST GUIDANCE. THE TECHNICAL BULLETIN IS INTENDED TO GUIDE LARGE-SCALE, LONG-DURATION DEVELOPMENT PROJECTS IN KARST TERRAIN, WHILE THE MVP PROJECT CONSTITUTES A SHALLOW, LINEAR SHORT-TERM CONSTRUCTION PROJECT WITH STRICT ENVIRONMENTAL CONTROLS AND LAND RECLAMATION TO PRE-CONSTRUCTION CONDITIONS.

THE KHA WAS INITIALLY PREPARED AS PART OF THE FERC ENVIRONMENTAL REPORT (RESOURCE REPORT #6 GEOLOGICAL RESOURCES) WITH THE MOST RECENT UPDATE SUBMITTED TO THE FERC IN FEBRUARY 2017. THE KHA INVOLVED DETAILING DESKTOP REVIEW OF PUBLIC AND PROPRIETARY DATA TO IDENTIFY KARST FEATURE FEATURES, WITH FIELD VERIFICATION TO CONFIRM AND ENHANCE THE DESKTOP REVIEW. THIS IS CONSISTENT WITH THE KARST INVESTIGATION CRITERIA PRESENTED IN THE DCR TECHNICAL BULLETIN NO. 2. MVP CONSIDERED THE RESULTS OF THE KHA AND IMPLEMENTED HUNDREDS OF ALIGNMENT ADJUSTMENTS TO AVOID SENSITIVE KARST FEATURES. MVP COMPLETED FIELD VERIFICATION ON ALL PARCELS ALONG THE CURRENT MVP ROUTE (CERTAIN PROPERTY OWNERS HAD PREVIOUSLY DENIED ACCESS TO ALL MVP SURVEYORS), AND MVP WILL UPDATE THE KHA FOR SUBMITTAL TO THE FERC PRIOR TO INITIATING LAND DISTURBANCE.

THE KMP WAS MOST RECENTLY UPDATED IN OCTOBER 2017 TO INCORPORATE FERC ENVIRONMENTAL CONDITIONS (IMPLEMENTATION PLAN #21). THE KHA WAS ALSO INCORPORATED IN THE PS&S, WHICH IS REVIEWED BY THE DEQ ON AN ANNUAL BASIS. MVP RECEIVED APPROVAL ON THE PS&S ON JUNE 20, 2017. THE KMP REQUIRES THAT MVP KARST SPECIALIST INSPECTORS BE ON-SITE DURING ALL PHASES OF LAND DISTURBING ACTIVITIES IN KARST TERRAIN. IN ADDITION, THE KMP REQUIRES THE KARST SPECIALIST REVIEW THE KARST AREA BEFORE THE FIELD REVIEW OF TRAIL FELLING ACTIVITIES TO VERIFY THAT NO KARST FEATURES WERE OVERLOOKED. THE REVIEW INCLUDES INSPECTION PROTOCOLS FOR NEWLY IDENTIFIED KARST FEATURES (IF ANY ARE FOUND DURING TRAIL FELLING ACTIVITIES OR LAND DISTURBANCE), OUTREACH INSTRUCTIONS FOR THE DCR KARST PROTECTION COORDINATOR, EROSION AND SEDIMENT CONTROL AND STORMWATER MANAGEMENT BEST MANAGEMENT PRACTICES, AS WELL AS AVOIDANCE AND MITIGATION STRATEGIES FOR KARST FEATURES. IN SUMMARY, THE KMP IS CONSISTENT WITH APPLICABLE GUIDANCE IN THE DCR TECHNICAL BULLETIN NO. 2 FOR KARST EVALUATIONS DURING CONSTRUCTION, EROSION AND SEDIMENT CONTROL, AND STORMWATER MANAGEMENT.

DURING PLANNING OF THE PROJECT, MVP ROUTE SURVEY AND DEVELOPMENT SPECIFICALLY AVOIDED CONSTRUCTION CONSTRAINTS INVOLVING SENSITIVE KARST FEATURES, BASED ON THE RESULTS OF THE KHA, BECAUSE OF THE POTENTIAL DIFFICULTIES ASSOCIATED WITH CONSTRUCTION IN THE VICINITY OF SENSITIVE KARST FEATURES. AS NOTED, MVP IMPLEMENTED SEVERAL MAJOR AND MINOR ROUTE ALIGNMENT ADJUSTMENTS TO AVOID SENSITIVE KARST FEATURES TO THE EXTENT PRACTICAL, WITH THE CURRENT ALIGNMENT AVOIDING ONE MINOR NUMBER OF KARST FEATURES, A SINKHOLE AND SENSITIVE WATER RESOURCES THAT WERE IDENTIFIED IN THE KHA. BASED ON THE RECOMMENDATIONS OF THE MVP AND DCR'S ONSITE KARST SPECIALIST INSPECTORS, ADDITIONAL MINOR ALIGNMENT ADJUSTMENTS WITHIN THE CONFINES OF THE LOD MAY BE COORDINATED WITH MVP AND IMPLEMENTED TO AVOID REMAINING FEATURES TO THE EXTENT PRACTICAL. THE KMP INCLUDES STABILIZATION AND MITIGATION MEASURES RECOMMENDED FOR KARST FEATURES THAT CANNOT BE AVOIDED.

MVP PROVIDED THE KHA AND KMP TO THE DCR - KARST PROTECTION COORDINATOR FOR REVIEW, AND INCORPORATED RECOMMENDATIONS FROM THE AGENCY. MVP ALSO COLLABORATED WITH THE DCR - KARST PROTECTION COORDINATOR TO COMPLETE SUPPLEMENTAL KARST HYDROGEOLOGIC EVALUATIONS (INCLUDING DYE TRACE STUDIES) IN THE VICINITY OF THE PROPOSED ALIGNMENT, IN SPECIFICALLY-IDENTIFIED KARST AREAS, AS A CONTINGENCY PLANNING EFFORT.

THE KMP DIRECTS, BASED ON OBSERVATIONS OF THE KARST SPECIALIST INSPECTORS, ADDITIONAL AVOIDANCE OR MITIGATION THAT MAY BE NECESSARY IF ANY NEW KARST FEATURES ARE ENCOUNTERED DURING LAND DISTURBANCE. AS NOTED, THE KARST SPECIALIST INSPECTORS WILL BE ON-SITE DURING ALL PHASES OF LAND DISTURBANCE IN KARST TERRAIN, AND UPON INITIAL LAND CLEARING WILL INSPECT THE LOD FOR KARST FEATURES THAT MAY HAVE BEEN OBSCURED BY VEGETATION.

PER SECTION 4.0, ITEM 5 OF THE KARST MITIGATION PLAN, THE INTENT OF ESC AND RELATED BEST MANAGEMENT PRACTICES (BMPs) IS TO CONFINE PROJECT-RELATED DISTURBANCE TO THE LOD, PROTECT SENSITIVE KARST FEATURES, AND MINIMIZE EROSION AND SENSITIVE VEGETATION IN THOSE AREAS. IN ADDITION TO ESC BMPs FOR STANDARD PIPELINE CONSTRUCTION, WHICH INCLUDES SPECIFICATIONS BY REGULATORY AGENCIES, ADDITIONAL BMPs WILL BE IMPLEMENTED AS SPECIFIED BY THE KARST SPECIALIST (KS).

RESTORATION BMP PHASING

THE FOLLOWING IS THE SEQUENCE OF EROSION AND SEDIMENT CONTROL BEST MANAGEMENT PRACTICE REMOVAL AND INSTALLATION RELATED TO RESTORATION ACTIVITIES. THIS WORK WILL OCCUR BETWEEN RESTORATION OF PIPELINE LIMIT OF DISTURBANCE TO PRE-CONSTRUCTION GRADES AND FINAL CLOSURE OF THE PROJECT DEFINED AS "ACHIEVING VEGETATIVE STABILIZATION". THE SEQUENCE IS:

- 1) REMOVE AND GRADE OUT THE CLEAN WATER DIVERSION DIKE.
- 2) REMOVE DOWNSLOPE BMPs UTILIZED DURING CONSTRUCTION AND IMMEDIATELY REPLACE WITH 12-IN COMPOST FILTER SOCKS ON SLOPES GREATER THAN 30%. IMMEDIATE 12-IN COMPOST FILTER SOCKS WILL BE PLACED PER THE SLOPE SPACING (MVP-ES3.2) TO ATTENUATE THE VELOCITY OF RUNOFF IN THE RECLAIMED AREA.
- 3) APPLY SPECIALTY SEEDS AS REQUIRED THAT WILL NOT BE HANDLED IN THE MULCH PHASE (STEP 4). SEED THE AREA USING THE SEED MIXES AND RATES SPECIFIED IN MVP-ES11.1 TO MVP-ES11.9 AND MVP-ES12.1 TO MVP-ES12.4.
- 4) APPLY MULCH IN THE FORM OF ORGANIC MULCH (PER MVP-ES45), SOIL STABILIZATION MATTING (PER VADEQ STD & SPEC 3.36), OR HYDRAULIC EROSION CONTROL PRODUCT (PER MVP-ES40).
- 5) FOLLOWING A DETERMINATION THAT THE SITE HAS ACHIEVED VEGETATIVE STABILIZATION, THE COMPOST FILTER SOCK WILL BE "OPENED" AND THE MULCH CONTAINED WITHIN WILL BE SPREAD WITHIN THE LIMITS OF DISTURBANCE.

NO.:	DATE:	DWN.:	CHKD.:	APPD.:	DESCRIPTION:
7	01/31/18	KAL	RE	DW	ADDED DETAILS FOR ROADS AND PAOS
6	01/26/18	KAL	RE	DW	ADDRESS VADEQ COMMENTS
5	01/08/18	KAL	RE	DW	ADDRESS VADEQ COMMENTS
4	11/28/17	KAL	RE	DW	ADDRESS VADEQ COMMENTS
3	11/01/17	KAL	RE	DW	ADDRESS VADEQ COMMENTS
2	08/18/17	KAL	RE	DW	ADDRESS VADEQ COMMENTS



Mountain

Valley

PIPELINE

EROSION AND SEDIMENT CONTROL PLANS

MOUNTAIN VALLEY PIPELINE PROJECT – H600 LINE

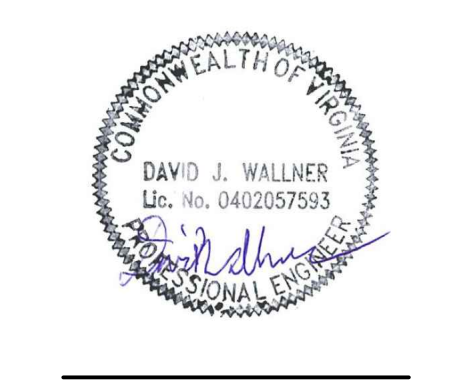
MOUNTAIN VALLEY PIPELINE, LLC

555 SOUTHPOINTE BOULEVARD, SUITE 200

CANONSBURG, PA 15317



GENERAL DETAILS SET



DRAWN BY: KAL

CHECKED BY: HT

APPROVED BY: _____ RE _____

DATE:	11/28/2017	
SCALE:	AS SHOWN	

DATE:	AS SHOWN	REVISION
NARRATIVE	4 OF 4	
