ATTACHMENT 4:

Design Calculations and Construction Details

Design Calculations

Erosion and Sedimentation Control Design
Supporting Information

The following section contains supporting information and calculations associated with the temporary erosion and sediment control measures required during the construction of the Sunoco Pennsylvania Pipeline Project (PPP). Included in this supporting information are completed Standard E&S Worksheet #22 from the Erosion and Sediment Pollution Control Program Manual, Technical Guidance Number 363-2134-008, March 2012 presenting the Plan Preparer Record of Training and Experience in Erosion and Sediment Pollution Control Methods and Techniques.

The design of the compost filter socks and waterbars was completed in accordance with the information contained within the Erosion and Sediment Pollution Control Program Manual. This information was provided by STV Inc for incorporation onto the project specific E&S design sheets prepared by Tetra Tech, Inc..

As engineer overseeing the efforts associated with this phase of the design, I certify to the best of my knowledge the information presented in this design package is true and accurate.

Name: Christopher D. Antoni

Professional Engineer No. PE057385

Date: 11/22/2016

COMMONWEALTH OF PENNSYLVANIA
REGISTERED PROFESSIONAL
CHRISTOPHER D. ANTONI
ENGINEER
No. 057385-E

COMPOST FILTER SOCK CALCULATIONS
E&S WORKSHEET #1

Chester County

Worksheet #1
Compost Filter Sock Table
Chester County

	Compost Filter Sock Table				
	Begin Sta.	**End Sta.**	**Upstream Slope, (ft/ft)**	**Slope Length Above Measure, ft**	**Compost Filter Sock Size, in**
	14334+50	14338+50	0.02	723	24
	14338+50	14345+50	0.04	101	12
	14346+60	14346+70	0.09	43	12
	14347+90	14348+10	0.12	67	12
	14348+10	14348+10	0.08	256	18
	14349+00	14349+10	0.05	159	12
	14350+65	14351+50	0.08	129	12
	14352+30	14352+90	0.05	244	12
	14352+90	14354+25	0.03	649	24
	14354+25	14356+50	0.04	474	18
	14357+30	14358+00	0.16	6	12
	14357+90	14360+70	0.18	219	12
	14358+40	14359+00	0.04	110	12
	14360+90	14361+25	0.06	165	12
*	14361+25	14363+50	0.08	145	12
*	14363+80	14369+26	0.12	87	12
	14369+26	14369+89	0.12	96	18
	14370+07	14371+75	0.17	108	18
	14372+40L	14373+85L	0.17	233	32
*	14372+43R	14374+00R	0.13	173	18
	14374+32	14375+48	0.09	101	12
*	14375+90	14377+35	0.06	128	12
	14378+00	14378+06	0.07	42	12
	14380+72	14380+82	0.05	141	12
	14381+15	14382+20	0.04	124	12
	ACCESS 1	14382+60	0.09	33	12
	ACCESS 2	14382+60	0.07	259	18
	ACCESS 3	14382+60	0.07	183	12
	14383+48	14383+56	0.06	82	12
	14384+71	14384+78	0.10	50	12
	14385+87	14386+60	0.07	100	12
	14387+33	14388+43	0.07	121	12
	14388+43	14390+78	0.08	107	12
	14390+78	14391+06	0.19	243	32
	14391+06	14391+70	0.05	126	12
*	14391+70	14392+60	0.04	71	12
	14392+79	14393+80	0.16	152	18
*	14396+65	14396+78	0.10	250	18

Notes:
1. Slopes >50% must have 32" DURASOXX independent of upslope length.
2. CFS installed with jayhook to be upsized one CFS size than slope/length requires.
(Denoted with *)

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Compost Filter Sock Table
Chester County

	Compost Filter Sock Table				
	Begin Sta.	End Sta.	Upstream Slope, (ft/ft)	Slope Length Above Measure, ft	Compost Filter Sock Size, in
*	14397+04	14398+22	0.05	124	12
	14398+63	14399+80	0.08	191	18
*	14400+00	14401+65	0.05	132	12
	14401+65	14402+62	0.10	279	24
	14402+62	14406+37	0.08	326	24
	14406+64	14408+47	0.16	108	18
*	14408+69	14409+51	0.13	68	12
	ACCESS 1	14410+95	0.05	596	32
	ACCESS 2	14410+95	0.07	465	32
	14409+78	14411+64	0.08	109	12
*	14411+87	14413+12	0.05	111	12
	14413+47	14413+47	0.06	17	12
	14414+95	14414+95	0.06	67	12
	14415+69	14415+69	0.06	68	12
	14415+49	14416+30	0.05	244	12
*	14416+54	14420+38	0.08	93	12
	14420+59	14421+14	0.14	283	32
*	14421+14	14422+79	0.10	97	12
*	14423+06	14424+82	0.11	96	12
	14425+33	14425+60	0.17	103	18
	14425+88	14427+85	0.11	350	32
	14427+85	14429+32	0.14	93	12
	14429+55	14432+00	0.09	166	12
	14432+00L	14433+95L	0.03	61	12
	14432+00R	14434+00R	0.07	90	12
	14434+37	14436+17	0.06	209	12
*	14435+83	14438+70	0.06	392	24
	14439+05	14439+20	0.23	26	12
	14439+67	14439+80	0.24	26	12
	14440+55	14440+72	0.06	32	12
*	14445+75	14446+82	0.06	99	12
	14447+06	14448+69	0.08	268	18
	14449+32	14452+15	0.08	111	12
	14453+35	14454+00	0.05	93	12
	14454+86	14455+40	0.07	46	12
	14455+88	14456+05	0.09	106	12
	14457+11	14457+70	0.08	64	12
	14458+25	14458+30	0.09	34	12

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Chester County

	Compost Filter Sock Table				
	Begin Sta.	**End Sta.**	**Upstream Slope, (ft/ft)**	**Slope Length Above Measure, ft**	**Compost Filter Sock Size, in**
	14458+80R	14458+80R	0.06	160	12
	14458+90L	14460+35L	0.04	91	12
	14460+40	14461+80	0.06	109	12
*	14461+95	14463+73	0.07	139	12
*	14463+90	14465+48	0.07	172	12
*	14465+58	14467+72	0.04	623	24
	14467+72	14468+63	0.05	104	12
*	14469+81	14473+50	0.02	674	12
*	14473+75	14477+25	0.02	880	24
	14477+25	14478+97	0.03	150	12
	14479+00	14479+50	0.05	62	12
*	14479+75	14481+25	0.03	153	12
*	14481+25	14482+41	0.04	227	12
*	14482+67	14484+20	0.07	115	12
*	14484+20	14484+77	0.05	330	18
*	14484+90	14486+10	0.05	112	12
	14486+10	14486+39	0.05	409	24
	14486+39	14489+80	0.04	641	24
*	14491+08	14491+85	0.05	86	12
*	14492+00	14492+77	0.06	143	12
*	14493+77	14496+62	0.03	442	18
*	14496+72	14498+03	0.04	135	12
	14498+03	14498+70	0.03	609	24
	14498+70	14501+20	0.03	100	12
	14501+35	14502+15	0.04	130	12
	14503+60	14504+80	0.08	159	12
	14505+47	14506+35	0.10	114	12
	14506+75	14507+85	0.08	104	12
	14508+12	14509+83	0.05	411	24
	14509+83	14515+02	0.04	590	24
	14516+06	14516+55	0.09	130	12
	14516+85	14519+23	0.13	104	12
	14519+55	14519+95	0.21	55	12
	14520+35	14521+00	0.18	76	12
	14521+78L	14521+90L	0.10	80	12
	14521+73R	14521+95R	.13/.25	115/76	24
	14523+83	14523+83	0.08	283	24
	14524+17	14524+17	0.13	114	18

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Compost Filter Sock Table

Chester County

	Compost Filter Sock Table				
	Begin Sta.	**End Sta.**	**Upstream Slope, (ft/ft)**	**Slope Length Above Measure, ft**	**Compost Filter Sock Size, in**
	14526+00	14526+00	0.11	64	12
	14526+17	14526+17	0.09	41	12
	14528+80	14528+80	0.16	80	12
	14530+00	14530+41	0.11	110	12
	14533+00	14533+97	0.07	119	12
	14534+43	14535+66	0.07	123	12
	14536+00	14536+65	0.06	256	18
	14536+69	14537+36	0.08	86	12
	14537+69	14538+30	0.09	105	12
	14540+25	14540+63	0.04	112	12
	14542+04	14542+69	0.06	127	12
	14543+00	14544+00	0.05	77	12
	14544+00	14544+72	0.08	66	12
	14544+72	14545+23	0.06	225	18
	14545+97	14546+71	0.08	64	12
	14546+71	14548+81	0.06	172	12
	14547+70	14547+70	0.05	19	12
	14548+81	14549+75	0.04	94	12
	14549+75	14554+00	0.04	396	24
	14554+80	14555+72	0.05	449	24
	14556+55	14556+83	0.06	403	24
	14557+24	14557+90	0.09	65	12
	14559+07	14559+85	0.10	93	12
	14559+94	14560+19	0.08	204	18
	14560+19	14561+07	0.08	164	12
	14561+07	14567+00	0.02	249	12
	14562+78	14564+25	0.04	117	12
	14567+07	14568+59	0.03	475	18
	14568+49	14568+73	0.07	84	12
	14568+60	14569+01	0.10	62	12
	14568+73	14570+11	0.05	428	24
	14569+03	14569+03	0.07	119	12
	14570+11	14570+67	0.07	132	12
	14571+19	14571+60	0.07	234	18
	14571+60	14575+26	0.06	268	18
	14575+26	14575+26	0.08	68	12
	14575+29	14575+29	0.05	56	12
	14575+69	14575+95	0.07	41	12

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	Begin Sta.	End Sta.	Upstream Slope, (ft/ft)	Slope Length Above Measure, ft	Compost Filter Sock Size, in
	14576+52	14576+98	0.03	94	12
	14577+39	14577+93	0.05	78	12
	14578+00	14583+19	0.01	158	12
	14583+50	14586+80	0.03	189	12
	14587+70	14588+25	0.06	85	12
	14588+80	14589+75	0.07	76	12
	14590+10	14591+52	0.08	106	12
	14592+60	14593+10	0.14	103	12
	14593+65	14594+35	0.18	78	12
	14595+15	14596+00	0.09	93	12
	14597+00	14597+54	0.04	50	12
	14597+85	14599+44	0.1	262	24
	14599+60	14600+20	0.04	99	12
	14600+60	14601+50	0.1	63	12
	14601+60	14602+00	0.08	52	12
	14602+85	14640+00	0.16	87	12
	14604+90	14605+85	0.06	484	32
	14605+90	14606+85	0.05	214	12
	14607+70	14608+00	0.04	522	24
	14608+00	14612+90	0.08	463	32
	14613+10	14614+70	0.08	99	12
	14615+10	14615+50	0.07	488	32
	14624+75	14624+75	0.2	30	12
	14627+41	14627+85	0.07	73	12
	14628+10	14628+42	0.07	89	12
	14628+60	14631+26	0.08	86	12
	14631+30	14631+85	0.07	95	12
	14632+25	14632+25	0.09	66	12
	14633+75	14634+17	0.12	50	12
	14635+45	14636+90	0.1	145	12
	14637+00	14638+50	0.1	235	18
	14639+23	14639+75	0.12	122	12
	14640+35	14640+70	0.13	90	12
	14641+60	14642+95	0.1	102	12
	14643+15	14644+16	0.07	92	12
	14644+20	14648+10	0.07	83	12
	14652+80	14653+40	0.2	81	18
	14654+75	14655+00	0.07	82	12

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	Begin Sta.	**End Sta.**	**Upstream Slope, (ft/ft)**	**Slope Length Above Measure, ft**	**Compost Filter Sock Size, in**
	14665+73	14665+73	0.07	57	12
	14660+20	14661+25	0.10	135	12
	14663+00	14664+11	0.25	112	24
	14664+30	14665+00	0.18	73	12
	14665+90	14666+20	0.13	32	12
	14677+00	14668+00	0.03	130	12
	14670+00	14670+70	0.07	171	12
	14670+75	14671+80	0.17	60	12
	14671+60	14672+75	0.12	69	12
	14672+90	14673+35	0.22	65	18
	14739+40 L	14739+40 L	0.11	55	12
	14739+40 R	14739+40 R	0.10	62	12
	14676+00	14677+15	0.02	88	12
	14678+18	14679+14	0.08	82	12
	14679+62	14681+24	0.04	107	12
	14682+50	14685+18	0.16	64	12
	14685+18	14686+27	0.16	90	12
	14686+44	14689+30	0.19	90	18
	14689+20	14691+27	0.28	99	24
	14690+44	14691+33	0.28	135	32
	14693+00	14694+81	0.32	87	24
	14964+83	1469555	0.29	83	18
	1495+60	14679+45	0.19	244	32
	14696+95	14697+42	0.11	73	12
	14697+46	14699+45	0.05	217	12
	14700+20	14700+20	0.09	47	12
	14703+55	14703+55	0.04	93	12
	14704+51	14705+95	0.10	82	12
	14706+00	14707+00	0.10	60	12
	14707+35	14707+35	0.11	38	12
	14709+60	14709+60	0.08	102	12
	14719+20	14719+60	0.07	55	12
	14720+07	14721+00	0.07	111	12
	14721+00	14723+09	0.08	334	24
	14723+09	14723+50	0.07	86	12
	14723+07	14725+38	0.17	119	18
	14725+59	14726+00	0.14	70	12
	14727+53	14728+80	0.07	61	12

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	Begin Sta.	**End Sta.**	**Upstream Slope, (ft/ft)**	**Slope Length Above Measure, ft**	**Compost Filter Sock Size, in**
	14728+56	14729+31	0.20	80	18
	14729+53	14730+20	0.28	71	18
	14732+13	14732+38	0.11	55	12
	14733+31	14733+64	0.14	72	12
	14735+42	14734+42	0.12	33	12
	14734+15	14735+00	0.11	65	12
	14735+43	14736+23	0.12	118	12
	14737+08	14737+70	0.16	77	12
	14737+08	14737+08	0.24	42	12
	14743+16	14743+16	0.10	100	12
	14743+28	14743+28	0.12	96	12
	14743+91	14745+00	0.08	116	12
	14745+00	14745+48	0.11	53	12
	14745+76	14746+12	0.26	47	18
	14746+54	14749+22	0.12	155	18
	14749+55	14750+07	0.18	68	12
	14750+53	14750+83	0.20	51	12
	14751+24	14752+28	0.12	82	12
	14753+78	14753+78	0.17	109	18
	14777+50	14777+50	0.17	225	24
	14781+75	14781+95	0.33	49	12
	14783+65	14783+65	0.05	37	12
	14783+90	14783+90	0.06	49	12
	14784+05	14784+05	0.22	9	12
	14784+31	14784+92	0.08	63	12
	14785+00	14785+40	0.03	63	12
	14786+00	14787+00	0.18	228	32
	14787+10	14789+20	0.15	268	32
	14792+06	14793+00	0.09	127	12
	14793+86	14794+67	0.10	103	12
	14795+48	14796+37	0.13	95	12
	14796+80	14797+87	0.15	105	18
	14798+23	14798+48	0.15	66	12
	14799+23	14800+49	0.10	119	12
	14800+41	14801+28	0.05	264	18
	14801+16	14802+46	0.06	248	18
	14825+50	14826+82	0.07	188	12
	14830+13	14832+15	0.03	134	12

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	Begin Sta.	**End Sta.**	**Upstream Slope, (ft/ft)**	**Slope Length Above Measure, ft**	**Compost Filter Sock Size, in**
	14839+70	14840+85	0.04	93	12
	14840+95	14840+95	0.04	106	12
	14842+54	14842+54	0.05	65	12
	14845+00	14848+33	0.11	223	18
	14848+48	14850+74	0.1	67	12
	14851+90	14851+90	0.24	86	18
	14853+00	14853+00	0.12	50	12
	14856+80	14855+30	0.08	169	12
	14856+00	14856+58	0.09	88	12
	14857+06	14858+00	0.09	137	12
	14877+20	14877+33	0.04	198	12
	14877+33	14877+70	0.06	64	12
	14878+75	14880+70	0.03	209	12
	14885+00	14886+24	0.05	420	24
	14928+59	14929+93	0.14	70	12
	14929+93	14929+63	0.08	163	12
	14930+00	14930+59	0.11	109	12
	14932+38	14933+51	0.05	96	12
	14953+52	14955+74	0.05	124	12
	14956+30 L	14959+00 L	0.07	59	12
	14956+30 R	14959+00 R	0.13	42	12
	14959+60 L	14964+00 L	0.05	19	12
	14959+75 R	14964+25 R	0.04	48	12
	14964+90	14968+25	0.09	84	12
	14968+90	14975+25	0.13	124	18
	15008+00	15012+50	0.03	230	12
	15012+85 R	15013+60 R	0.06	79	12
	15013+30 L	15013+30 L	0.07	78	12
	15014+25	15015+50	0.05	250	18
	15015+75	15020+85	0.05	201	12
	15021+00	15025+80	0.02	335	12
	15044+25	15045+30	0.05	105	12
	15046+75	151047+80	0.08	85	12
	15048+00	15051+00	0.04	428	18
	15051+00	15055+20	0.05	196	12
	15055+20	15058+00	0.03	235	12
	15058+00	15058+00	0.02	100	12
	15062+25	15062+80	0.12	68	12

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	Begin Sta.	**End Sta.**	**Upstream Slope, (ft/ft)**	**Slope Length Above Measure, ft**	**Compost Filter Sock Size, in**
	15065+00	15065+80	0.09	181	18
	15083+00	15083+90	0.11	123	12
	15084+50	15086+30	0.06	154	12
	15086+80 R	15089+00 R	0.04	244	12
	15089+00 L	15089+00 L	0.20	16	12
	15089+20	15089+65	0.13	22	12
	15095+65	15102+25	0.02	475	12
	15102+00	15104+50	0.27	32	12
	15103+90	15104+00	0.07	152	12
	15104+25	15104+35	0.07	160	12
	15104+50	15112+00	0.05	484	24
	15109+40 R	15110+70 R	0.02	59	12
	15118+85	15121+00	0.15	66	12
	15121+00	15121+15	0.05	57	12
	15155+00	15159+80	0.06	493	24
	15159+80	15163+00	0.07	330	24
	15163+00	15165+20	0.03	503	18
	Workspace L	Workspace L	0.15	59	12
	Workspace R	Workspace R	0.10	109	12
	15194+00	15197+00	0.09	393	32
	15197+00	15199+10	0.12	361	32
	15199+50	105202+50	0.16	182	18
	15203+00 R	15203+00 R	0.06	33	12
	15203+00	15207+00	0.03	437	18
	15241+00	15242+80	0.09	367	32
	15242+80	15245+00	0.08	159	12
	15245+00	15245+50	0.05	81	12
	15245+70	15246+00	0.08	40	12
	15289+10 LLL	15290+60 LLL	0.07	408	24
	15288+00 LL	15292+25 LL	0.07	391	24
	15288+00 L	15292+25 L	0.05	553	32
	15292+50	15295+00	0.11	76	12
	15319+50 L	15326+50 L	0.19	37	12
	15319+50 R	15326+50 R	0.10	31	12
	15326+50 L	15337+00 L	0.20	31	12
	15326+50 R	15337+00 R	0.27	45	18
	15340+90	15346+10	0.05	607	32
	15377+00	15378+75	0.05	137	12

Notes:
1. Slopes >50% must have 32" DURASOXX independent of upslope length.
2. CFS installed with jayhook to be upsized one CFS size than slope/length requires.
   (Denoted with *)

Worksheet #1
Compost Filter Sock Table
Chester County

	Compost Filter Sock Table				
	Begin Sta.	**End Sta.**	**Upstream Slope, (ft/ft)**	**Slope Length Above Measure, ft**	**Compost Filter Sock Size, in**
	15378+75	15380+70	0.07	218	18
	15380+00	15381+20	0.06	80	12
	15380+90	15388+10	0.10	59	12
	15381+20	15383+25	0.10	72	12
	15383+45	15383+95	0.09	260	18
	15383+85	15385+00	0.11	208	18
	15383+95	15385+25	0.24	60	18
	15385+20	15388+95	0.22	44	12
	Workspace	Workspace	0.05	420	24
	15415+20	15416+70	0.11	103	12
	15417+00	15417+00	0.08	170	12
	15424+00	15430+90	0.17	40	12
	15430+90 SW	15432+80 SW	0.10	51	12
	15430+90NE	15433+45 NE	0.14	29	12
	15433+50	15438+15	.09/0.03	145/99	18
	15438+00	15439+10	0.11	19	12
	15438+15	15440+90	0.08	94	12
	15440+45	15440+55	0.06	112	12
	15441+15	15442+00	0.08	106	12
	15443+00NE	15446+00NE	0.11	53	12
	15443+00SW	15447+00SW	0.12	57	12
	15446+20	15449+90	0.04	150	12
	15487+00	15487+75	0.04	576	24
	15515+25	15520+00	0.14	64	12
	15521+85	15521+95	0.07	30	12
	15521+86	15521+97	0.30	121	32
	15521+97	15522+50	0.22	105	12

Notes:
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(Denoted with *)

Delaware County

Worksheet #1
Compost Filter Sock Table
Delaware County

	Compost Filter Sock Table				
	Begin Sta.	**End Sta.**	**Upstream Slope, (ft/ft)**	**Slope Length Above Measure, ft**	**Compost Filter Sock Size, in**
	15582+35	15582+35	0.20	83	18
	15582+35	15582+85	0.14	129	18
	15583+20R	15583+80R	0.12	93	12
	15582+85	15583+80	0.15	41	12
	15583+50	15583+22	0.17	36	12
	15583+85	15585+25	0.09	110	12
	15584+20 R	15585+20 R	0.05	9	12
	15585+25	15586+90	0.10	90	12
	15585+20 R	15585+75 R	0.04	22	12
	15586+95	15590+50	0.19	16	12
	15586+80 R	15588+00 R	0.04	309	12
	15589+00 R	15592+10 R	0.05	12	12
	15590+50	15594+45	0.13	64	12
	15592+10 R	15593+20 R	0.09	121	12
	15594+50	15595+40	0.04	180	12
	15597+45 R	15598+20 R	0.03	9	12
	15597+10	15598+20	0.16	108	18
	15599+53 R	15600+35 R	0.11	108	12
	15600+35 R	15601+00 R	0.17	180	24
	15601+00 R	15602+47 R	0.09	278	24
	15602+40	15605+75	0.08	86	12
	15604+10	15605+25	0.03	26	12
	15605+85	15605+85	0.05	60	12
	15606+80	15606+80	0.03	7	12
	15618+80	15621+20	0.03	504	18
	15622+80	15625+10	0.03	188	12
	15632+35	15632+75	0.03	78	12
	15632+40	15632+50	0.04	579	18
	15633+80	15633+80	0.05	62	12
	15634+90	15635+00	0.07	212	18
	15635+10	15636+25	0.05	94	12
	15636+00	15636+30	0.11	57	12
	15636+40 L	15636+40 L	0.08	52	12
	15636+40 R	15636+40 R	0.10	48	12
	15636+70	15637+30	3%	172	12
	15636+80	15637+22	5%	39	12
	15637+40	15638+10	4%	447	18
	15638+70	15639+40	0.03	140	12

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(Denoted with *)

Worksheet #1
Compost Filter Sock Table
Delaware County

	Compost Filter Sock Table				
	Begin Sta.	**End Sta.**	**Upstream Slope, (ft/ft)**	**Slope Length Above Measure, ft**	**Compost Filter Sock Size, in**
	15640+85	15640+90	0.03	136.6	12
	15643+60	15643+60	0.08	279.1	18
	15644+00	15645+00	0.09	145.1	12
	15654+45	15655+90	0.04	84	12
	15655+90	15658+85	0.05	306	18
	15658+85	15660+25	0.04	120	12
*	Workspace		0.042/0.056	263.9/106.3	12
*	15660+90	15663+35	0.03	130.2	18
*	15663+35	15663+90	0.03	147.2	12
	15664+36	15665+24	0.05	103.4	12
	15666+08L	15666+13L	0.09	45	12
	15667+90L	15669+00L	0.04	198.9	12
	15668+66R	15671+65 R	0.04	119.6	12
	15669+70L	15670+15L	0.04	22.7	12
*	15670+15	15672+33	0.01	175.6	12
*	15672+33	15678+93	0.03	322.6	12
*	15678+93	15681+68	0.03	335	12
	15681+97	15682+40	0.04	412.4	18
	15682+45	15683+12	0.04	136	12
	15684+74	ACCESS	0.06	107.4	12
	15685+90	15686+40	0.06	88.8	12
	15685+00	15688+15	0.05	488	24
	15688+13	15689+04	0.05	144	12
	15689+10	15691+00	0.05	173	12
	15691+27	15691+27	0.05	237	12
*	15691+30	15694+00	0.04	115	12
	15696+90	15697+90	0.04	619	24
	15728+14	15729+87	0.05	199	12
	15729+87	15732+00	0.07	185	12
	15732+40	15735+00	0.04	275	12
	15735+00	15737+00	0.04	230.4	12
	15737+75	15738+47	0.05	350	24
	15738+87	15740+22	0.06	113	12
	15740+20R	15743+66R	0.05	139	12
	15739+58L	15744+00L	0.17	6	12
*	15744+15	15747+70	0.09	110	12
	15746+40L	15748+10 L	0.03	112	12
	15747+85R	15748+70R	0.05	159	12

Notes:
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(Denoted with *)

Worksheet #1
Compost Filter Sock Table
Delaware County

	Compost Filter Sock Table				
	Begin Sta.	**End Sta.**	**Upstream Slope, (ft/ft)**	**Slope Length Above Measure, ft**	**Compost Filter Sock Size, in**
	15749+15	15750+00	0.07	93	12
	15750+26	15751+12	0.08	106	12
	15751+56	15752+95	0.06	166	12
	15751+21L	15757+90L	0.06	64	12
*	15753+15	15758+04	0.04	190	12
	15758+00	15762+35	0.03	386	12
	15762+15L	15765+70L	0.06	137	12
	15765+70L	15766+15 L	0.04	192	18
	15766+00	15768+05	0.03	535	18
	15768+15	15770+25	0.02	313	12
	15770+25	15771+48	0.12	128	12
	15772+74R	15773+45R	0.06	177	12
	15773+20L	15773+20L	0.05	579	32
	15812+54	15813+55	0.06	214	12
	15814+50	15815+60	0.21	130	18
	15815+60	15815+75	0.14	320	32
	15816+00	15816+38	0.18	191	24
	15816+72	15816+81	0.23	71	18
	15820+65	15820+65	0.11	93	12
*	15820+88	15821+50	0.04	74	12
	15821+88	15823+15	0.12	111	12
	15823+38	15824+76	0.10	125	12
	15824+98	15826+43	0.13	124	18
	15826+62	15827+12	0.11	45	12
	15827+27	15828+71	0.24	54.1	18
	15828+88	15832+34	0.08	200	18
	15832+47	15835+35	0.42	81	32
	15835+52	15836+90	0.04	89	12
	15836+90	15838+85	0.06	320	18
	15838+85	15839+50	0.07	84	12
	15840+17	15840+17	0.08	24	12
	15841+21	15842+44	0.07	340	24
*	15842+44	15844+91	0.09	246	18
	15852+03	15854+65	0.04	410	24
	15854+78	15855+34	0.20	45	12
	15855+46	15855+95	0.28	40	12
	15859+03	15859+03	0.16	70	12
*	15859+36	15861+87	0.08	134	12

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Worksheet #1
Compost Filter Sock Table
Delaware County

	Compost Filter Sock Table				
	Begin Sta.	**End Sta.**	**Upstream Slope, (ft/ft)**	**Slope Length Above Measure, ft**	**Compost Filter Sock Size, in**
	15862+00	15863+75	0.07	110	24
	15863+75	15864+38	0.08	337.3	24
	15865+00	15865+00	0.10	31	12
	15865+88	15867+09	0.09	100	12
	15867+23	15868+36	0.10	103	12
	15868+50	15869+85	0.09	143	12
	15870+00	15871+42	0.09	132	12
	15871+64	15872+75	0.08	115	12
	15873+20	15875+15	0.11	173	18
	15875+82	15879+52	0.04	233	12
	15880+00	15880+10	0.05	166	12
	15880+35	15880+75	0.06	105	12
*	15881+73	15882+10	0.07	157	12
*	15882+25	15883+15	0.05	234	12
	15887+45	15887+75	0.06	74.3	18
	15887+75	15887+78	5.00	167.3	12
	15888+55	15889+05	0.19	86	18
	15889+05	15894+03	0.07	145	12
	15921+48	15923+25	0.03	140	12
	15924+20	15926+40	0.05	181.5	12
	15929+33	15930+94	0.06	199	12
	15931+73R	15932+11 R	0.20	80	18
	15931+80 L	15931+92 L	0.14	180	18
	15932+58	15932+62	0.22	32	12
	15932+46	15933+19	0.17	77	12
	15933+33	15933+87	0.39	23.4	12
	15934+47	15935+07	0.14	86	12
	15935+11	15935+11	0.12	157	18
	15937+28	15938+36	0.11	135	12
	15938+64	15940+25	0.06	247	18
	15940+25	15942+36	0.04	512	24
	15942+36	15945+33	0.08	324	24
	15945+68	15946+26	0.14	69	12
	15946+66	15947+19	0.24	62	12
	15949+16	15949+16	0.19	63	12
	15950+95	15952+29	0.14	118	18
	15952+44	15952+60	0.06	93	12
	15952+60	15952+75	0.39	82	24

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Worksheet #1
Compost Filter Sock Table
Delaware County

	Compost Filter Sock Table				
	Begin Sta.	End Sta.	Upstream Slope, (ft/ft)	Slope Length Above Measure, ft	Compost Filter Sock Size, in
	15952+95	15953+20	0.50	66	32
	15953+79	15954+40	0.34	79	24
	15955+77	15957+22	0.07	122	12
	15957+22	15957+68	0.07	212	18
	15957+80	15957+80	0.13	31	12
	15958+32	15958+32	0.10	25	12
	15958+45	18959+30	0.02	45	12
	15958+26	15959+46	0.08	64	12
	15963+33	15963+33	9.00	430	32
	15966+50	15967+47	0.27	62	18
	15967+52	15967+63	0.35	49	18
	15967+80 L	15967+80 L	0.27	78	18
	15967+80 R	15968+75 R	0.25	107	24
	15969+60	16969+85	0.23	44	12
	15970+38	15971+00	0.12	91	12
	15975+60	15976+10	0.19	63	12
	15977+35	15978+10	0.17	73	12
	15978+70	15979+30	0.11	79	12
	15980+00	15981+20	0.08	169	12
	15981+20	15982+23	0.07	109	12
	15982+13	15983+62	0.06	100	12
	15983+62	15983+62	0.09	74	12
	15984+95	15985+40	0.12	58	12
	15985+40	15987+40	0.06	301	18
	15987+80	15989+10	0.10	135	12
	15989+60	15991+10	0.11	170	18
	15991+60	15991+60	0.11	54	12
	15992+25	15993+00	0.04	132	12
	15993+85	15993+85	0.12	64	12
	15994+10	15994+10	0.04	112	12
	16000+90	16001+40	0.10	75	12
	16001+90	16002+70	0.07	234	18
	16002+73	16004+20	0.05	259	18
	16004+20	16007+40	0.02	434	12
	16007+00R	16010+70R	0.02	40	12
	16007+40L	16011+50L	0.03	61	12
	16010+90R	16011+90R	0.03	96	12
	16012+60	16012+80	0.08	76	12

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Compost Filter Sock Table
Delaware County

	Compost Filter Sock Table				
	Begin Sta.	**End Sta.**	**Upstream Slope, (ft/ft)**	**Slope Length Above Measure, ft**	**Compost Filter Sock Size, in**
	16012+80	16013+80	0.07	112	12
	16013+80	16014+20	0.07	56	12
	16014+20	16014+20	0.06	138	12
	16014+20	16016+10	0.04	650	24
	16016+10	16016+70	0.24	104	18
	16017+70	16018+40	0.05	109	12
	16018+85	16023+40	0.02	260	12
	16024+25R	16025+25R	0.06	114	12
	16024+10L	16024+65L	0.04	107	12
	16024+80L	16025+45L	0.04	69	12
	16025+75	16026+15	0.12	86	12
	16028+00	16030+00	0.50	57	32
	16030+00	16031+25	0.50	97	32
	16031+70	16034+30	0.56	85	32
	16034+55	16034+90	0.29	41	12
	16035+45	16036+00	0.14	144	18
	16033+80	16034+20	0.20	57	12
	16034+75	16035+00	0.22	18	12
	16084+70L	16084+70L	0.01	170	12
	16084+70R	16092+35R	0.02	85	12
	16093+20	16093+20	0.03	186	12
	16107+55	16109+40	0.12	52	12
	16109+70	16112+95	0.13	271	32
	16112+95	16113+15	0.13	223	24
	16113+15	16113+70	0.14	188	18
	16113+70	16115+25	0.11	194	18
	16115+30	16116+70	0.04	203	12
	16116+70	16119+10	0.01	298	12
	16119+10	16122+10	0.02	84	12
	16123+50	16123+50	0.01	228	12
	16125+20R	16128+70R	0.3	35	12
	16123+75L	16128+65L	0.13	32	12
	16128+65	16129+60	0.03	183	12
	16129+60	16130+40	0.01	6	12
	16130+70	16132+70	0.01	203	12
	16133+25	16135+40	0.01	186	12
	16163+20	16163+60	0.01	143	12
	16163+50	16163+50	0.02	118	12

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Compost Filter Sock Table
Delaware County

	Compost Filter Sock Table				
	Begin Sta.	**End Sta.**	**Upstream Slope, (ft/ft)**	**Slope Length Above Measure, ft**	**Compost Filter Sock Size, in**
	16163+70	16163+70	0.01	144	12
	16163+70	16164+90	0.02	113	12
	16164+90	16165+30	0.01	175	12
	16163+30	16163+40	0.01	140	12
	16164+90	16165+45	0.01	169	12
	16165+45	16173+00	0.01	142	12
	16173+00	16178+70	0.02	135	12
	16178+70	16180+80	0.01	185	12
	16182+00	16184+36	0.05	178	12

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CLEAN WATER DIVERSION BERM CALCULATIONS

CLEAN WATER DIVERSION BERM CALCULATIONS

Chester County

TABLE FOR CALCULATING THE PEAK RUNOFF RATE FOR DRAINAGE PIPES USED FOR CLEAN WATER DIVERSION

Start Sta.	End Sta.	Area of Drainage (sq ft)	Length of Sheet Flow (ft)	Slope of Ground during Sheet Flow (ft/ft)	Soil Type	Roughness Coefficient (n)	Time of Concentration in Sheet Flow (min)	Length of Shallow Concentrated Flow (ft)	Slope of Ground during Shallow Concentrated Flow (ft/ft)	Shallow Concentrated Flow Velocity (ft/sec)	Time of Concentration in Shallow Concentrated Flow (min)	Total Time of Concentration (min)	2-Year Storm Rainfall Intensity (in/hr)	Runoff Coefficients for the Rational Equation	Channel Longitudinal Slope (ft/ft)	Channel Side Slope (H:V) (ft/ft)	Peak Runoff Rate (CFS)	Size of Diversion Sock (in)	Pipe Slope (ft/ft)	Size of Slope Pipe (in)
14341+95	14343+95	111,375	100	0.03	Type D	0.300	9.20	596	0.04	1.50	6.62	15.82	3.23	0.20	0.02	12.5:1	**1.65**	**12**	**0.05**	**8**
14343+95	14348+60	71,119	100	0.04	Type D	0.300	8.60	346	0.06	1.65	3.49	12.10	3.64	0.20	0.02	10:1	**1.19**	**12**	**0.03**	**8**
14364+55	14366+25	24,858	100	0.05	Type D	0.300	8.17	187	0.17	1.00	3.12	11.28	3.75	0.20	0.01	12:1	**0.43**	**12**	**0.12**	**6**
14367+90	14372+60	207,485	100	0.12	Type D	0.300	6.65	342	0.12	0.85	6.71	13.36	3.49	0.20	0.01	5.5:1	**3.33**	**18**	**0.11**	**12**
14385+60	14385+30	92,577	100	0.05	Type D	0.300	8.17	670	0.05	1.60	6.98	15.14	3.30	0.20	0.02	21:1	**1.40**	**12**	**0.14**	**8**
14390+70	14393+40	72,140	100	0.25	Type D	0.300	5.61	292	0.70	1.80	2.70	8.31	4.19	0.20	0.02	12:1	**1.39**	**12**	**0.05**	**8**
14419+75	14422+10	151,551	100	0.13	Type D	0.300	6.53	721	0.12	2.40	5.01	11.54	3.71	0.20	0.03	11:1	**2.58**	**12**	**0.05**	**12**
14428+70	14429+40	304,778	100	0.05	Type D	0.300	8.17	286	0.12	2.30	2.07	10.24	3.89	0.20	0.01	6:1	**5.45**	**18**	**0.18**	**12**
14501+50	14503+10	93,570	100	0.03	Type D	0.300	9.20	652	0.04	0.95	11.44	20.64	2.82	0.20	0.01	24:1	**1.21**	**12**	**0.05**	**8**
14503+10	14505+00	704,015	100	0.02	Type D	0.300	10.11	964	0.06	1.10	14.61	24.72	2.54	0.20	0.01	22:1	**8.21**	**18**	**0.03**	**12 (2)**
14520+20	14521+55	16,755	100	0.04	Type D	0.300	8.60	247	0.09	1.40	2.94	11.54	3.71	0.20	0.04	8:1	**0.29**	**12**	**0.13**	**6**
14544+15	14544+75	14,786	100	0.07	Type D	0.300	7.55	414	0.06	1.60	4.31	11.86	3.67	0.20	0.01	18:1	**0.25**	**12**	**0.07**	**6**
14545+35	14546+50	62,264	100	0.06	Type D	0.300	7.82	533	0.06	1.60	5.55	13.38	3.49	0.20	0.01	12.5:1	**1.00**	**12**	**0.04**	**8**
14548+00	14550+20	101,807	100	0.05	Type D	0.300	8.17	401	0.05	1.55	4.31	12.48	3.60	0.20	0.02	12:1	**1.68**	**12**	**0.04**	**12**

TABLE FOR CALCULATING THE PEAK RUNOFF RATE FOR DRAINAGE PIPES USED FOR CLEAN WATER DIVERSION

Start Sta.	End Sta.	Area of Drainage (sq ft)	Length of Sheet Flow (ft)	Slope of Ground during Sheet Flow (ft/ft)	Soil Type	Roughness Coefficient (n)	Time of Concentration in Sheet Flow (min)	Length of Shallow Concentrated Flow (ft)	Slope of Ground during Shallow Concentrated Flow (ft/ft)	Shallow Concentrated Flow Velocity (ft/sec)	Time of Concentration in Shallow Concentrated Flow (min)	Total Time of Concentration (min)	2-Year Storm Rainfall Intensity (in/hr)	Runoff Coefficients for the Rational Equation	Channel Longitudinal Slope (ft/ft)	Channel Side Slope (H:V) (ft/ft)	Peak Runoff Rate (CFS)	Size of Diversion Sock (in)	Pipe Slope (ft/ft)	Size of Slope Pipe (in)
14600+00	14600+20	13,974	100	0.02	Type D	0.300	10.11	417	0.12	2.30	3.02	13.14	3.52	0.37	0.02	10:1	0.42	12	0.05	6
14460+40	14601+00	22,964	100	0.06	Type D	0.300	7.82	236	0.17	2.80	1.40	9.23	4.04	0.37	0.03	7:1	0.79	12	0.04	8
14628+20	14629+00	36,674	100	0.06	Type D	0.800	12.37	547	0.05	0.55	16.58	28.95	2.31	0.20	0.04	17:1	0.39	12	0.06	6
14629+10	14631+50	90,448	100	0.04	Type D	0.800	13.60	478	0.08	0.75	10.62	24.23	2.57	0.20	0.03	7:1	1.07	12	0.08	8
14631+70	14632+80	128,228	100	0.08	Type D	0.800	11.57	396	0.10	0.70	9.43	21.00	2.79	0.20	0.04	12:1	1.64	12	0.04	12
14644+00	14646+70	38,342	100	0.09	Type D	0.800	11.26	290	0.09	1.40	3.45	14.71	3.34	0.31	0.03	10:1	0.91	12	0.04	8
14646+70	14648+60	7,675	100	0.01	Type D	0.800	18.81	117	0.03	0.42	4.64	23.45	2.62	0.20	0.03	13:1	0.09	12	0.01	6
14678+40	14679+80	150,957	100	0.06	Type D	0.800	12.37	768	0.18	1.00	12.80	25.17	2.51	0.20	0.06	10:1	1.74	12	0.03	12
14679+80	14682+10	179,764	100	0.09	Type D	0.800	11.26	649	0.20	1.10	9.83	21.09	2.78	0.20	0.03	5:1	2.30	12	0.07	12
14682+10	14684+20	165,592	100	0.03	Type D	0.800	14.55	809	0.17	1.00	13.48	28.03	2.35	0.20	0.04	6:1	1.79	12	0.08	8
14684+20	14685+60	134,259	100	0.05	Type D	0.800	12.91	817	0.17	1.00	13.62	26.53	2.44	0.20	0.05	5:1	1.50	12	0.10	8
14685+60	14687+00	34,636	100	0.18	Type D	0.800	9.57	399	0.23	1.20	5.54	15.11	3.30	0.20	0.06	5:1	0.52	12	0.13	6
14690+20	14693+80	103,359	100	0.11	Type D	0.800	10.74	466	0.21	1.10	7.06	17.80	3.05	0.20	0.12	3:1	1.45	12	0.20	6
14693+80	14696+40	93,150	100	0.11	Type D	0.800	10.74	554	0.10	0.70	13.19	23.93	2.59	0.20	0.03	3:1	1.11	12	0.33	6
14704+50	14706+00	200,243	100	0.06	Type D	0.800	12.37	455	0.09	0.70	10.83	23.21	2.64	0.20	0.01	8:1	2.42	18	0.06	12
14744+00	14744+00	193,760	100	0.04	Type D	0.800	13.60	724	0.24	1.25	9.65	23.26	2.63	0.20	0.05	6:1	2.34	12	0.09	12
14784+30	14785+40	9,971	92	0.45	Type D	0.800	7.43	0	0.00	0.00	0.00	7.43	4.34	0.20	0.05	7:1	0.20	12	0.04	6
14848+00	14851+90	108,259	100	0.06	Type D	0.400	8.95	424	0.12	2.30	3.07	12.02	3.65	0.40	0.07	8:1	3.63	12	0.10	12

TABLE FOR CALCULATING THE PEAK RUNOFF RATE FOR DRAINAGE PIPES USED FOR CLEAN WATER DIVERSION

Start Sta.	End Sta.	Area of Drainage (sq ft)	Length of Sheet Flow (ft)	Slope of Ground during Sheet Flow (ft/ft)	Soil Type	Roughness Coefficient (n)	Time of Concentration in Sheet Flow (min)	Length of Shallow Concentrated Flow (ft)	Slope of Ground during Shallow Concentrated Flow (ft/ft)	Shallow Concentrated Flow Velocity (ft/sec)	Time of Concentration in Shallow Concentrated Flow (min)	Total Time of Concentration (min)	2-Year Storm Rainfall Intensity (in/hr)	Runoff Coefficients for the Rational Equation	Channel Longitudinal Slope (ft/ft)	Channel Side Slope (H:V) (ft/ft)	Peak Runoff Rate (CFS)	Size of Diversion Sock (in)	Pipe Slope (ft/ft)	Size of Slope Pipe (in)
15522+45	15522+90	7,971	100	0.05	Type D	0.020	2.30	125	0.19	3.00	0.69	5.00	4.82	0.28	0.01	3.5:1	**0.25**	**12**	**0.21**	6
		9,318																		

Chester County
Temporary Diversion Berm Calculations

STATION	Roughness Coefficient	Channel Slope (ft/ft)	Normal Depth (ft)	Left Side Slope (ft/ft (H:V))	Right Side Slope (ft/ft (H:V))	Discharge (ft^3/s)	Flow Area (ft^2)	Wetted Perimeter (ft)	Hydraulic Radius (ft)	Top Width (ft)	Critical Depth (ft)	Critical Slope (ft/ft)	Velocity (ft/s)	Velocity Head (ft)	Specific Energy (ft)	Froude Number	Flow Type
14341+95 - 14343+95	0.025	0.02	0.33	0.1	12.5	1.65	0.68	4.47	0.15	4.15	0.34	0.0182	2.41	0.09	0.42	1.05	Supercritical
14343+95 - 14348+60	0.025	0.02	0.32	0.1	10	1.19	0.51	3.52	0.15	3.22	0.32	0.0189	2.32	0.08	0.4	1.03	Supercritical
14364+55 - 14366+25	0.025	0.01	0.23	0.1	12	0.43	0.32	3	0.11	2.79	0.2	0.0217	1.34	0.03	0.26	0.7	Subcritical
14367+90 - 14372+60	0.025	0.01	0.68	0.1	5.5	3.33	1.29	4.47	0.29	3.79	0.61	0.0168	2.59	0.1	0.78	0.78	Subcritical
14385+60 - 14385+30	0.025	0.02	0.25	0.1	21	1.4	0.68	5.59	0.12	5.35	0.26	0.0192	2.06	0.07	0.32	1.02	Supercritical
14390+70 - 14393+40	0.025	0.02	0.31	0.1	12	1.39	0.6	4.1	0.15	3.8	0.32	0.0186	2.33	0.08	0.4	1.04	Supercritical
14419+75 - 14422+10	0.025	0.03	0.38	0.1	11	2.58	0.8	4.58	0.17	4.22	0.42	0.0171	3.22	0.16	0.54	1.3	Supercritical
14428+70 - 14429+40	0.025	0.01	0.79	0.1	6	5.45	1.89	5.58	0.34	4.8	0.72	0.0156	2.89	0.13	0.92	0.81	Subcritical
14501+50 - 14503+10	0.025	0.01	0.26	0.1	24	1.21	0.81	6.5	0.13	6.26	0.23	0.0197	1.49	0.03	0.29	0.73	Subcritical
14503+10 - 14505+00	0.025	0.01	0.55	0.1	22	8.21	3.35	12.68	0.26	12.17	0.51	0.0152	2.45	0.09	0.64	0.82	Subcritical
14520+20 - 14521+55	0.025	0.04	0.18	0.1	8	0.29	0.13	1.63	0.08	1.46	0.2	0.0228	2.21	0.08	0.26	1.3	Supercritical
14544+15 - 14544+75	0.025	0.01	0.16	0.1	18	0.25	0.23	3.06	0.08	2.91	0.14	0.0238	1.07	0.02	0.18	0.67	Subcritical
14545+35 - 14546+50	0.025	0.01	0.31	0.1	12.5	1	0.61	4.22	0.14	3.92	0.27	0.0194	1.64	0.04	0.35	0.73	Subcritical
14548+00 - 14550+20	0.025	0.02	0.34	0.1	12	1.68	0.69	4.4	0.16	4.08	0.34	0.0181	2.44	0.09	0.43	1.05	Supercritical
14460+40 - 14601+00 CHN	0.025	0.03	0.29	0.1	7	0.79	0.3	2.35	0.13	2.07	0.31	0.02	2.62	0.11	0.4	1.21	Supercritical
14600+00 - 14600+20 CHN	0.025	0.02	0.22	0.1	10	0.42	0.23	2.38	0.1	2.18	0.21	0.0217	1.79	0.05	0.27	0.96	Subcritical
14628+20 - 14629+00 CHN	0.025	0.04	0.15	0.1	17	0.39	0.19	2.7	0.07	2.56	0.17	0.0224	2.04	0.06	0.21	1.32	Supercritical
14629+10 - 14631+50 CHN	0.025	0.03	0.33	0.1	7	1.07	0.38	2.64	0.14	2.32	0.36	0.0192	2.82	0.12	0.45	1.23	Supercritical
14631+70 - 14632+80 CHN	0.025	0.04	0.29	0.1	12	1.64	0.52	3.83	0.14	3.55	0.34	0.0182	3.15	0.15	0.45	1.45	Supercritical
14644+00 - 14646+70 CHN	0.025	0.03	0.27	0.1	10	0.91	0.36	2.95	0.12	2.7	0.29	0.0196	2.53	0.1	0.37	1.22	Supercritical
14646+70 - 14648+60 CHN	0.025	0.03	0.1	0.1	13	0.09	0.07	1.42	0.05	1.33	0.1	0.0268	1.34	0.03	0.13	1.05	Supercritical
14678+40 - 14679+80 CHN	0.025	0.06	0.3	0.1	10	1.74	0.45	3.3	0.14	3.02	0.37	0.018	3.86	0.23	0.53	1.76	Supercritical
14679+80 - 14682+10 CHN	0.025	0.03	0.5	0.1	5	2.3	0.64	3.05	0.21	2.55	0.55	0.0178	3.62	0.2	0.7	1.28	Supercritical
14682+10 - 14684+20 CHN	0.025	0.04	0.4	0.1	6	1.79	0.49	2.83	0.17	2.44	0.46	0.0181	3.68	0.21	0.61	1.45	Supercritical
14684+20 - 14685+60 CHN	0.025	0.05	0.39	0.1	5	1.5	0.38	2.36	0.16	1.97	0.46	0.0188	3.94	0.24	0.63	1.58	Supercritical
14685+60 - 14687+00 CHN	0.025	0.06	0.25	0.1	5	0.52	0.16	1.53	0.1	1.28	0.3	0.0217	3.24	0.16	0.41	1.61	Supercritical
14690+20 - 14693+80 CHN	0.025	0.12	0.4	0.1	3	1.45	0.25	1.67	0.15	1.24	0.56	0.0207	5.8	0.52	0.92	2.28	Supercritical
14693+80 - 14696+40 CHN	0.025	0.03	0.47	0.1	3	1.11	0.34	1.96	0.18	1.46	0.5	0.0214	3.22	0.16	0.63	1.17	Supercritical
14704+50 - 14706+00 CHN	0.025	0.01	1.58	0.1	0.67	2.42	0.96	3.49	0.28	1.22	1.2	0.0441	2.52	0.1	1.68	0.5	Subcritical
14744+00 - 14744+00 CHN	0.025	0.05	0.42	0.1	6	2.34	0.55	3	0.18	2.58	0.52	0.0175	4.27	0.28	0.71	1.64	Supercritical
14784+30 - 14785+40 CHN	0.025	0.05	0.16	0.1	7	0.2	0.09	1.28	0.07	1.12	0.18	0.0241	2.25	0.08	0.24	1.41	Supercritical
14848+00 - 14851+90 CHN	0.025	0.07	0.42	0.1	8	3.63	0.71	3.79	0.19	3.38	0.55	0.0163	5.14	0.41	0.83	1.98	Supercritical
15522+45 to 15522+90 CH	0.025	0.01	0.31	0.1	3.5	0.25	0.17	1.44	0.12	1.12	0.26	0.0252	1.45	0.03	0.34	0.65	Subcritical

Chester County
Temporary Slope Pipe Calculations

STATION	Roughness Coefficient	Channel Slope (ft/ft)	Normal Depth (ft)	Diameter (ft)	Discharge (ft^3/s)	Flow Area (ft^2)	Wetted Perimeter (ft)	Hydraulic Radius (ft)	Top Width (ft)	Critical Depth (ft)	Percent Full (%)	Critical Slope (ft/ft)	Velocity (ft/s)	Velocity Head (ft)	Specific Energy (ft)	Froude Number	Maximum Discharge (ft^3/s)	Discharge Full (ft^3/s)	Slope Full (ft/ft)	Flow Type
14341+95 - 14343+95	0.023	0.05	0.6	0.67	1.65	0.33	1.68	0.2	0.4	0.59	90.1	0.0508	4.93	0.38	0.98	0.95	1.66	1.55	0.05683	SubCritical
14343+95 - 14348+60	0.023	0.03	0.54	0.67	1.19	0.31	1.51	0.2	0.52	0.52	81.3	0.0334	3.88	0.23	0.78	0.89	1.29	1.2	0.02956	SubCritical
14364+55 - 14366+25	0.023	0.12	0.22	0.5	0.43	0.08	0.72	0.11	0.5	0.33	43.4	0.0298	5.26	0.43	0.65	2.28	1.18	1.1	0.01838	SuperCritical
14367+90 - 14372+60	0.023	0.11	0.5	1	3.33	0.39	1.57	0.25	1	0.78	49.9	0.0301	8.5	1.12	1.62	2.39	7.18	6.68	0.02735	SuperCritical
14385+60 - 14385+30	0.023	0.14	0.35	0.67	1.4	0.19	1.08	0.17	0.67	0.56	52.4	0.04	7.49	0.87	1.22	2.5	2.79	2.59	0.04092	SuperCritical
14390+70 - 14393+40	0.023	0.05	0.5	0.67	1.39	0.28	1.39	0.2	0.59	0.55	74	0.0396	4.97	0.38	0.88	1.27	1.66	1.55	0.04033	SuperCritical
14419+75 -14442+10	0.023	0.05	0.54	1	2.58	0.44	1.66	0.26	1	0.69	54.3	0.0245	5.93	0.55	1.09	1.58	4.84	4.5	0.01642	SuperCritical
14428+70 - 14429+40	0.023	0.18	0.58	1	5.45	0.47	1.73	0.27	0.99	0.94	58	0.0633	11.53	2.07	2.65	2.94	9.19	8.54	0.07325	SuperCritical
14501+50 - 14503+10	0.023	0.05	0.45	0.67	1.21	0.25	1.28	0.19	0.63	0.52	66.6	0.034	4.85	0.37	0.81	1.36	1.66	1.55	0.03056	SuperCritical
14503+10 - 14505+00	0.023	0.03	1.01	1.5	8.21	1.27	2.89	0.44	1.4	1.11	67.6	0.0237	6.46	0.65	1.66	1.2	11.06	10.28	0.01912	SuperCritical
14520+20 - 14521+55	0.023	0.13	0.17	0.5	0.29	0.06	0.63	0.1	0.47	0.27	34.3	0.0252	4.87	0.37	0.54	2.42	1.23	1.14	0.00836	SuperCritical
14544+15 - 14544+75	0.023	0.07	0.19	0.5	0.25	0.07	0.66	0.1	0.48	0.25	37.4	0.0243	3.73	0.22	0.4	1.77	0.9	0.84	0.00621	SuperCritical
14545+35 - 14546+50	0.023	0.04	0.42	0.67	1	0.23	1.23	0.19	0.65	0.47	63	0.029	4.27	0.28	0.71	1.25	1.49	1.38	0.02088	SuperCritical
14548+00 - 14550+20	0.023	0.04	0.45	1	1.68	0.34	1.47	0.23	1	0.55	45.1	0.0202	4.89	0.37	0.82	1.47	4.33	4.03	0.00696	SuperCritical
14460+40 - 14601+00 PIP	0.023	0.04	0.36	0.67	0.79	0.19	1.11	0.18	0.67	0.42	54.1	0.0253	4.06	0.26	0.62	1.32	1.49	1.38	0.01303	SuperCritical
14460+40 - 14601+00 PIP	0.023	0.06	0.25	0.5	0.39	0.1	0.79	0.13	0.5	0.32	50.1	0.0283	3.96	0.24	0.49	1.57	0.84	0.78	0.01512	SuperCritical
14600+00 - 14600+20 PIP	0.023	0.05	0.28	0.5	0.42	0.11	0.84	0.13	0.5	0.33	55.4	0.0294	3.76	0.22	0.5	1.4	0.76	0.71	0.01754	SuperCritical
14629+10 - 14631+50 PIP	0.023	0.08	0.35	0.67	1.07	0.19	1.09	0.17	0.67	0.49	52.7	0.0305	5.68	0.5	0.85	1.89	2.11	1.96	0.0239	SuperCritical
14631+70 - 14632+80 PIP	0.023	0.04	0.44	1	1.64	0.34	1.46	0.23	0.99	0.54	44.5	0.02	4.86	0.37	0.81	1.47	4.33	4.03	0.00663	SuperCritical
14644+00 - 14646+70 PIP	0.023	0.04	0.4	0.67	0.91	0.22	1.18	0.18	0.66	0.45	59.2	0.0273	4.19	0.27	0.67	1.29	1.49	1.38	0.01729	SuperCritical
14646+70 - 14648+60 PIP	0.023	0.01	0.18	0.5	0.09	0.06	0.65	0.1	0.48	0.15	36.4	0.0221	1.39	0.03	0.21	0.67	0.34	0.32	0.00081	SubCritical
14678+40 - 14679+80 PIP	0.023	0.03	0.5	1	1.74	0.39	1.57	0.25	1	0.56	49.9	0.0204	4.44	0.31	0.81	1.25	3.75	3.49	0.00747	SuperCritical
14679+80 - 14682+10 PIP	0.023	0.07	0.46	1	2.3	0.35	1.49	0.24	1	0.65	45.9	0.0229	6.54	0.66	1.12	1.94	5.73	5.33	0.01305	SuperCritical
14682+10 - 14684+20 PIP	0.023	0.08	0.5	0.67	1.79	0.28	1.41	0.2	0.58	0.61	75.2	0.0584	6.29	0.62	1.12	1.58	2.11	1.96	0.06689	SuperCritical
14684+20 - 14685+60 PIP	0.023	0.1	0.41	0.67	1.5	0.22	1.2	0.19	0.65	0.57	60.8	0.0439	6.69	0.69	1.1	2.01	2.35	2.19	0.04697	SuperCritical
14685+60 - 14687+00 PIP	0.023	0.13	0.24	0.5	0.52	0.09	0.76	0.12	0.5	0.37	47.3	0.0339	5.69	0.5	0.74	2.34	1.23	1.14	0.02689	SuperCritical
14690+20 - 14693+80 PIP	0.023	0.2	0.42	0.5	1.45	0.18	1.16	0.15	0.37	0.49	84.2	0.1903	8.22	1.05	1.47	2.08	1.53	1.42	0.20906	SuperCritical
14693+80 - 14696+40 PIP	0.023	0.33	0.24	0.67	1.11	0.11	0.86	0.13	0.64	0.5	36.2	0.0314	9.65	1.45	1.69	4.03	4.28	3.98	0.02572	SuperCritical
14704+50 - 14706+00 PIP	0.023	0.06	0.49	1	2.42	0.39	1.56	0.25	1	0.67	49.4	0.0235	6.25	0.61	1.1	1.77	5.31	4.93	0.01444	SuperCritical
14744+00 - 14744+00 PIP	0.023	0.09	0.43	1	2.34	0.32	1.43	0.23	0.99	0.65	43.2	0.0231	7.21	0.81	1.24	2.22	6.5	6.04	0.0135	SuperCritical
14784+30 - 14785+40 PIP	0.023	0.04	0.19	0.5	0.2	0.07	0.67	0.1	0.49	0.22	38.6	0.0233	2.87	0.13	0.32	1.33	0.68	0.63	0.00398	SuperCritical
14848+00 - 14851+90 CH	0.023	0.1	0.54	1	3.63	0.43	1.65	0.26	1	0.81	54.1	0.033	8.37	1.09	1.63	2.24	6.85	6.37	0.0325	SuperCritical
15522+45 to 15522+90 PI	0.023	0.21	0.14	0.5	0.25	0.05	0.56	0.08	0.45	0.25	28	0.0243	5.54	0.48	0.62	3.08	1.56	1.45	0.00621	SuperCritical

Delaware County

TABLE FOR CALCULATING THE PEAK RUNOFF RATE FOR DRAINAGE PIPES USED FOR CLEAN WATER DIVERSION

Start Sta.	**End Sta.**	**Area of Drainage (sq ft)**	**Length of Sheet Flow (ft)**	**Slope of Ground during Sheet Flow (ft/ft)**	**Soil Type**	**Roughness Coefficient (n)**	**Time of Concentration in Sheet Flow (min)**	**Length of Shallow Concentrated Flow (ft)**	**Slope of Ground during Shallow Concentrated Flow (ft/ft)**	**Shallow Concentrated Flow Velocity (ft/sec)**	**Time of Concentration in Shallow Concentrated Flow (min)**	**Total Time of Concentration (min)**	**2-Year Storm Rainfall Intensity (in/hr)**	**Runoff Coefficients for the Rational Equation**	**Channel Longitudinal Slope (ft/ft)**	**Channel Side Slope (H:V) (ft/ft)**	**Peak Runoff Rate (CFS)**	**Size of Diversion Sock (in)**	**Pipe Slope (ft/ft)**	**Size of Slope Pipe (in)**
15637+75	15639+30	56,902	100	0.05	Type D	0.300	8.17	430	0.06	1.70	4.22	12.38	3.61	0.20	0.02	25:1	**0.94**	**12**	**0.02**	**8**
15654+90	15655+85	16,172	100	0.07	Type D	0.800	11.94	284	0.06	1.70	2.78	14.72	3.34	0.20	0.03	15:1	**0.25**	**12**	**0.03**	**6**
15656+00	15657+70	172,702	100	0.05	Type D	0.800	12.91	589	0.05	1.50	6.54	19.46	2.91	0.20	0.02	17:1	**2.31**	**12**	**0.05**	**12**
15657+70	15661+75	135,372	100	0.02	Type D	0.800	16.00	527	0.04	1.40	6.27	22.27	2.70	0.20	0.02	15:1	**1.68**	**12**	**0.05**	**12**
15660+15	15662+40	167,769	100	0.04	Type D	0.800	13.60	512	0.04	1.40	6.10	19.70	2.89	0.20	0.02	25:1	**2.22**	**12**	**0.04**	**12**
15662+40	15663+75	87,898	100	0.04	Type D	0.800	13.60	960	0.03	1.20	13.33	26.94	2.41	0.20	0.02	20:1	**0.97**	**12**	**0.03**	**8**
15689+50	15689+50	53,035	100	0.04	Type D	0.800	13.60	374	0.05	1.50	4.16	17.76	3.05	0.20	0.04	18:1	**0.74**	**12**	**0.03**	**8**
15695+30	15695+45	227,590	100	0.03	Type D	0.800	14.55	1194	0.03	1.25	15.92	30.47	2.23	0.20	0.03	28:1	**2.33**	**12**	**0.02**	**12**
15695+45	15697+65	168,097	100	0.03	Type D	0.800	14.55	739	0.03	1.25	9.85	24.40	2.56	0.20	0.03	28:1	**1.98**	**12**	**0.03**	**12**
15814+35	15814+35	30,056	100	0.05	Type D	0.300	8.17	383	0.08	2.00	3.19	11.36	3.74	0.20	0.05	5:1	**0.52**	**12**	**0.05**	**6**
15814+40	15819+80	28,200	100	0.04	Type D	0.300	8.60	340	0.10	2.20	2.58	11.18	3.76	0.20	0.13	12:1	**0.49**	**12**	**0.11**	**6**
15858+80	15861+65	49,545	100	0.05	Type D	0.800	12.91	256	0.19	1.00	4.27	17.18	3.10	0.20	0.02	13:1	**0.71**	**12**	**0.11**	**6**
15861+75	15863+50	131,158	100	0.03	Type D	0.300	9.20	529	0.11	0.80	11.02	20.22	2.85	0.20	0.02	11:1	**1.71**	**12**	**0.08**	**8**
15886+50	15887+45	113,393	100	0.03	Type D	0.300	9.20	795	0.06	1.70	7.79	16.99	3.12	0.20	0.03	16:1	**1.62**	**12**	**n/a**	**n/a**
15924+30	15925+70	105,901	100	0.12	Type D	0.300	6.65	980	0.14	1.70	9.61	16.26	3.19	0.20	0.03	14:1	**1.55**	**12**	**0.02**	**12**
15951+40	15951+55	28,019	100	0.16	Type D	0.300	6.22	344	0.23	1.20	4.78	11.00	3.79	0.20	0.02	10:1	**0.49**	**12**	**0.05**	**6**
15961+25	15966+90	92,954	100	0.08	Type D	0.300	7.32	140	0.26	1.30	1.79	9.11	4.06	0.20	0.09	7:1	**1.73**	**12**	**n/a**	**n/a**
15964+55	15966+20	12,877	100	0.08	Type D	0.300	7.32	153	0.16	1.70	1.50	8.82	4.11	0.20	0.10	4:1	**0.24**	**12**	**n/a**	**n/a**
15967+05	15967+55	3,360	100	0.18	Type D	0.300	6.05	91	0.52	1.00	1.52	7.57	4.31	0.30	0.32	1.5:1	**0.10**	**12**	**n/a**	**n/a**

TABLE FOR CALCULATING THE PEAK RUNOFF RATE FOR DRAINAGE PIPES USED FOR CLEAN WATER DIVERSION

Start Sta.	End Sta.	Area of Drainage (sq ft)	Length of Sheet Flow (ft)	Slope of Ground during Sheet Flow (ft/ft)	Soil Type	Roughness Coefficient (n)	Time of Concentration in Sheet Flow (min)	Length of Shallow Concentrated Flow (ft)	Slope of Ground during Shallow Concentrated Flow (ft/ft)	Shallow Concentrated Flow Velocity (ft/sec)	Time of Concentration in Shallow Concentrated Flow (min)	Total Time of Concentration (min)	2-Year Storm Rainfall Intensity (in/hr)	Runoff Coefficients for the Rational Equation	Channel Longitudinal Slope (ft/ft)	Channel Side Slope (H:V) (ft/ft)	Peak Runoff Rate (CFS)	Size of Diversion Sock (in)	Pipe Slope (ft/ft)	Size of Slope Pipe (in)
15991+60	15991+90	248,954	100	0.03	Type D	0.300	9.20	624	0.08	2.00	5.20	14.40	3.38	0.20	0.01	43:1	**3.86**	**12**	**0.04**	**12**
15991+90	15992+80	102,526	100	0.05	Type D	0.300	8.17	463	0.07	1.80	4.29	12.45	3.60	0.20	0.03	10:1	**1.69**	**12**	**0.03**	**12**

Delaware County
Temporary Diversion Berm Calculations

STATION	Roughness Coefficient	Channel Slope (ft/ft)	Normal Depth (ft)	Left Side Slope (ft/ft (H:V))	Right Side Slope (ft/ft (H:V))	Discharge (ft^3/s)	Flow Area (ft^2)	Wetted Perimeter (ft)	Hydraulic Radius (ft)	Top Width (ft)	Critical Depth (ft)	Critical Slope (ft/ft)	Velocity (ft/s)	Velocity Head (ft)	Specific Energy (ft)	Froude Number	Flow Type
15367+75 - 15639+30	0.025	0.02	0.2	0.1	25	0.94	0.52	5.32	0.1	5.13	0.2	0.0205	1.79	0.05	0.25	0.99	Subcritical
15567+70 - 15661+75	0.025	0.02	0.31	0.1	15	1.68	0.72	4.96	0.15	4.67	0.31	0.0183	2.33	0.08	0.39	1.04	Supercritical
15654+90 - 15655+85	0.025	0.03	0.14	0.1	15	0.25	0.15	2.25	0.07	2.12	0.15	0.0236	1.69	0.04	0.18	1.12	Supercritical
15656+00 - 15657+70	0.025	0.02	0.33	0.1	17	2.31	0.94	5.99	0.16	5.68	0.34	0.0177	2.45	0.09	0.43	1.06	Supercritical
15660+15 - 15662+40	0.025	0.02	0.28	0.1	25	2.22	1	7.34	0.14	7.08	0.29	0.0183	2.22	0.08	0.36	1.04	Supercritical
15662+40 - 15663+75	0.025	0.04	0.2	0.1	20	0.97	0.39	4.16	0.09	3.98	0.23	0.02	2.47	0.09	0.29	1.38	Supercritical
15689+50 - 15689+50	0.025	0.02	0.21	0.1	18	0.74	0.41	4.03	0.1	3.84	0.21	0.0206	1.82	0.05	0.26	0.99	Subcritical
15695+30 - 15695+45	0.025	0.03	0.25	0.1	28	2.33	0.91	7.4	0.12	7.16	0.28	0.0183	2.55	0.1	0.36	1.26	Supercritical
15695+45 - 15697+65	0.025	0.03	0.24	0.1	28	1.98	0.81	6.96	0.12	6.74	0.26	0.0187	2.45	0.09	0.33	1.25	Supercritical
15814+35 - 15814+35	0.025	0.05	0.26	0.1	5	0.52	0.17	1.59	0.11	1.32	0.3	0.0217	3.02	0.14	0.4	1.48	Supercritical
15814+40 - 15819+80	0.025	0.02	0.21	0.1	12	0.49	0.27	2.77	0.1	2.57	0.21	0.0214	1.79	0.05	0.26	0.97	Subcritical
15861+75 - 15863+50	0.025	0.02	0.24	0.1	13	0.71	0.37	3.32	0.11	3.1	0.24	0.0204	1.94	0.06	0.29	0.99	Subcritical
15861+75 - 15863+50	0.025	0.02	0.35	0.1	11	1.71	0.68	4.23	0.16	3.9	0.36	0.018	2.5	0.1	0.45	1.05	Supercritical
15886+50 - 15887+45	0.025	0.03	0.28	0.1	16	1.62	0.61	4.7	0.13	4.44	0.3	0.0184	2.65	0.11	0.38	1.26	Supercritical
15924+30 - 15925+70	0.025	0.03	0.29	0.1	14	1.55	0.58	4.3	0.13	4.03	0.31	0.0184	2.7	0.11	0.4	1.26	Supercritical
15951+40 - 15951+55	0.025	0.02	0.23	0.1	10	0.49	0.26	2.52	0.1	2.3	0.23	0.0213	1.86	0.05	0.28	0.97	Subcritical
15961+25 - 15966+90	0.025	0.09	0.32	0.1	7	1.73	0.36	2.57	0.14	2.26	0.43	0.0181	4.81	0.36	0.68	2.12	Supercritical
15964+55 - 15966+20	0.025	0.1	0.19	0.1	4	0.24	0.07	0.96	0.07	0.77	0.24	0.0248	3.34	0.17	0.36	1.93	Supercritical
15967+05-15967+55	0.025	0.32	0.17	0.1	1.5	0.1	0.02	0.47	0.05	0.27	0.25	0.0386	4.43	0.3	0.47	2.69	Supercritical
15991+60 - 15991+90	0.025	0.01	0.32	0.1	43	3.86	2.23	14.15	0.16	13.86	0.29	0.0179	1.73	0.05	0.37	0.76	Subcritical
15991+90 - 15992+80	0.025	0.03	0.34	0.1	10	1.69	0.57	3.72	0.15	3.4	0.37	0.018	2.96	0.14	0.47	1.27	Supercritical

Delaware County
Temporary Slope Pipe Calculations

STATION	Roughness Coefficient	Channel Slope (ft/ft)	Normal Depth (ft)	Diameter (ft)	Discharge (ft^3/s)	Flow Area (ft^2)	Wetted Perimeter (ft)	Hydraulic Radius (ft)	Top Width (ft)	Critical Depth (ft)	Percent Full (%)	Critical Slope (ft/ft)	Velocity (ft/s)	Velocity Head (ft)	Specific Energy (ft)	Froude Number	Maximum Discharge (ft^3/s)	Discharge Full (ft^3/s)	Slope Full (ft/ft)	Flow Type
15367+75 - 15639+30	0.023	0.02	0.53	0.67	0.94	0.3	1.46	0.2	0.55	0.46	78.6	0.0278	3.16	0.16	0.68	0.76	1.05	0.98	0.01845	SubCritical
15567+70 - 15661+75	0.023	0.05	0.42	1	1.68	0.32	1.42	0.22	0.99	0.55	42.3	0.0202	5.32	0.44	0.86	1.66	4.84	4.5	0.00696	SuperCritical
15654+90 - 15665+85	0.023	0.03	0.24	0.5	0.25	0.09	0.76	0.12	0.5	0.25	47.3	0.0243	2.73	0.12	0.35	1.13	0.59	0.55	0.00621	SuperCritical
15656+00 - 15657+70	0.023	0.05	0.51	1	2.31	0.4	1.59	0.25	1	0.65	50.8	0.023	5.77	0.52	1.03	1.61	4.84	4.5	0.01316	SuperCritical
15660+15 - 15662+40	0.023	0.03	0.58	1	2.22	0.47	1.73	0.27	0.99	0.64	58	0.0225	4.7	0.34	0.92	1.2	3.75	3.49	0.01215	SuperCritical
15662+40 - 15663+75	0.023	0.03	0.46	0.67	0.97	0.26	1.3	0.2	0.62	0.47	68.3	0.0284	3.78	0.22	0.68	1.04	1.29	1.2	0.01964	SuperCritical
15689+50 - 15689+50	0.023	0.03	0.38	0.67	0.74	0.21	1.14	0.18	0.66	0.41	56.8	0.0246	3.58	0.2	0.58	1.13	1.29	1.2	0.01143	SuperCritical
15695+30 - 15695+45	0.023	0.02	0.69	1	2.33	0.58	1.96	0.29	0.93	0.65	68.8	0.0231	4.05	0.25	0.94	0.9	3.06	2.85	0.01339	SubCritical
15695+45 - 15697+65	0.023	0.03	0.54	1	1.98	0.43	1.65	0.26	1	0.6	53.9	0.0214	4.58	0.33	0.87	1.23	3.75	3.49	0.00967	SuperCritical
15814+35 - 15814+35	0.023	0.05	0.32	0.5	0.52	0.13	0.92	0.14	0.48	0.37	63.6	0.0339	3.94	0.24	0.56	1.33	0.76	0.71	0.02689	SuperCritical
15814+40 - 15819+80	0.023	0.11	0.24	0.5	0.49	0.09	0.77	0.12	0.5	0.36	48	0.0324	5.26	0.43	0.67	2.15	1.13	1.05	0.02387	SuperCritical
15858+80 - 15861+65	0.023	0.11	0.3	0.5	0.71	0.12	0.89	0.14	0.49	0.42	60.2	0.0473	5.75	0.51	0.81	2.02	1.13	1.05	0.05012	SuperCritical
15861+75 - 15863+50	0.023	0.08	0.48	0.67	1.71	0.27	1.36	0.2	0.6	0.6	72.3	0.0539	6.26	0.61	1.09	1.63	2.11	1.96	0.06104	SuperCritical
15924+30 - 15925+70	0.023	0.02	0.53	1	1.55	0.42	1.62	0.26	1	0.53	52.6	0.0197	3.7	0.21	0.74	1.01	3.06	2.85	0.00593	SuperCritical
15951+40 - 15951+55	0.025	0.05	0.32	0.5	0.49	0.13	0.93	0.14	0.48	0.36	64.7	0.0383	3.65	0.21	0.53	1.21	0.7	0.65	0.02821	SuperCritical
15991+60 - 15991+90	0.023	0.04	0.78	1	3.86	0.66	2.18	0.3	0.82	0.83	78.5	0.0356	5.84	0.53	1.31	1.15	4.33	4.03	0.03675	SuperCritical
15991+90 - 15992+80	0.023	0.03	0.49	1	1.69	0.38	1.55	0.25	1	0.55	49.1	0.0202	4.41	0.3	0.79	1.25	3.75	3.49	0.00704	SuperCritical

E&S WORKSHEET #22 AND RESUMES OF PLAN PREPARERS

E&S WORKSHEET #22 AND RESUMES OF PLAN PREPARERS

STANDARD E&S WORKSHEET # 22
PLAN PREPARER RECORD OF TRAINING AND EXPERIENCE IN EROSION AND SEDIMENT POLLUTION CONTROL METHODS AND TECHNIQUES

NAME OF PLAN PREPARER: Jessica D. Adams, P.E.

FORMAL EDUCATION:

Name of College or Technical Institute: Lehigh University

Curriculum or Program: Civil Engineering

Dates of Attendance: **From:** 08/1989 **To:** 05/1994

Degree Received Bachelor of Science - Civil Engineering

OTHER TRAINING:

Name of Training:	NPDES and PCSM Permitting	E&S Manual Training	BMPs for E&S Plans
Presented By:	PADEP	PADEP	Newell, Tereska & Mackay
Date:	05/2014	08/2012	02/2012

EMPLOYMENT HISTORY:

Current Employer: STV Energy Services, Inc.

Telephone: 610-385-8312

Former Employer: Hanover Engineering Assoc., Inc.

Telephone: 610-691-5644

RECENT E&S PLANS PREPARED:

Name of Project:	SXL-PPP/OPP Oversight	PPL-Hughesville	PPL-Wescosville-Hosensack
County:	Delaware County	Lycoming County	Lehigh County
Municipality:	Borough of Marcus Hook	Wolf & Muncy Creek	Upper Macungie, Lower Macungie, Upper Milford, Lower Milford
Permit Number:	Pending	PAG02004116012	PAI023912025
Approving Agency:	PADEP	PADEP	Lehigh County/PADEP

Jessica D. Adams, PE

CIVIL ENGINEER

Ms. Adams is a civil engineer with more than 15 years of experience providing energy, commercial, industrial, and municipal land development design. Her expertise includes site evaluation, planning, and construction cost estimation, with a focus on stormwater management, site grading, erosion and sediment control facilities, utilities layout, and roadway design. With a wealth of experience in the Lehigh Valley and eastern Pennsylvania, Ms. Adams manages and prepares documents for permitting. She maintains a thorough knowledge of local, state, and federal codes regarding documentation and regulations.

FIRM
STV

EDUCATION
BACHELOR OF SCIENCE, CIVIL ENGINEERING; LEHIGH UNIVERSITY

BACHELOR OF ARTS, ARCHITECTURE; LEHIGH UNIVERSITY

PROFESSIONAL REGISTRATIONS
PROFESSIONAL ENGINEER, PA

COMPUTER SKILLS
HYDRAFLOW STORM SEWERS, HYDRAFLOW HYDROGRAPHS, VTPSUHM, HEC-RAS

Project Experience

Colonial Pipeline Company Fire Suppression - Civil Engineer

Providing civil site design and designs for stormwater management facilities and erosion and sediment controls for fire suppression projects at various Colonial Pipeline liquid petroleum tank farms throughout the eastern United States. Ms. Adams is providing detention basin and outlet control design for fire water supply. She is also coordinating the other disciplines involved in the projects as well as attending client review meetings and construction pre-bid meetings. In addition, Ms. Adams assists in preparing construction cost estimates.

UGI 12-Inch Natural Gas Pipeline Susquehanna River Crossing - Civil Engineer

Designing the erosion and sediment controls for a 12-inch natural gas pipeline to be installed underground by horizontal directional drill (HDD) across the Susquehanna River in Steelton, PA. Ms. Adams is preparing designs for post-construction stormwater management. In addition, Ms. Adams is managing and preparing the required civil engineering, as well as required permitting for the Pennsylvania Department of Environmental Protection, National Pollutant Discharge Elimination System, FAA, and Pennsylvania Department of Transportation to help maintain the project schedule.

PPL Transmission Line Rebuild - Civil Engineer

Evaluating and finalizing the location of temporary construction access routes, pull pad areas, and temporary staging areas along various PPL transmission line corridors in eastern Pennsylvania. Ms. Adams is preparing designs for erosion and sediment control and post-construction stormwater management. She is also managing and preparing the required Pennsylvania Department of Environmental Protection and National Pollutant Discharge Elimination System permitting to help keep the project on schedule.

Sunoco Eagle Point Rail Extension - Civil Engineer

Providing site layout design and grading for a railroad upgrade and realignment project in Westville, NJ. Ms. Adams is designing stormwater management and erosion and sediment controls. She is also preparing the reports for an on-site detention basin, outlet structures, and conveyance systems required for local and state permitting. In addition, Ms. Adams assisted in evaluating and relocating existing utilities to accommodate the rail realignment.

PPL Transmission ROW Encroachment - Civil Engineer

Reconfigured the ground grade below transmission lines to establish proper vertical clearance for compliance with state and federal standards. Ms. Adams prepared grading plans and erosion and sediment control design at PPL sites across seven counties in eastern PA. She is also documenting

Jessica D. Adams, PE

CIVIL ENGINEER

her reports for presentation to the client.

Sunoco Wallis Run Road Washout - Civil Engineer

Determined the alignment for the relocation of 1,000 feet of new 8-inch petroleum pipeline for the Wallis Run Road washout in Gamble Township, PA. The temporary relocation was above ground and buried in stone. Ms. Adams provided the final relocation, which featured an open trench design and replaced the pipeline underground. In addition, she designed the associated pavement restoration, roadway drainage, and erosion and sediment control. Ms. Adams also obtained permitting from PennDOT and the Pennsylvania Department of Environmental Protection as needed.

PPL Transmission Line Rebuild - Civil Engineer

Evaluating and finalizing the location of temporary construction access routes, pull pad areas, and temporary staging areas along various PPL transmission line corridors in eastern Pennsylvania. Ms. Adams is preparing designs for erosion and sediment control and post-construction stormwater management. She is also managing and preparing the required Pennsylvania Department of Environmental Protection and National Pollutant Discharge Elimination System permitting to help keep the project on schedule.

LVIP, Inc. Lehigh Valley Industrial Park VI - Civil Design Engineer

Prepared stormwater management reports for four interconnected stormwater detention basin/ outlet structures and associated collection systems for a new 44-lot, 180-acre industrial park in Bethlehem, PA, for Lehigh Valley Industrial Park (LVIP), Inc. Ms. Adams' stormwater designs involved tying into existing PennDOT roadway detention basins.

STANDARD E&S WORKSHEET # 22
PLAN PREPARER RECORD OF TRAINING AND EXPERIENCE IN EROSION AND SEDIMENT POLLUTION CONTROL METHODS AND TECHNIQUES

NAME OF PLAN PREPARER: Christopher D. Antoni, P.E., P.Eng.

FORMAL EDUCATION:

Name of College or Technical Institute: Pennsylvania State University // Villanova University

Curriculum or Program: Civil Engineering, Environmental Engineering Minor // Civil Engineering

Dates of Attendance: **From:** 08/1991 // 08/2002 **To:** 05/1995 // 05/2006

Degree Received Bachelor of Science // Master of Engineering

OTHER TRAINING:

Name of Training:	Oil and Gas Industry Training (ESCGP-2)	
Presented By:	PADEP	
Date:	03/2011 and 05/2013	

EMPLOYMENT HISTORY:

Current Employer: STV Energy Services, Inc.

Telephone: 610-385-8233

Former Employer: STV Incorporated

Telephone: 610-385-8200

RECENT E&S PLANS PREPARED:

Name of Project:	SXL-PPP/OPP Oversight	SXL-Allegheny Access	PNGPC-Delaware River Crossing
County:	Delaware County	Lawrence & Beaver Counties	Delaware County
Municipality:	Borough of Marcus Hook	Darlington, S. Beaver, Chippewa and Brighton Townships	Tinicum Township
Permit Number:	Pending	OG0413003	ESG00045160001
Approving Agency:	PADEP	PADEP	DCCD

Christopher Antoni, PE

CHIEF PIPELINE ENGINEER | ENGINEERING CHIEF | SENIOR VICE PRESIDENT

Mr. Antoni is the Senior Vice President of STV Energy Services, reporting directly to the Executive Vice President and Energy National Practice Leader. He is responsible for overseeing the civil and environmental engineering of multi-discipline pipeline and facility projects related to the petroleum and gas pipeline industries. Mr. Antoni is a seasoned project manager with more than 20 years of experience in site development, hydrologic and hydraulic (H&H) analyses, environmental permitting, stormwater management, floodplain analysis, geotechnical and subsurface investigations, wastewater collection and treatment, wetland mitigation, and stream restoration. Most of his background focuses on the design of natural gas and petroleum product pipelines. Mr. Antoni has also worked on highway and bridge projects and a wide range of commercial, government, transportation, and industrial facilities.

Project Experience

Sunoco Allegheny Access Pipeline Project - Project Engineer

Designing a 160-mile-long natural gas/liquids pipeline between Tiffin, OH, and Vanport, PA. The two-phase project includes the return to service of the Inland Line to allow deliveries to Mogadore, OH. Eighty miles of the line are being replaced with 12-inch piping; the remaining portions are being repaired as necessary. In addition, a number of facility upgrades are being made. Phase II includes increasing the rate from Cedar Point to Mogadore to 80,000 barrels per day and the installation of a new line from Mogadore to Vanport. The Sunoco Logistics line from Vanport to Delmont, PA, will be used for this project. A number of facility upgrades were necessary during the project.

Sunoco Logistics Pipeline Total Spur - Project Engineer

Developing conceptual pipeline routes for a feasibility study and providing environmental permitting and detailed design for a 6-mile-long, 30-inch crude oil spur line from the proposed Motiva Crude oil pipeline in Port Arthur, TX. Mr. Antoni is the responsible engineer-in-charge of the civil and pipeline engineering team that is designing and providing permitting for the new pipeline.

Sunoco WTG South Project - Project Engineer

Developed the design of a new pipeline system for delivering crude oil from the West Texas Gulf (WTG) 26-inch-diameter pipeline to Mid-Valley Pipeline Company's Longview Station and Oiltanking's (OTI) terminal in Houston. Mr. Antoni oversaw the design of the grading plans for Goodrich Station, which will serve as an intermediate storage area along the delivery route. He directed the preparation of grading plans for earthen dikes to contain two 80,000-bbl storage tanks, as well as a station roadway and pump and equipment pad areas. Additionally, Mr. Antoni managed the stormwater pollution and prevention, as well as erosion control plans, for the site work and the pipeline design for a 3.6-mile, 26-inch pipeline that carries West Texas Intermediate and West Texas Sour crudes from the storage tanks to the Longview and OTI stations via the Kilgore 10-inch pipeline.

Regency Energy Partners (formerly PVR) Marcellus Gas Gathering Meshoppen Pipeline - Project Manager/Project Engineer

Designing and permitting a 9.5-mile-long, 16-inch natural gas gathering pipeline in Wyoming and Susquehanna counties, PA. Mr. Antoni is managing all efforts of the pipeline project, including

FIRM
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EDUCATION
MASTER OF ENGINEERING, CIVIL ENGINEERING; VILLANOVA UNIVERSITY

BACHELOR OF SCIENCE, CIVIL ENGINEERING, ENVIRONMENTAL ENGINEERING MINOR; PENNSYLVANIA STATE UNIVERSITY

PROFESSIONAL ENGINEER
ALABAMA, CALIFORNIA, COLORADO, DISTRICT OF COLUMBIA, GEORGIA, IDAHO, INDIANA, ILLINOIS, IOWA, KANSAS, KENTUCKY, LOUISIANA, MAINE, MARYLAND, MICHIGAN, MINNESOTA, MISSISSIPPI, MISSOURI, MONTANA, NEBRASKA, NEW YORK, NEW MEXICO, NORTH CAROLINA, NORTH DAKOTA, OHIO, OKLAHOMA, PENNSYLVANIA, SOUTH DAKOTA, TENNESSEE, TEXAS, UTAH, VIRGINIA, WASHINGTON, WEST VIRGINIA, AND WYOMING

CERTIFICATIONS
STREAM RESTORATION COURSE CERTIFICATION; RUTGERS

TRAINING
OSHA 40-HOUR HAZWOPER

OSHA 1910.119 PROCESS SAFETY MANAGEMENT; MEGA SAFETY INSTITUTE

FRESHWATER WETLANDS CONSTRUCTION; LEARNING CENTER OF APPLIED ENVIRONMENTAL TECHNOLOGY

MEMBERSHIPS
AMERICAN SOCIETY OF CIVIL ENGINEERS

Christopher Antoni, PE

CHIEF PIPELINE ENGINEER | ENGINEERING CHIEF | SENIOR VICE PRESIDENT

the land development permit for a new compressor station. He is also developing project specifications and bid documents for the project.

Regency Energy Partners (formerly PVR) Marcellus Gas Gathering Loyalsock Gathering System - Project Engineer

Providing pipeline routing and civil engineering design for three compressor stations and approximately 27 miles of pipeline in Lycoming County, PA. Mr. Antoni is responsible for managing the civil and pipeline engineering teams that are designing and providing permitting for the system.

Regency Energy Partners (formerly PVR) Marcellus Gas Gathering Wellsboro - Project Engineer

Providing designs for the installation of an approximately 22-mile-long, 24-inch natural gas gathering pipeline in Tioga and Lycoming counties, PA. Mr. Antoni is the responsible engineer-in-charge of the civil and pipeline engineering team that is designing and providing permitting for the installation of the pipeline.

Sunoco Pipeline, L.P. Wales Road Pipeline Relocation - Project Manager

Evaluating impacts to Sunoco's 22-inch crude oil pipeline resulting from road improvements to Wales Road in Wood County, Ohio. Mr. Antoni is managing the design and permitting of the relocation route for the pipeline. This project involves detailed coordination with ODOT on their proposed construction methodologies and their design of the stormwater management system.

Sunoco Pipeline Menards Store Pipeline Relocation - Project Manager

Managed a multi-office effort on the design and permitting of this pipeline relocation in Toledo, OH. STV designed and permitted a 1,500-foot relocation of Sunoco's two 8-inch Toledo to Inkster petroleum products pipelines, which resulted from the encroachment of a Menards Home Improvement Center on the Sunoco right-of-way. Mr. Antoni was responsible for the pipeline design, erosion and sediment controls, and specifications. He coordinated with Menards and Sunoco right-of-way.

Buckeye Partners L.P. Union Lake Road Pipeline Relocation - Project Manager/Project Engineer

Directed the preliminary and final design for the relocation of 900 feet of Buckeye's existing 8-inch petroleum products pipeline, because of impacts from the reconstruction of Union Lake Road in Oakland County, MI. Mr. Antoni collaborated with the owner, pipeline contractor, and highway design engineer. He also applied for highway and erosion and sedimentation pollution control permits, as well as directed survey subconsultants.

Sunoco Pipeline Motiva Crude Terminaling Project - Project Civil Engineer

Evaluated the feasibility of several pipeline routes and developed preliminary and final design plans for an 8.3-mile, 30-inch crude oil pipeline from Sunoco's Nederland Marine Terminal to Motiva's Port Arthur Refinery in Nederland and Port Arthur, TX. Mr. Antoni developed permit documentation for Texas DOT (TxDOT), Jefferson County Drainage District #7, Kansas City Southern Railroad, the Jefferson County Road Commission, and the Lower Neches Valley Authority. He also developed project specifications and managed the projection of the project plans. In addition,

Christopher Antoni, PE

CHIEF PIPELINE ENGINEER | ENGINEERING CHIEF | SENIOR VICE PRESIDENT

Mr. Antoni optimized the site layout of a new crude oil tank farm comprising six new 550,000-bbl tanks. He provided grading for secondary containment and access roads.

Sunoco Pipeline, L.P. US 24 Pipeline Relocation - Project Manager/Project Engineer

Evaluating impacts to 2.5 miles of Sunoco's 6-inch DSPL petroleum products pipeline resulting from road improvements to Telegraph Road (US24) in Monroe County, Michigan. Mr. Antoni is overseeing the design and permitting of the relocation route for the pipeline. This project involves detailed coordination with MDOT on their proposed construction methodologies and their design of the stormwater management system, because the existing pipeline lies with the road right-of-way.

Buckeye Pipe Line Taylor to Northwest Airlines Jet Line - Project Engineer

Directed engineering design and a feasibility study for a 2-mile pipeline connection from Taylor, MI, to an existing Northwest Airline jet line at the Detroit Metro Airport in Romulus, MI. The project extends from the Buckeye Taylor Tank Terminal, along an existing Norfolk Southern railroad corridor, to a connection point in the Northwest pipeline within the railroad's right-of-way. Mr. Antoni was the lead civil engineer and oversaw pipeline design and layout, erosion and sediment control plans, and Norfolk Southern railroad occupancy permitting.

Sunoco Pipeline Little Schuylkill Pipeline Relocation - Project Engineer

Provided engineering and permitting services for the relocation of approximately 200 feet of a 6-inch petroleum products pipeline within the Little Schuylkill River in Tamaqua, PA. The project necessitated a streambank restoration to regrade the disturbed embankment. The plan seeded and covered the embankment with an erosion control blanket. Mr. Antoni participated in the development of an erosion and sedimentation pollution control plan, pipe layout, and design. He also oversaw the development of all plans.

Sunoco Pipeline Geddes Brook Pipeline Maintenance - Project Engineer

Provided civil and environmental engineering for the design of a 1-to-1 bank stabilization and the replacement of a 90-foot section of exposed pipeline in Camillus, NY. Mr. Antoni oversaw design of the pipeline replacement, development of erosion and sediment control plans, and development of permit and construction drawings and specifications. He coordinated with geotechnical engineers to design a stabilization method for the severe slopes and with local agencies to obtain permits. He also aided in the preparation of the environmental permit packages for the New York State DEP (NYSDEP) and the USACE.

ExxonMobil Pipeline Delaware River Crossing Replacement - Project Engineer

Oversaw the conceptual design and feasibility study for ExxonMobil's Paulsboro to Malvern 12-inch petroleum products pipeline in Philadelphia. As the lead civil engineer, Mr. Antoni oversaw pipeline design and layout, which included a 5,200-foot-long directional drill across the Delaware River. He was responsible for erosion and sediment pollution control design; and national pollutant discharge elimination system, Conrail, and local municipal permitting. Mr. Antoni also coordinated with the Philadelphia International Airport and UPS to obtain temporary workspace for the drill.

STANDARD E&S WORKSHEET # 22
PLAN PREPARER RECORD OF TRAINING AND EXPERIENCE IN EROSION AND SEDIMENT POLLUTION CONTROL METHODS AND TECHNIQUES

NAME OF PLAN PREPARER: Samuel P. Gilbert, P.E.

FORMAL EDUCATION:

Name of College or Technical Institute: University of Pittsburgh

Curriculum or Program: Civil Engineering

Dates of Attendance: **From:** 08/2002 **To:** 05/2006

Degree Received Bachelor of Science

OTHER TRAINING:

Name of Training:	Oil and Gas Industry Training	E&S Manual Training
Presented By:	PADEP	PADEP
Date:	2013	2012 and 2015

EMPLOYMENT HISTORY:

Current Employer: STV Energy Services, Inc.

Telephone: 610-385-8434

Former Employer: NePo Associates, Inc.

Telephone: 610-296-3080

RECENT E&S PLANS PREPARED:

Name of Project:	SXL-PPP/OPP Oversight	PPL-Linden 69kV	PPL-Lackawanna X4-048 IPP
County:	Delaware County	Lycoming County	Lackawanna County
Municipality:	Borough of Marcus Hook	City of Williamsport	Archbald, Jessup & Blakely Boroughs
Permit Number:	Pending	PAG02004116010	PAI023515003
Approving Agency:	PADEP	Lycoming County Conservation District	PADEP

Samuel Gilbert, PE

CIVIL ENGINEER

Mr. Gilbert is a civil designer with 10 years of experience in designing grading, roadway layout, utility placement, erosion and sediment control (ES&C) and stormwater management plans. He has worked on a number of land development projects, which involved presenting at municipal government meetings, coordinating with subcontractors, consulting with clients, and obtaining state, local, and environmental permits.

Project Experience

Energy Transfer Partners (formerly Regency Energy Partners) Inflection Phase II - Project Engineer

Completed plans and permitting for an approximately 10-mile pipeline in Lycoming County, PA. Mr. Gilbert provided plans and profile drawings, E&SC plans, and post construction stormwater management plans. He designed the crossing and restoration methods for several township roads, streams, and wetlands. Mr. Gilbert also performed pipe stress calculations for the 12-inch steel pipeline and classification per 49 CFR Part 192.

Colonial Pipeline Company Linden Junction Manifold, Linden, NJ - Civil Engineer

Providing civil engineering support for the upgrade of a 178-acre tank farm in Linden, NJ. Mr. Gilbert is performing stormwater management and storm drainage calculations for the proposed driveway and other site improvements. He is also assisting in obtaining the required township and state environmental permits. Mr. Gilbert performed pipeline stress calculations for all existing and proposed piping on the site to make certain that the redesign of the driveways would not overstress the petroleum product pipelines.

Colonial Pipeline Company Cobbs Creek Reservoir Relocation - Project Engineer

Provided civil engineering services for the 2.5-mile relocation of 32-inch and 36-inch high-pressure Colonial petroleum product pipelines in Cumberland County, VA. Mr. Gilbert assisted in the design of the pipeline route based on the terrain. He conducted an additional engineering analysis of pipe logistics for the project and is designing the E&SC facilities along the pipeline alignment. Mr. Gilbert also developed a cost estimate for the project.

Colonial Pipeline Company Cobbs Creek Reservoir Relocation - Project Engineer

Provided civil engineering services for the 2.5-mile relocation of 32-inch and 36-inch high-pressure Colonial petroleum product pipelines in Cumberland County, VA. Mr. Gilbert assisted in the design of the pipeline route based on the terrain. He conducted an additional engineering analysis of pipe logistics for the project and is designing the E&SC facilities along the pipeline alignment. Mr. Gilbert also developed a cost estimate for the project.

PPL Electric Utilities Susquehanna-Harwood Reconductor Project - Civil Engineer

Provided civil engineering for the replacement of all conductor cable, conductor splices, and dead-end assemblies along the 14 mile length of PPL's Susquehanna-Harwood #1 and #2 230 kV line corridor in Luzerne County, PA. STV began the project with a secondary source data review to identify potential civil and environmental permits and approvals that might be required. The firm conducted wetland delineations on all proposed access roads for pull point locations and staging areas. The team also provided all resource agency coordination and developed a permitting needs assessment document. STV then performed all civil design and environmental permitting services.

FIRM
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EDUCATION
BACHELOR OF SCIENCE, CIVIL ENGINEERING; UNIVERSITY OF PITTSBURGH

PROFESSIONAL ENGINEER
PENNSYLVANIA

CERTIFICATIONS
OSHA 40-HOUR HEALTH AND SAFETY TRAINING FOR WORK AT HAZARDOUS WASTE SITES

TRAINING
OIL AND GAS INDUSTRY TRAINING; PENNSYLVANIA DEPARTMENT OF ENVIRONMENTAL PROTECTION (PADEP)

E&S MANUAL TRAINING; PADEP

COMPUTER SKILLS
AUTOCAD, CIVIL 3D, SURVCADD, HYDRAFLOW, HYDROGRAPHS, STORMSEWERS, HEC-RAS, HEC-HMS, WIN-TR20, AND AUTOTURN

Samuel Gilbert, PE

CIVIL ENGINEER

PPL Lock Haven Switchyard - Project Engineer

Leading the site design and permitting for the construction of an electrical switchyard in Lock Haven, PA. Mr. Gilbert performed stormwater management, storm drainage, and stream capacity calculations. Because of wetland and stream impacts on the site, PPL was required to mitigate the impacts at an offsite location. Mr. Gilbert led the civil engineering design for the offsite mitigation, which included the creation of two wetland areas and stream bank improvements. During the planning phase, he provided extensive coordination between county, state, and federal regulatory agencies. Prior to final design, Mr. Gilbert was involved in the conceptual design and was the lead civil engineer during the feasibility study.

PPL Lycoming - Lock Haven No. 1 and No. 2 Transmission Line Rebuild - Project Engineer

Designing E&SC plans for a 12-mile, 69-kV transmission line rebuild between Lycoming and Lock Haven, PA. Mr. Gilbert is responsible for designing all access roads and work pads, including associated grading. He is also obtaining necessary permitting including National Pollutant Discharge Elimination System, a U.S. Army Corps of Engineers joint permit, and all required Pennsylvania Department of Transportation highway occupancy permits for the proposed structures and driveways.

Colonial Pipeline Company Lee Hall Reservoir Relocation - Project Engineer

Completed issued for bid plans, documents, and specifications for the relocation of a 10-inch petroleum products pipeline in Newport News, VA. Mr. Gilbert presented the project to bidders at the pre-bid meeting and addressed requests for information. He also incorporated all project and construction documents into a project closure book for Colonial Pipeline's official corporate records

Linde Evraz Oxygen and Nitrogen Pipelines - Civil Engineering Specialist

Provided civil engineering for the installation of a 6-inch oxygen and 6-inch nitrogen pipeline between the Linde plant and the Evraz Claymont steel mill, in New Castle County, DE. Mr. Gilbert coordinated with the New Castle County Department of Land Use to obtain a permit for construction within the floodplain and worked with Amtrak to construct the pipelines within the railroad right-of-way. Mr. Gilbert was also involved in coordination efforts between the external utilities and the subsurface utility engineer, to determine the most favorable route.

PPL Hershey Reese 138/69-kV Tie Line - Civil Engineering Specialist

Designed E&SC plans for PPL electricity poles statewide as part of the North American Electric Reliability Corporation (NERC) compliance program in Pennsylvania for PPL. The utility retained the firm to address height issues after surveys determined that the power lines were too close to the ground. Mr. Gilbert assisted in developing plans to grade the surrounding right-of-way to provide the proper clearance.

STANDARD E&S WORKSHEET # 22
PLAN PREPARER RECORD OF TRAINING AND EXPERIENCE IN EROSION AND SEDIMENT POLLUTION CONTROL METHODS AND TECHNIQUES

NAME OF PLAN PREPARER: Heath Kearney, P.E. (NJ)

FORMAL EDUCATION:

Name of College or Technical Institute: Norwich University Military College of Vermont // Drexel University

Curriculum or Program: Civil Engineering // Finance

Dates of Attendance: **From:** 08/1997 // 08/2010 **To:** 12/2001 // 05/2014

Degree Received Bachelor of Science // Master of Business Administration

OTHER TRAINING:

Name of Training:	Oil and Natural Gas Training	Stormwater BMP Manual Training
Presented By:	PADEP	PADEP
Date:	10/2012	03/2007

EMPLOYMENT HISTORY:

Current Employer: STV Energy Services, Inc.

Telephone: 610-385-8568

Former Employer: STV Incorporated

Telephone: 610-385-8200

RECENT E&S PLANS PREPARED:

Name of Project:	SXL-PPP/OPP Oversight	SXL-Allegheny Access	Brunner Island Gas Co.-Firing
County:	Delaware County	Lawrence & Beaver Counties	York County
Municipality:	Borough of Marcus Hook	Darlington, S. Beaver, Chippewa and Brighton Townships	East Manchester Township
Permit Number:	Pending	OG0413003	ESG0013315002
Approving Agency:	PADEP	PADEP	YCCD

Heath Kearney, PE

CIVIL/PIPELINE LEAD ENGINEER

Mr. Kearney is a civil and pipeline lead engineer with more than 14 years of experience in pipeline design, site development, stormwater management, and project management. He has worked on a wide range of natural gas and petroleum pipeline, site contamination, and sediment control projects. Mr. Kearney has calculated and analyzed pipeline stress from data provided, and has developed erosion and sediment control measures and the associated narratives for permitting agencies. He frequently conducts research and communicates with multiple agencies to facilitate the permitting process. Mr. Kearney also oversees multiple short- and long-range horizontal directional drills (HDD) through various types of terrain, including streams, rivers, wetlands, parks, railroad tracks, and shipyards. His prior experience as a combat leader, a chief company logistical officer, and assistant operations officer in the U.S. Army, for which he received commendations, augments his skills in adeptly managing and deploying heavy equipment and personnel.

FIRM
STV

EDUCATION
MASTER OF BUSINESS ADMINISTRATION, FINANCE; DREXEL UNIVERSITY

BACHELOR OF SCIENCE, CIVIL ENGINEERING; NORWICH UNIVERSITY MILITARY COLLEGE OF VERMONT

PROFESSIONAL ENGINEER
NEW JERSEY

TRAINING
TRANSMISSION PIPELINE DESIGN WORKSHOP; SOUTHERN GAS ASSOCIATION

PENNSYLVANIA DEPARTMENT OF ENVIRONMENTAL PROTECTION STORMWATER BMP MANUAL TRAINING SESSION; DELAWARE AND CHESTER COUNTY CONSERVATION DISTRICT

OSHA 40-HOUR HAZWOPER

RECIPROCAL COURSE 21 BASIC PLUS; DELAWARE VALLEY SAFETY COUNCIL

Project Experience

PBF PRC Delaware River Natural Gas Pipeline - Project Engineer

Designing the replacement and relocation of an 8-inch natural gas pipeline supplying the Paulsboro Refining Co.; the pipeline extends from Tinicum Township, PA, and crosses the Delaware River to PBF Energy's Paulsboro, NJ, refinery. It will be replaced with a 24-inch pipeline, and will be relocated from an existing meter pad across the Delaware River to the Paulsboro Refining Company's property. The total relocation is 3.5 miles and the intercept horizontal directional drill (HDD) is approximately 8,000 lf.

Mears Noresco UGI 12-inch Susquehanna Crossing - Project Manager

Coordinated the 4,100-foot-long directional drill of a 12-inch natural gas pipeline crossing the Susquehanna River in Harrisburg, PA. Mr. Kearney provided oversight for permitting, including National Pollutant Discharge Elimination System (NPDES), Pennsylvania Department of Transportation (PennDOT), Norfolk Southern Railroad, Amtrak, and the Pennsylvania Department of Environmental Protection (PADEP) GP-5 approvals. During installation, it was discovered that 40 feet of casing that was used to facilitate the drill broke off and remained in the hole 30 feet belowground. Mr. Kearney then led the permitting effort to excavate 30 feet below a PennDOT state highway to remove the casing and prepare a major modification to the NPDES permit.

Sunoco Logistics Allegheny Access - Lead Pipeline Engineer

Managed pipeline engineering services for the design and construction management of a Sunoco Logistics pipeline in Ohio and Pennsylvania. Because of the rapid timeline for permitting, the project was executed and broken into roughly two segments that proceed on a parallel path. Segment 1 runs for 86 miles, from Inland Fostoria West, OH, to Tiffin, OH, and then on to Easton, OH. Segment 2 runs for 74 miles, from Mogadore, OH, to Vanport Junction, PA. Mr. Kearney led a team of 10 engineers in the field, approved contractor HDD execution plans, and performed HDD oversight for 65 drills. He ialso reviewed and provided recommendations for RFIs and field adjustments. During the design phase, Mr. Kearney coordinated, supervised, and approved the complex designs between 6 of the firm's offices, including 20 CAD operators, 18 engineers, 18 surveyors, and 11 environmental scientists. He also led the effort for the pipeline's land development approval in South Beaver Township, PA, and the approval for using First Energy's ROW by attending multiple meetings and negotiations.

Heath Kearney, PE

CIVIL/PIPELINE LEAD ENGINEER

Sunoco Logistics/NJTA New Jersey Turnpike Interchanges 6 to 9 Widening Program - Project Engineer

Supported the project engineer in the design and installation of 3.25 miles of 16-inch high-pressure high pressure petroleum pipeline for the proposed pipeline relocation along the New Jersey Turnpike for Sunoco Logistics and the New Jersey Turnpike Authority (NJTA). Mr. Kearney assisted the design of erosion and sedimentation control measures and in the generation of an erosion and sedimentation/storm water pollution prevention plan narrative, specifically during the multiple design revisions to obtain approval for numerous large construction staging areas. Mr. Kearney also performed both off-site and on-site HDD oversight during the construction phase. The project consists of widening the New Jersey Turnpike from interchanges 6 to 9 and covers the Townships of Mansfield, Bordentown, and Chesterfield in Burlington County as well as the Township of Hamilton in Mercer County, NJ.

Omega Partners New Transfer Pipelines and Dock Connections - Lead Project Engineer

Led engineering services for a crude expansion project that consisted of designing multiple pipelines to connect Omega Partners' terminal in Hartford, IL, to a barge loading dock on the Mississippi River. The connected pipelines, which were referred to as the West Pipelines, included three 16-inch crude oil pipelines and one 4-inch natural gas pipeline. Additional pipelines were referred to as the East and North Pipelines, and included one 6-inch natural gas line, one 30-inch crude oil pipeline, one 20-inch crude oil pipeline, and a 4-inch PVC conduit line. Mr. Kearney also led the effort to obtain permits from all federal, state, and local authorities, including approvals from the U.S. Army Corps of Engineers for crossing a Mississippi River levee via HDD.

Sunoco Logistics US 24 (Telegraph Road) Pipeline Relocation - Project Engineer

Designed the fast-track, 1.5-mile relocation of a 6-inch pipeline along the shoulder of US 24 (Telegraph Road) north of Monroe, MI. The full-depth pavement installation of an expanded shoulder on U.S. 24 impacted the exiting Sunoco pipeline, requiring its relocation for the duration of the project. Mr. Kearney designed the relocation as three HDDs ranging from 800 to 1,400 feet with connecting trench-installed pipeline to avoid conflicts.

Buckeye Pipeline Kleen Energy Ultra Low Sulfur Diesel Pipeline - Project Engineer

Responsible for the preliminary and final engineering and permitting support services associated with the installation of 4.6 miles of 12-inch high-pressure ultra low sulfur diesel pipeline from Buckeye's Middletown Junction, through the City of Middletown, CT, to the Kleen Energy Power Generating Facility. He then coordinated design review permit efforts with the City of Middletown Planning and Zoning Commission, City of Middletown Inland Wetland and Waterways Commission, City of Middletown Economic Development Commission, Providence & Worchester Railroad, Connecticut River Costal Conservation District, and Connecticut Department of Environmental Protection. Multiple methods of installation were used in this project, including three HDDs of wetlands, streams, roadways, and longitudinal occupancy of a railroad corridor, as well as miles of standard trench installation through roadways and cross country. During the construction phase, Mr. Kearney oversaw all four HDD installations, including three of the four drills using gyroscopic steering technology.

STANDARD E&S WORKSHEET # 22
PLAN PREPARER RECORD OF TRAINING AND EXPERIENCE IN EROSION AND SEDIMENT POLLUTION CONTROL METHODS AND TECHNIQUES

NAME OF PLAN PREPARER: Robert J. Lindgren, P.E.

FORMAL EDUCATION:

Name of College or Technical Institute: Virginia Military Institute

Curriculum or Program: Civil/Structural Engineering

Dates of Attendance: **From:** 08/1981 **To:** 05/1985

Degree Received Bachelor of Science

OTHER TRAINING:

Name of Training:	ESCGP-2	
Presented By:	PADEP	
Date:	5/23/2013	

EMPLOYMENT HISTORY:

Current Employer: STV Energy Services, Inc.

Telephone: 610-385-8435

Former Employer: STV Incorporated

Telephone: 610-385-8200

RECENT E&S PLANS PREPARED:

Name of Project:	SXL-PPP/OPP Oversight	SXL-Allegheny Access	SXL-Glen Riddle
County:	Delaware County	Lawrence & Beaver Counties	Delaware County
Municipality:	Borough of Marcus Hook	Darlington, S. Beaver, Chippewa and Brighton Townships	Tinicum Township
Permit Number:	Pending	OG0413003	
Approving Agency:	PADEP	PADEP	Delaware County SCD

Robert Lindgren, PE
QUALITY ASSURANCE

Mr. Lindgren is a senior civil and structural engineer with experience in all aspects of structural analysis, testing, and design, as well as site planning, civil design and construction project management. His civil engineering expertise includes topographic surveys, stormwater drainage and detention pond design, pavement design, environmental remediation, permit application preparation, underground storage tank removals/replacements, site grading, and geometric layout of access roadways and parking lots. His structural design background consists of masonry, steel, concrete, and timber structures. Mr. Lindgren has a top secret U.S. Navy clearance.

FIRM
STV

EDUCATION
BACHELOR OF SCIENCE, CIVIL/STRUCTURAL ENGINEERING; VIRGINIA MILITARY INSTITUTE

PROFESSIONAL ENGINEER
PENNSYLVANIA

Project Experience

Sunoco Logistics Pipeline Allegheny Access Project - QA Reviewer

Providing quality assurance (QA) review for the development of a front end engineering and design study for the installation of three pipeline segments within existing rights-of-way through Ohio and Western Pennsylvania. Totaling 160 miles, the pipelines will enable Sunoco to enhance product deliveries throughout Ohio and Western Pennsylvania.

Sunoco Logistics Pipeline SEPTA/Wawa - QA Reviewer

Provided quality assurance (QA) review for the feasibility study and conceptual cost estimate for the half-mile relocation of Sunoco Logistics' existing 8-inch pipeline in Delaware County, PA. The pipeline relocation was necessary to avoid property conflicts with commercial retailer Wawa Dairy Farms and to allow SEPTA to build a new commuter train station.

PPL Lock Haven Switchyard Replacement - QA Reviewer

Provided quality assurance (QA) review for a feasibility study to provide PPL with a preliminary assessment of the alternatives for the replacement of the switchyard in Lock Haven, PA, to a location south of the existing switchyard on existing PPL property. STV was responsible for all civil and land development, environmental, and project management services. The new switchyard design would conform to 138-kV standards (operated at 69 kV) and would be a PPL standard breaker-and-a-half open air configuration, capable of terminating eight 69-kV transmission lines.

PPL Hershey 69-kV Underground Transmission Line - QA Reviewer

Provided quality assurance (QA) review of a feasibility study regarding routing a 69-kV underground transmission line through Hershey, PA. Installation of the underground transmission line was required because of local restrictions on overhead transmission lines through downtown Hershey. The study evaluated several route options with respect to constructability, avoidance of existing and proposed utilities, and identification of environmental and cultural resource concerns for the 2-mile transmission line, which was required to improve reliability of an electrical substation serving in excess of 4,000 electric service customers.

Sunoco Logistics Pipeline Corson's Lane Sinkhole Pipeline Relocation - QA Reviewer

Provided quality assurance (QA) review for the relocation of a 14-inch pipeline in Montgomery County, PA. The relocation was necessary as a result of a sinkhole that had undermined the pipeline. The project involved an extensive geotechnical investigation, including geophysical and subsurface investigations to determine a viable relocation route.

Robert Lindgren, PE

QUALITY ASSURANCE

PPL Susquehanna-Harwood Reconductor Project - Project Manager

Coordinated the replacement of all conductor cable, conductor splices, and dead-end assemblies along the length of the PPL Susquehanna-Harwood 230-kV line corridor. The transmission line corridor extends from the Susquehanna switchyard, located on Ruckle Hill Road in Wapwallopen, PA, for approximately 14 miles to the Harwood substation, located on Commerce Drive in Harwood, PA. The project also included the rehabilitation and replacement of various structures along the line.

PPL Lycoming-Lock Haven No. 1 and No. 2 69-kV Rebuild - Assistant Project Manager

Coordinating a feasibility study and permitting needs analysis for the Lycoming-Lock Haven No. 1 and No. 2 rebuild project, which involves the replacement of approximately 335 structures and a conductor from Jersey Shore to Castanea, PA. The project corridor extends approximately 12 miles from PPL's Jersey Shore switchyard to the Lock Haven substation in Castanea.

PPL NERC Ground-to-Conductor Clearance Program - Project Manager

Coordinated the site visit planning, site investigations, and field review report generation for more than 175 ground-to-clearance violations requiring investigation for remediation in accordance with new North American Electric Reliability Corporation (NERC) standards to improve reliability of the electrical grid.

STANDARD E&S WORKSHEET # 22
PLAN PREPARER RECORD OF TRAINING AND EXPERIENCE IN EROSION AND SEDIMENT POLLUTION CONTROL METHODS AND TECHNIQUES

NAME OF PLAN PREPARER: Henry D. Wills, P.E., S.I.T.

FORMAL EDUCATION:

Name of College or Technical Institute: Pennsylvania State University

Curriculum or Program: Civil Engineering

Dates of Attendance: **From:** 08/2003 **To:** 05/2007

Degree Received Bachelor of Science

OTHER TRAINING:

Name of Training:	NPDES & PCSM Permitting	Oil and Gas Seminar	Chapter 102 Regulations
Presented By:	SEPRCDC	PADEP	PADEP
Date:	2014	2012 and 2013	2011

EMPLOYMENT HISTORY:

Current Employer: STV Energy Services, Inc.

Telephone: 610-385-8390

Former Employer: SSM Group, Inc.

Telephone: 610-621-2000

RECENT E&S PLANS PREPARED:

Name of Project:	SXL-PPP/OPP Oversight	PNGPC-Del. River Crossing	Brunner Island Gas Co.-Firing Project
County:	Delaware County	Delaware County	York County
Municipality:	Borough of Marcus Hook	Tinicum Township	East Manchester Township
Permit Number:	Pending	ESG00045160001	ESG0013315002
Approving Agency:	PADEP	DCCD	YCCD

Henry Wills, PE

CIVIL ENGINEER

Mr. Wills is a civil engineer with experience in the energy and pipeline industries, municipal engineering, and land development. He is skilled at translating preliminary draft designs to field conditions through on-site inspections to determine practical design solutions. With a strong background in stormwater management, erosion and sediment control (E&SC), and utility work, Mr. Wills specializes in utility test tools and horizontal directional drill (HDD) oversight, as well as software programs such as VTPSUHM, Hydraflow, and HEC-RAS. He is also experienced with obtaining environmental and engineering permits from various entities, including the Pennsylvania Department of Transportation (PennDOT), the Pennsylvania Department of Environmental Protection (PADEP), and county conservation districts.

FIRM
STV

EDUCATION
BACHELOR OF SCIENCE, CIVIL ENGINEERING; PENN STATE UNIVERSITY

PROFESSIONAL REGISTRATIONS
PROFESSIONAL ENGINEER, PA

SURVEYOR IN TRAINING, PA

TRAINING/ CERTIFICATIONS
NPDES & PCSM PERMITTING WORKSHOP; SOUTHEASTERN PENNSYLVANIA RESOURCE CONSERVATION & DEVELOPMENT COUNCIL

OIL & GAS SEMINAR; PENNSYLVANIA DEPARTMENT OF ENVIRONMENTAL PROTECTION

CHAPTER 102 REGULATIONS; PENNSYLVANIA DEPARTMENT OF ENVIRONMENTAL PROTECTION (PADEP)

OSHA 40-HOUR HAZWOPER CERTIFICATION

Project Experience

PBF Energy Delaware River Natural Gas Pipeline Replacement - Project Engineer

Providing civil engineering services for the replacement and relocation of an 8-inch natural gas pipeline extending from Tinicum Township, PA, and crossing the Delaware River to PBF Energy's Paulsboro, NJ, refinery. The pipeline will be replaced with a 24-inch pipeline starting at an existing meter junction, going 3,500 lf southwest to a point where it will cross the Delaware River and exit on the Paulsboro Refining Company's property. From there, the pipe will neck down to 12 inches and traverse 1,500 lf to an existing manifold. The existing meter junction is located northwest of the Philadelphia International Airport (PHL) in Tinicum Township. The pipeline must be relocated to accommodate the expanding of the navigation channel by the U.S. Army Corps of Engineers. Mr. Wills assisted with a feasibility study and natural gas pipeline design from the Paulsboro refinery to a 16-inch Spectra transmission line adjacent to PHL. The design includes a 24-inch pipe route, access, temporary workspace, HDD layout, cost estimates, and AA for relocating the pipeline. He also assisted the preparation of RFPs for subsurface utility engineering services, as well as the HDD contractor design consulting, and early bid for HDD construction. Mr. Wills is currently assisting with completion of the Resource Report for submission to the Federal Energy Regulatory Commission (FERC). Additional permitting includes Conrail occupation, an ESCGP-2 from the Delaware County Conservation District, an erosion and sediment submission to the Gloucester County Soil Conservation District, and a New Jersey DEP permit, as well as additional permits from local municipalities.

Energy Transfer Partners (formerly Regency Energy Partners) Midstream Pipeline Projects - Project Engineer

Completed plans and permitting for various midstream pipelines in Lycoming, Tioga, and Wyoming counties, PA. Mr. Wills created preliminary alignment options by conducting field surveys and taking notes and photographs to determine constructability methods, such as HDD, auger bores, and trenching. He also assisted in preparing pipe stress calculations and class location studies, and provided support for stakeouts, as-built surveys, and environmental studies.

Sunoco Logistics Ohio and Pennsylvania Pipeline RUMAs - Project Engineer

Assisting with the determination of construction haul routes and the creation of haul route plans and road use maintenance agreements (RUMAs) for a 350-mile Sunoco Logistics project that extends from Scio, OH, to Marcus Hook, PA. The agreements are obtained from local municipalities, PennDOT, the state, counties, and U.S. Army Corps of Engineers. Mr. Wills is researching ordinances and coordinating with municipalities. He is also attending meetings and conducting site visits to look for potential issues. In addition, Mr. Wills is assisting with the creation of a spreadsheet to track

Henry Wills, PE

CIVIL ENGINEER

local roads, state routes, posted weight limits, bridges, and structures that would impact routes, and he drives routes to document existing conditions.

PPL Brunner Island Gas Supply Pipeline - Project Engineer

Providing engineering and permitting services for the conversion of the Brunner Island Steam Electric Station to use natural gas in York County, PA. Supplying natural gas to Brunner Island requires construction of an 18-inch or 24-inch pipeline connecting to a Texas Eastern line approximately 3.5 miles from the island. Mr. Wills is completing pipe stress calculations and a class location study for the transmission line. He is also designing the HDD, erosion and sediment control, and the grading of the meter site. In addition, Mr. Wills coordinated with surveyors for the topographic survey and wrote the RFP for the subsurface utilities engineering investigation. He also provided permitting assistance and obtained railroad occupancy licenses from Norfolk Southern for HDD and auger bore pipeline crossings, highway occupancy permits from PennDOT, an ESCGP-2 permit from the York County Conservation District, and a Special Exception for a Public Utility Facility Use in an Agricultural Zoning District from East Manchester Township.

Glenn Springs Holdings Delaware River Outfall Replacement - Project Engineer

Providing plans and permitting services for the replacement of an outfall pipe and diffuser in the Delaware River in New Castle County, DE, for Glenn Springs Holdings, Inc. The outfall discharges some stormwater runoff and treated groundwater effluent. Mr. Wills is responsible for Standard Plan and Floodplain Permit application submissions to the New Castle County Department of Land Use. A new 8.6-inch pipe will be used to tie-in to an existing 10-inch pipe. Design considerations include trenched portions, surface lay, and an HDD option.

Colonial Pipeline Company Buckeye Perth Amboy Terminal Relocation - Project Engineer

Prepared plans and profiles for a pipeline relocation to satisfy requirements by Colonial Pipeline and Conrail for a proposed ladder track at the Buckeye Perth Amboy Terminal in Perth Amboy, NJ. Mr. Wills also conducted pipe stress calculations, prepared the submission to Conrail, and coordinated with surveyors and a geotechnical engineer.

Buckeye Partners LP One-Call Reviews - Junior Project Engineer

Assisted with the completion of various one-call reviews for potential conflicts with development projects in New York and Pennsylvania. Mr. Wills reviewed plans in accordance with Buckeye Partners' Right-of-Way Use Restrictions Specification. He also drafted a review memo and performed pipe stress calculations, as needed.

Buckeye Partners LP 124th Street Reconstruction - Junior Project Engineer

Provided engineering services for the relocation of an approximately 1.5-mile, 16-inch high pressure petroleum pipeline along 124th Street in New Berlin, WI. Mr. Wills estimated the number of test holes required and determined approximate locations. He also observed the utility locations, took notes and photographs, and coordinated information with the surveyor.

Construction Details

STANDARD E&S WORKSHEET # 22
PLAN PREPARER RECORD OF TRAINING AND EXPERIENCE IN EROSION AND SEDIMENT POLLUTION CONTROL METHODS AND TECHNIQUES

NAME OF PLAN PREPARER: Robert F. Simcik

FORMAL EDUCATION:

Name of College or Technical Institute: University of Pittsburgh

Curriculum or Program: Civil Engineering

Dates of Attendance: From: 1984 To: 1989

Degree Received: Bachelor of Science in Engineering
PA PE 050435E Feb 22, 2001

OTHER TRAINING:

Name of Training:	PA DEP 102 Training	WMCCD Engineers' Workshop
Presented By:	DEP Regional; Greensburg, PA	"Erosion Control & Stormwater Management / NPDES" Training
Date:	04/03/2014	3/18/16 (and years prior)

EMPLOYMENT HISTORY:

Current Employer: Tetra Tech

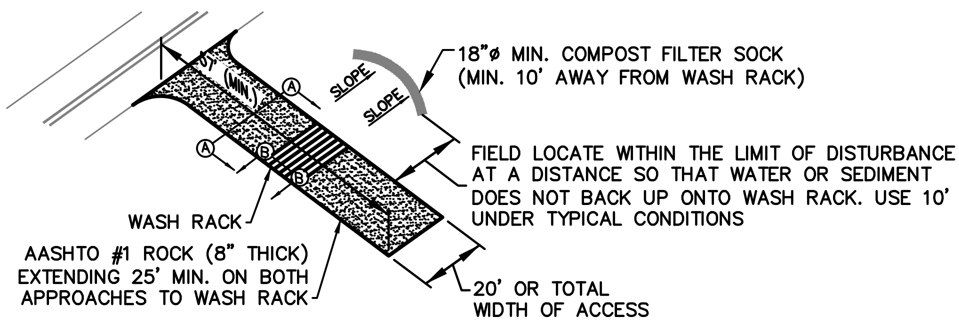
Telephone: (412) 921-8163
Last 25 years

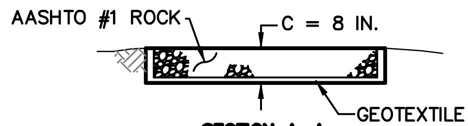
Former Employer: N/A

Telephone: -

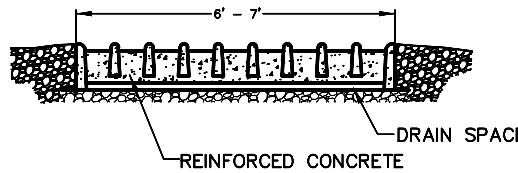
RECENT E&S PLANS PREPARED:

Name of Project:	Sunoco ME1	OPP (Ohio Pipeline)	Renick to Shields (Stonehenge Appl.)
County:	Allegheny, Washington and Westmoreland	OH and WV PA - Washington	Butler
Municipality:	multiple	Borough to Houston Borough Independence → Chartiers	Center, Oakland, and Clay
Permit Number:	ESG6513806	ESG0012515002	ESG16-019-0008
Approving Agency:	WMCCD / SWRO	WCCD	NWRO





SECTION A–A



SECTION B–B

NOTE:

REASONABLE METHODS WHICH ARE SANCTIONED BY THE PADEP AS ALTERNATIVES TO INSTALLATION OF TIRE WASH STATIONS ON PUBLIC ROAD ACCESS POINTS FOR GATHERING PIPELINE PROJECTS IN EV/HQ WATERSHEDS INCLUDE:

1. FOR PAVED SURFACE PUBLIC ROADS: USE OF A VACUUM TRUCK SWEEPER OR SWEEPER WITH A CATCH BIN ATTACHMENT.
2. FOR DIRT OR GRAVEL SURFACE PUBLIC ROADS: RIGOROUS MANUAL REMOVAL OF MUD/DIRT FROM VEHICLE/EQUIPMENT TIRES PRIOR TO EXITING CONSTRUCTION SITE, SUPPLEMENTED BY IMMEDIATE RECOVER, BY MANUAL OR MECHANICAL MEANS, OF SOIL WHICH MAY BECOME DISCHARGED ONTO PUBLIC ROADWAYS. DUST CONTROL AND/OR COMPACTION VIA ROLLING OF THE DIRT PUBLIC ROAD SURFACE WILL BE IMPLEMENTED AS NEEDED.

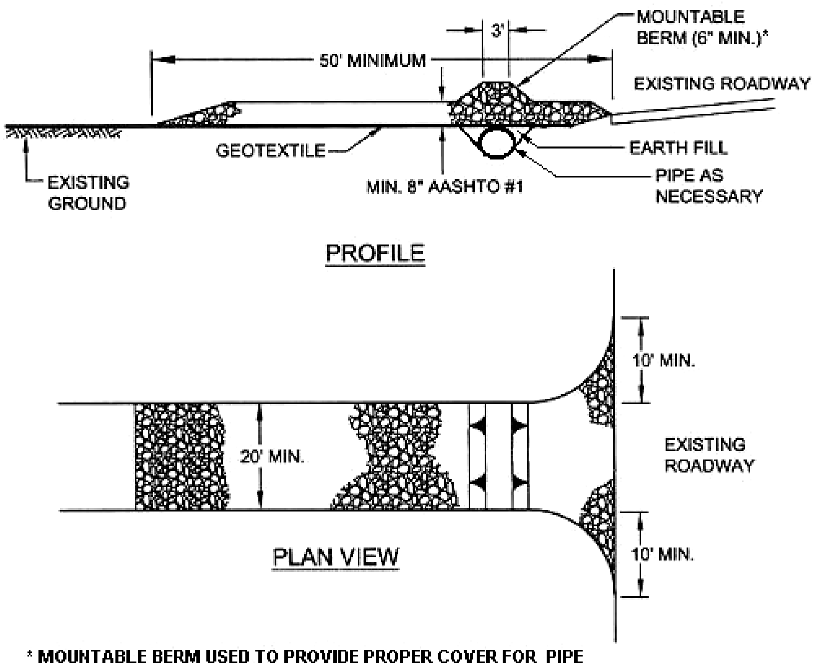
A PREDICATE FOR UTILIZING ALTERNATIVE 1 AND 2 ABOVE IS THAT THE ROCK PAD CONSTRUCTION ENTRANCE MUST BE EXTENDED TO A MINIMUM TOTAL LENGTH OF 100 FEET AND MUST BE CONSTANTLY MAINTAINED INCLUDING STRUCTURE THICKNESS TO INSURE ITS EFFECTIVENESS REMAINS INTACT AT ALL TIMES.

FREQUENCY OF MECHANICAL AND/OR MANUAL CONTROLS WILL BE DEPENDENT UPON CONSTRUCTION TRAFFIC INTENSITY, WEATHER AND SOIL MOISTURE CONDITIONS. AT A MINIMUM FOR PAVED ROADS – ANY DAY IN WHICH CONSTRUCTION TRAFFIC IS EXITING THE ROCK CONSTRUCTION ENTRANCE, THE VACUUM TRUCK SWEEPER OR SWEEPER WITH A CATCH BIN ATTACHMENT SHALL CLEAN THE ROADWAY AT THE END OF THE WORK DAY AND PRIOR TO ANY FORECASTED RAIN EVENT. THE REQUIREMENT IS TO NOT INTRODUCE SEDIMENT LOAD FROM CONSTRUCTION TRAFFIC ONTO PUBLIC ROAD SURFACES AND INTO ROAD DITCHES WHICH WILL FLOW INTO THE EV/HQ WATER RESOURCES WHICH ARE THE SUBJECT OF THE INCREASED PROTECTION MEASURES.

AASHTO #1 ROCK CONSTRUCTION ENTRANCE

NOT TO SCALE

STANDARD CONSTRUCTION DETAIL # 3-1
Rock Construction Entrance



Modified from Maryland DOE

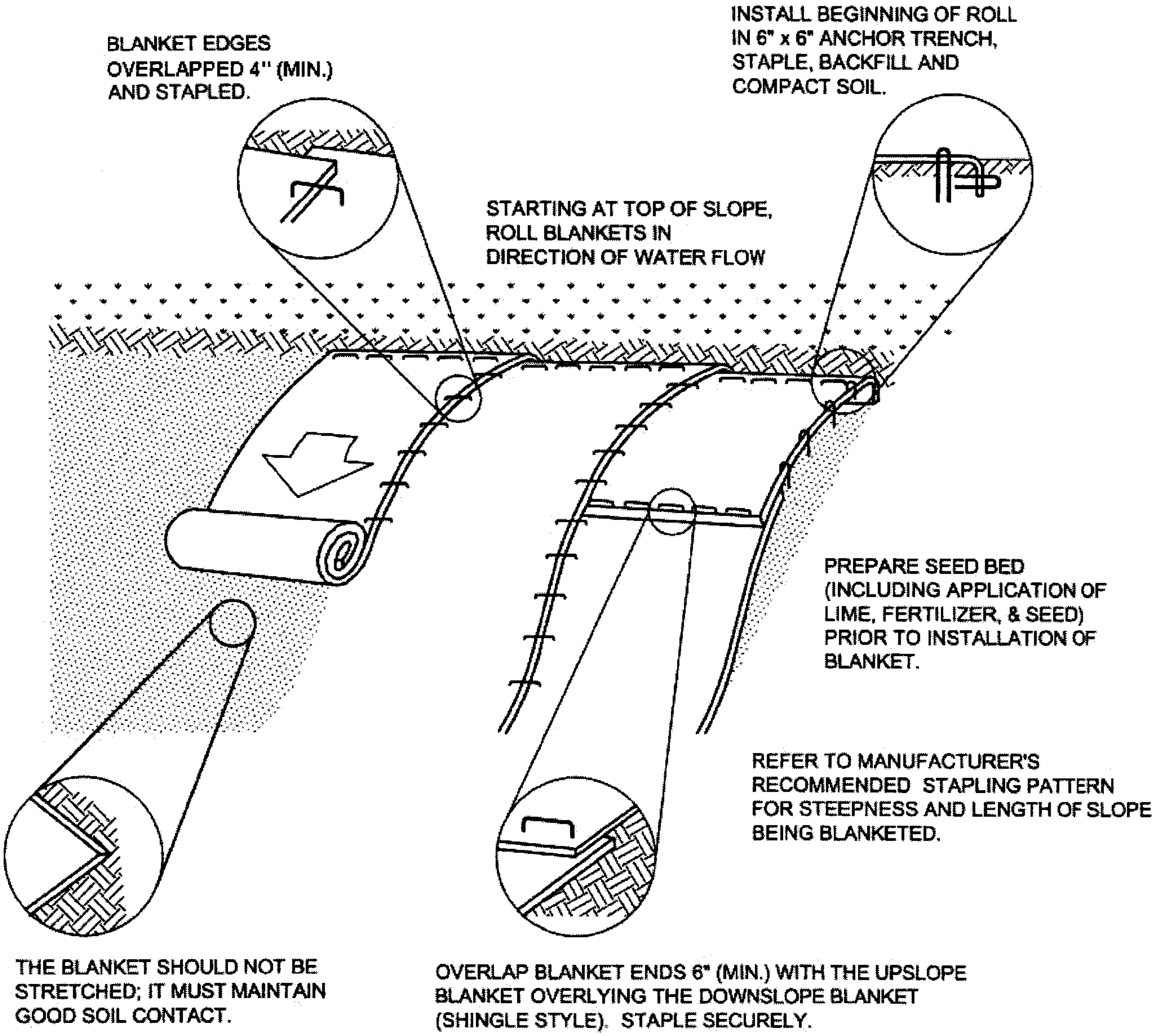
Remove topsoil prior to installation of rock construction entrance. Extend rock over full width of entrance.

Runoff shall be diverted from roadway to a suitable sediment removal BMP prior to entering rock construction entrance.

Mountable berm shall be installed wherever optional culvert pipe is used and proper pipe cover as specified by manufacturer is not otherwise provided. Pipe shall be sized appropriately for size of ditch being crossed.

MAINTENANCE: Rock construction entrance thickness shall be constantly maintained to the specified dimensions by adding rock. A stockpile shall be maintained on site for this purpose. All sediment deposited on paved roadways shall be removed and returned to the construction site immediately. If excessive amounts of sediment are being deposited on roadway, extend length of rock construction entrance by 50 foot increments until condition is alleviated or install wash rack. Washing the roadway or sweeping the deposits into roadway ditches, sewers, culverts, or other drainage courses is not acceptable.

STANDARD CONSTRUCTION DETAIL # 11-1
Erosion Control Blanket Installation



Source Unknown

Seed and soil amendments shall be applied according to the rates in the plan drawings prior to installing the blanket.

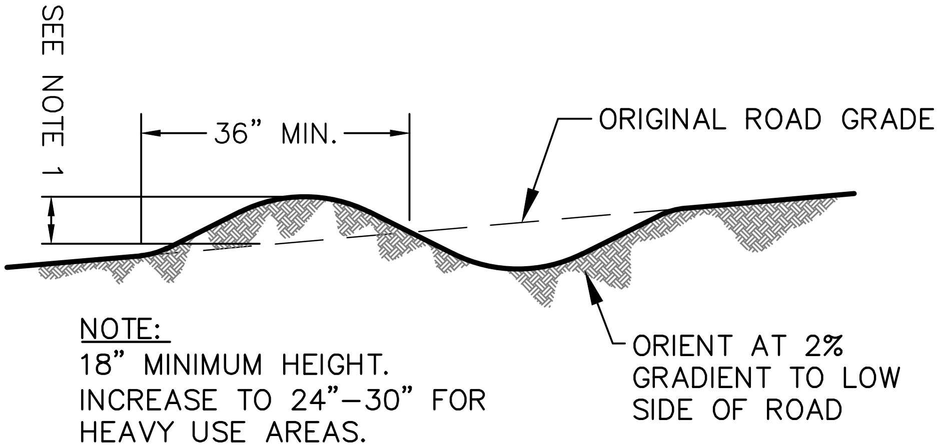
Provide anchor trench at toe of slope in similar fashion as at top of slope.

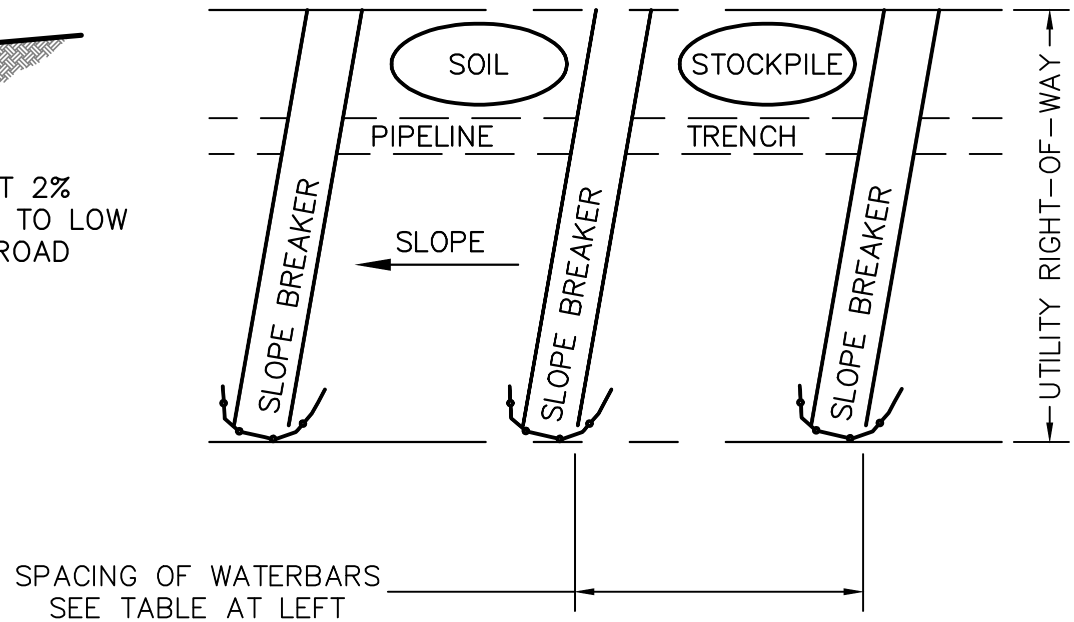
Slope surface shall be free of rocks, clods, sticks, and grass.

Blanket shall have good continuous contact with underlying soil throughout entire length. Lay blanket loosely and stake or staple to maintain direct contact with soil. Do not stretch blanket.

The blanket shall be stapled in accordance with the manufacturer's recommendations.

Blanketed areas shall be inspected weekly and after each runoff event until perennial vegetation is established to a minimum uniform 70% coverage throughout the blanketed area. Damaged or displaced blankets shall be restored or replaced within 4 calendar days.





MAXIMUM SPACING FOR WATERBAR'S	
% SLOPE	SPACING (FT)
<5	250
5–15	150
15–30	100
>30	50

NOTE:

WATERBARS SHALL DISCHARGE TO A STABLE AREA. WATERBARS SHALL BE INSPECTED WEEKLY (DAILY ON ACTIVE ROADS) AND AFTER EACH RUNOFF EVENT. DAMAGED OR ERODED WATERBARS SHALL BE RESTORED TO ORIGINAL DIMENSIONS WITHIN 24 HOURS OF INSPECTION. MAINTENANCE OF WATERBARS SHALL BE PROVIDED UNTIL ROADWAY, SKIDTRAIL, OR RIGHT OF WAY HAS ACHIEVED PERMANENT STABILIZATION.

WATERBAR DETAIL

NOT TO SCALE

COMPOST FILTER SOCK - **Sediment Removal Efficiency: HIGH. This device is an ABACT for HQ and EV watersheds.** Compost filter socks are a type of contained compost filter berm. They consist of a biodegradable or photodegradable mesh tube filled, typically using a pneumatic blower, with a coarse compost filter media that meets certain performance criteria (e.g. hydraulic flow through rate, total solids removal efficiency, total suspended solids removal efficiency, turbidity reduction, nutrient removal efficiency, metals removal efficiency, and motor oil removal efficiency).

York County Conservation District

Compost filter socks are flexible and can be filled in place or in some cases filled and moved into position. They are especially useful on steep slopes. Heavy vegetation should be removed prior to installing the sock. Compost socks can also be used on rocky slopes if sufficient preparation is made to ensure good contact of the sock with the underlying soil along its entire length. They may also be used on pavement as a perimeter control. Socks used in this manner range in diameter from 8” to 32”. **Note: The flat dimension of the sock should be at least 1.5 times the nominal diameter. Also, some settlement of the tube typically occurs after installation.** The nominal diameter of the tube is the dimension to be used for design purposes (i.e. Figure 4.2). Socks with diameters less than 12” should only be used for residential housing lots of ¼ acre or less that are tributary to a sediment basin or sediment trap.

As with other sediment barriers, filter socks should be placed parallel to contour with both ends of the sock extended upslope at a 45 degree angle to the rest of the sock to prevent end-arounds (Figure 4.1). Socks placed on earthen slopes should be anchored with stakes driven through the center of the sock (Standard Construction Detail #4-1) or immediately downslope of the sock at intervals recommended by the manufacturer. Where socks are placed on paved surfaces, concrete blocks should be used immediately downslope of the socks (at the same intervals recommended for the stakes) to help hold the sock in place.

The maximum slope length above a compost filter sock should not exceed those shown in Figure 4.2. **NOTE: Slope length is not addressed by use of multiple rows of compost socks.** The anticipated functional life of a biodegradable filter sock should be 6 months; for photodegradable socks it is 1 year. Some other types may last longer. Projects with disturbances anticipated to last longer than the functional life of a sock should plan to replace the socks periodically or use another type of BMP.

Upon stabilization of the tributary area, the filter sock may be left in place and vegetated or removed. In the latter case, the mesh is typically cut open and the mulch spread as a soil supplement. In either case, the stakes should be removed.

Filter socks using other fillers may be approved on a case-by-case basis if sufficient supporting information (including manufacturer's specs and independent test data) is provided. However, they might not qualify as ABACTs. Wherever compost socks are used, Table 4.1 should be placed on a detail sheet.

TABLE 4.1
Compost Sock Fabric Minimum Specifications

Material Type	3 mil HDPE	5 mil HDPE	5 mil HDPE	Multi-Filament Polypropylene (MFPP)	Heavy Duty Multi-Filament Polypropylene (HDMFPP)
Material Characteristics	Photo-degradable	Photo-degradable	Bio-degradable	Photo-degradable	Photo-degradable
Sock Diameters	12" 18"	12" 18" 24" 32"	12" 18" 24" 32"	12" 18" 24" 32"	12" 18" 24" 32"
Mesh Opening	3/8"	3/8"	3/8"	3/8"	1/8"
Tensile Strength		26 psi	26 psi	44 psi	202 psi
Ultraviolet Stability % Original Strength (ASTM G-155)	23% at 1000 hr.	23% at 1000 hr.		100% at 1000 hr.	100% at 1000 hr.
Minimum Functional Longevity	6 months	9 months	6 months	1 year	2 years
Two-ply systems					
Inner Containment Netting			**HDPE biaxial net** **Continuously wound** **Fusion-welded junctures** **3/4" X 3/4" Max. aperture size**		
Outer Filtration Mesh			**Composite Polypropylene Fabric (Woven layer and non-woven fleece mechanically fused via needle punch)** **3/16" Max. aperture size**		
Sock fabrics composed of burlap may be used on projects lasting 6 months or less.					

Filtrexx & JMD

Compost should be a well decomposed, weed-free organic matter derived from agriculture, food, stump grindings, and yard or wood/bark organic matter sources. The compost should be aerobically composted. The compost should possess no objectionable odors and should be reasonably free (<1%

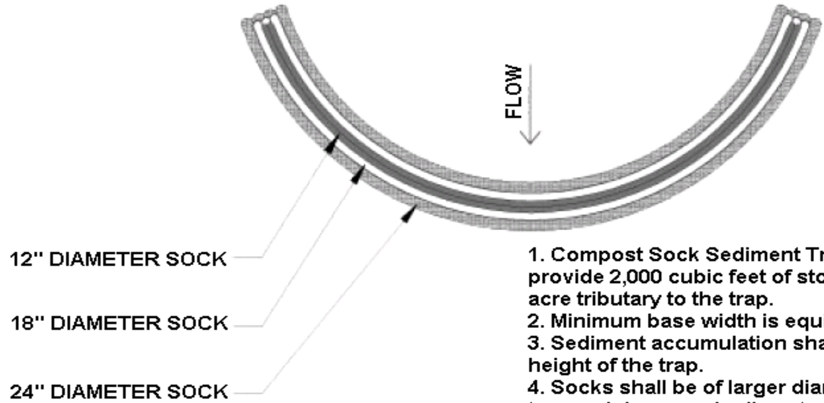
by dry weight) of man-made foreign matter. The compost product should not resemble the raw material from which it was derived. Wood and bark chips, ground construction debris or reprocessed wood products are not acceptable as the organic component of the mix.

The physical parameters of the compost should comply with the standards in Table 4.2. The standards contained in the PennDOT Publication 408 are an acceptable alternative.

TABLE 4.2
Compost Standards

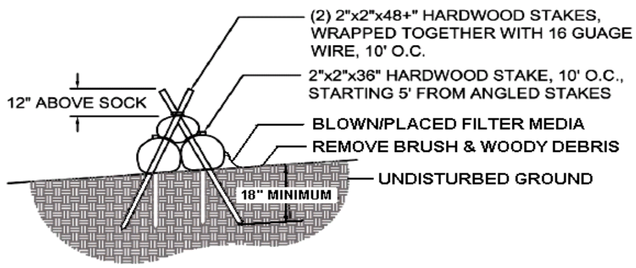
Organic Matter Content	**25% - 100%** (dry weight basis)
Organic Portion	Fibrous and elongated
pH	5.5 - **8.5**
Moisture Content	**30% - 60%**
Particle Size	**30% - 50**% pass through **3/8" sieve**
Soluble Salt Concentration	5.0 dS/m (mmhos/cm) Maximum

STANDARD CONSTRUCTION DETAIL #3-11
Compost Sock Sediment Trap



1. Compost Sock Sediment Trap shall be sized to provide 2,000 cubic feet of storage capacity for each acre tributary to the trap.
2. Minimum base width is equivalent to the height.
3. Sediment accumulation shall not exceed 1/3 the total height of the trap.
4. Socks shall be of larger diameter at the base of the trap and decrease in diameter for successive layers as indicated to the left.
5. Ends of the trap shall be a minimum of 1 foot higher in elevation than the mid-section, which shall be located at the point of discharge.

PLAN VIEW



Adapted from Filtrexx **STAKING DETAIL**

Sock material shall meet the standards of Table 4.1. Compost shall meet the standards of Table 4.2.

Compost sock sediment traps shall not exceed three socks in height and shall be stacked in pyramidal form as shown above. Minimum trap height is one 24" diameter sock. Additional storage may be provided by means of an excavated sump 12" deep extending 1 to 3 feet upslope of the socks along the lower side of the trap.

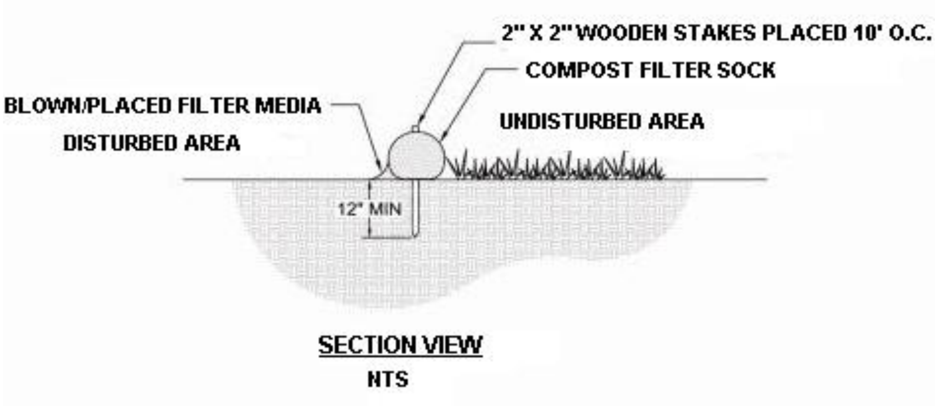
Compost sock sediment traps shall provide 2,000 cubic feet storage capacity with 12" freeboard for each tributary drainage acre. (See manufacturer for anticipated settlement.)

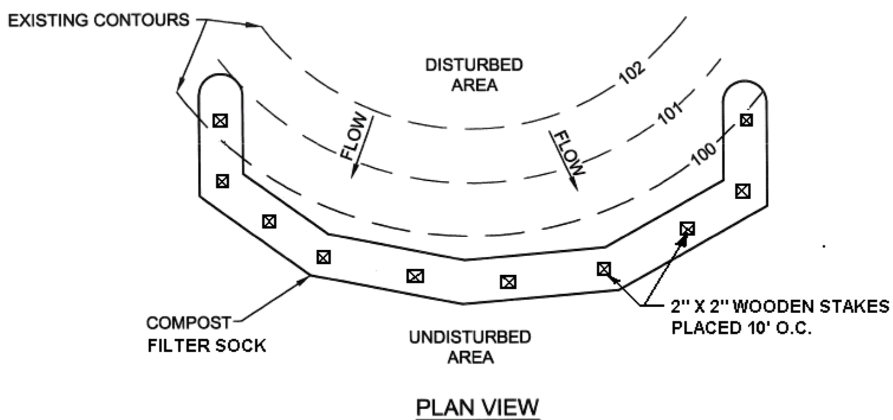
The maximum tributary drainage area is 5.0 acres. Since compost socks are "flow-through," no spillway is required.

Compost sock sediment traps shall be inspected weekly and after each runoff event. Sediment shall be removed when it reaches 1/3 the height of the socks.

Photodegradable and biodegradable socks shall not be used for more than 1 year.

STANDARD CONSTRUCTION DETAIL #4-1
COMPOST FILTER SOCK





Filtrexx **NTS**

Sock fabric shall meet standards of Table 4.1. Compost shall meet the standards of Table 4.2.

Compost filter sock shall be placed at existing level grade. Both ends of the sock shall be extended at least 8 feet up slope at 45 degrees to the main sock alignment (Figure 4.1). Maximum slope length above any sock shall not exceed that shown on Figure 4.2. Stakes may be installed immediately downslope of the sock if so specified by the manufacturer.

Traffic shall not be permitted to cross filter socks.

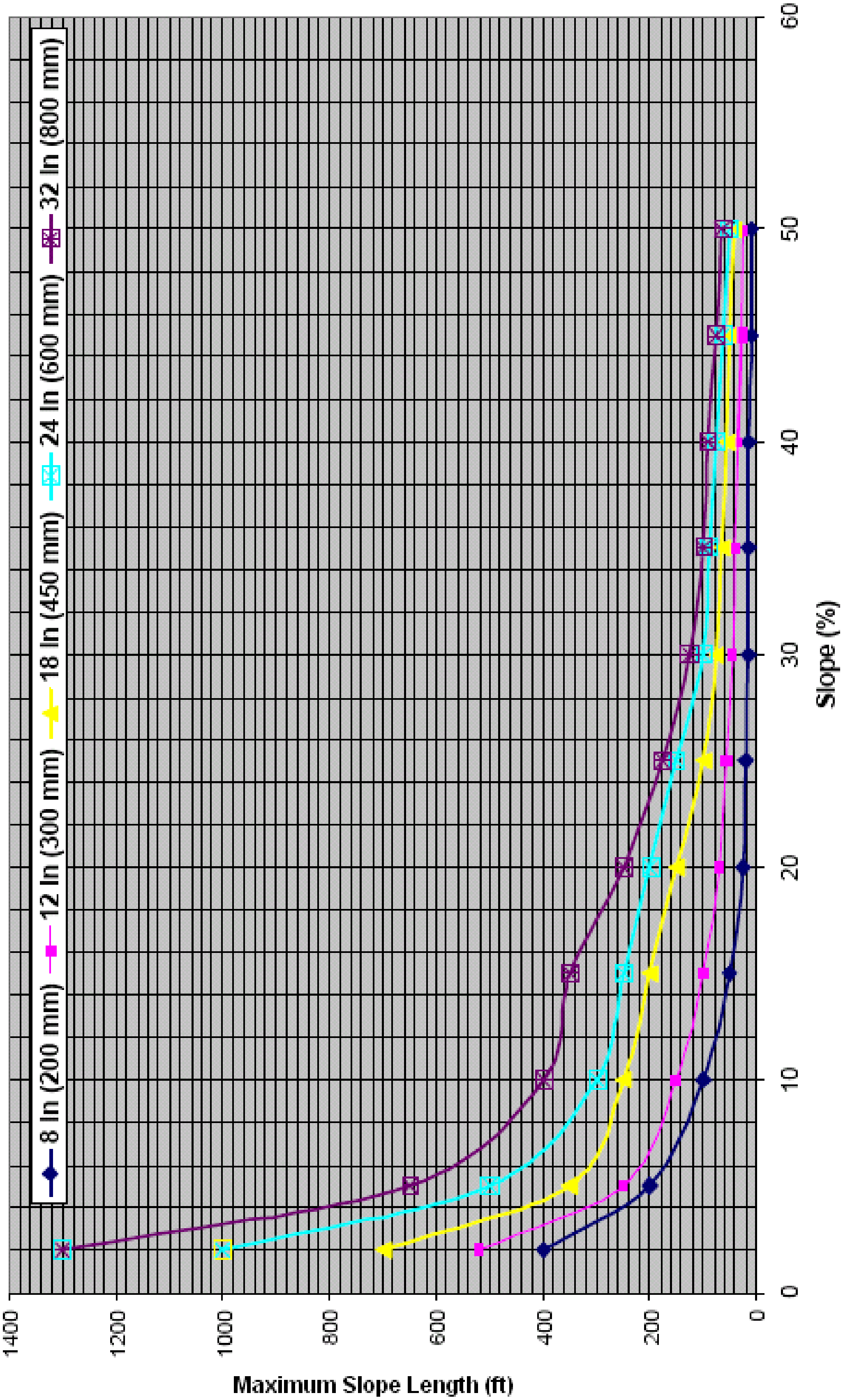
Accumulated sediment shall be removed when it reaches half the aboveground height of the sock and disposed in the manner described elsewhere in the plan.

Socks shall be inspected weekly and after each runoff event. Damaged socks shall be repaired according to manufacturer's specifications or replaced within 24 hours of inspection.

Biodegradable filter socks shall be replaced after 6 months; photodegradable socks after 1 year. Polypropylene socks shall be replaced according to manufacturer's recommendations.

Upon stabilization of the area tributary to the sock, stakes shall be removed. The sock may be left in place and vegetated or removed. In the latter case, the mesh shall be cut open and the mulch spread as a soil supplement.

FIGURE 4.2
MAXIMUM PERMISSIBLE SLOPE LENGTH ABOVE COMPOST FILTER SOCKS

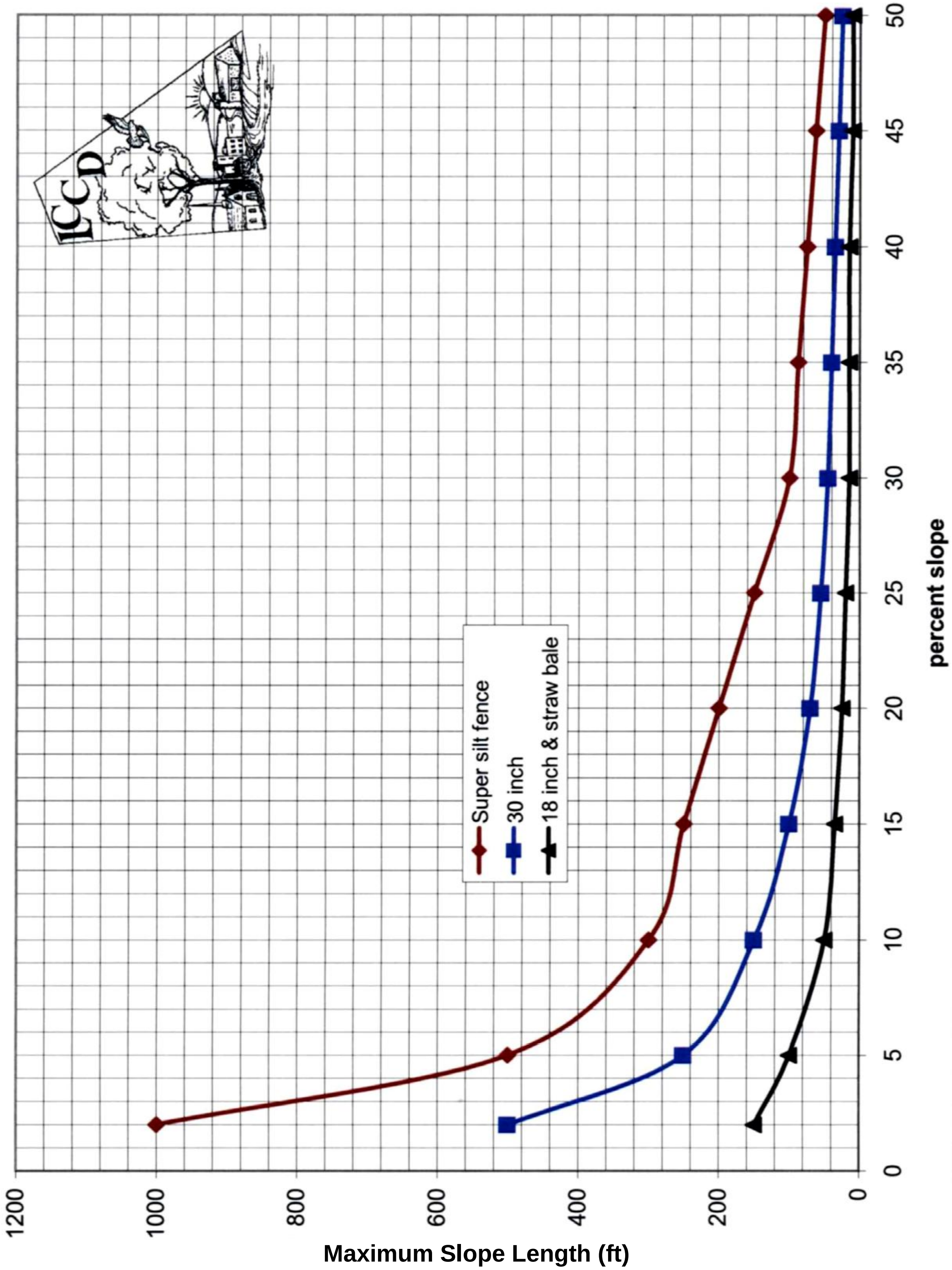


NOTE: 8" diameter socks should only be used to control small (≤ ¼ acre) disturbed areas on individual house lots).

Adapted from Filtrexx

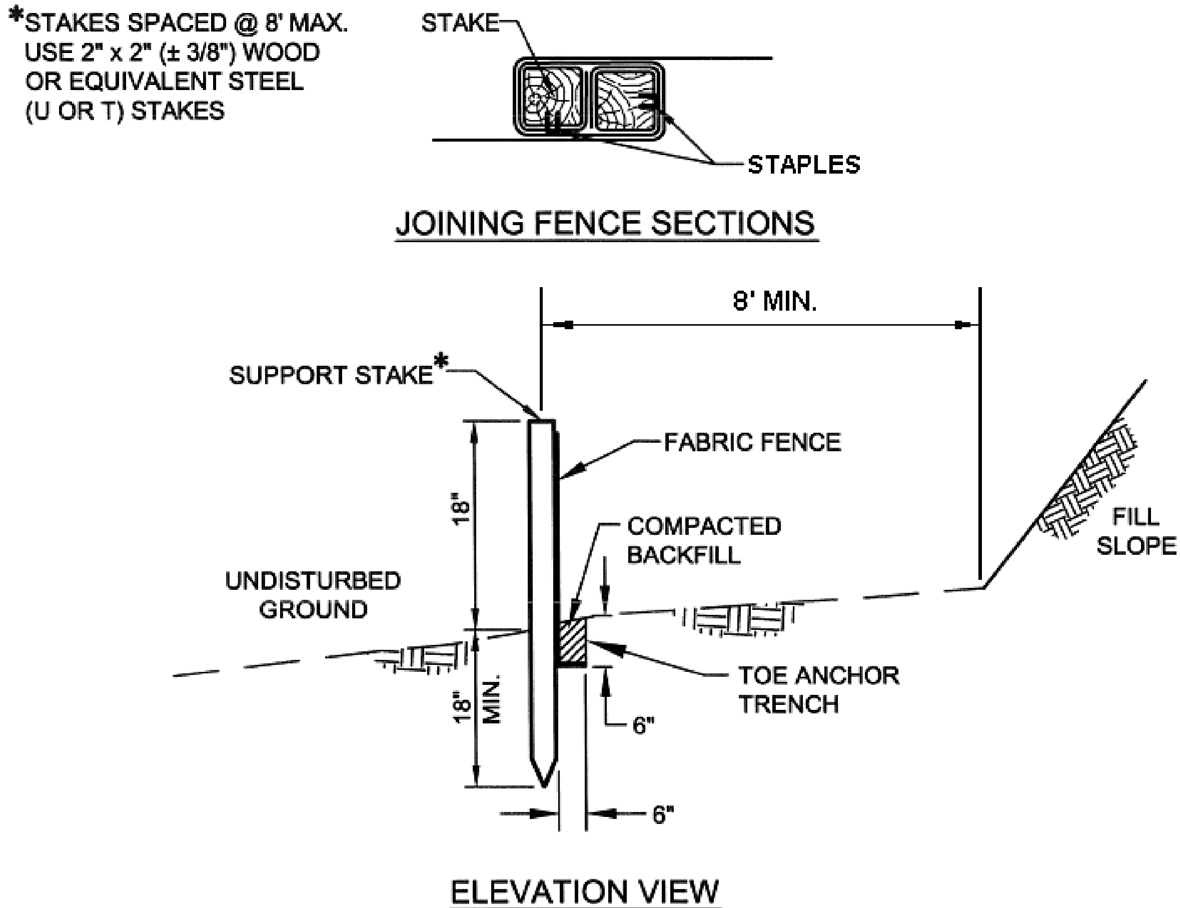
FIGURE 4.3

Maximum Permissible Slope Length above Silt Fence and Straw Bale Barriers



Lebanon County Conservation District

STANDARD CONSTRUCTION DETAIL # 4-7
Standard Silt Fence (18" High)



PA DEP

Fabric shall have the minimum properties as shown in Table 4.3.

Fabric width shall be 30" minimum. Stakes shall be hardwood or equivalent steel (U or T) stakes.

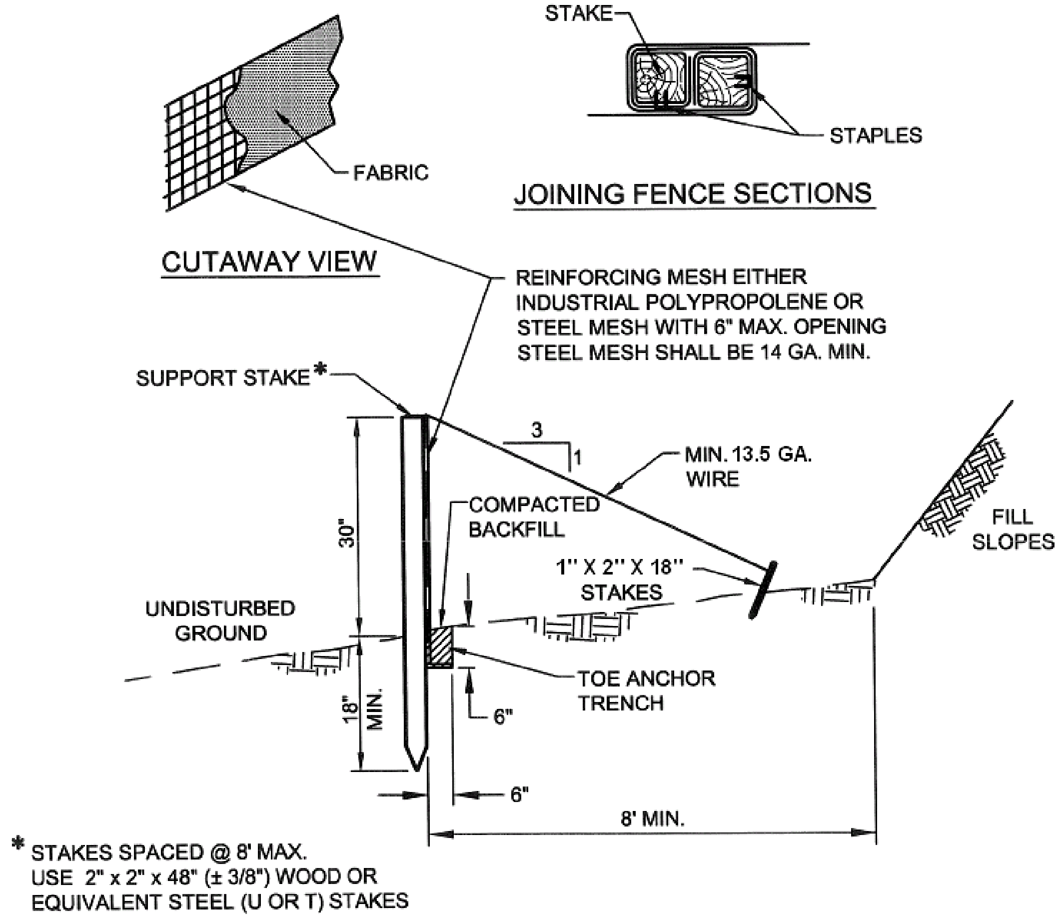
Silt fence shall be placed at level existing grade. Both ends of the fence shall be extended at least 8 feet up slope at 45 degrees to the main fence alignment (see Figure 4.1).

Sediment shall be removed when accumulations reach half the aboveground height of the fence.

Any section of silt fence which has been undermined or topped shall be immediately replaced with a rock filter outlet (Standard Construction Detail # 4-6).

Fence shall be removed and properly disposed of when tributary area is permanently stabilized.

STANDARD CONSTRUCTION DETAIL # 4-8
Reinforced Silt Fence (30" High)



PA DEP

Fabric shall have the minimum properties as shown in Table 4.3.

Fabric width shall be 42" minimum. Stakes shall be hardwood or equivalent steel (U or T) stakes. An 18" support stake shall be driven 12" minimum into undisturbed ground.

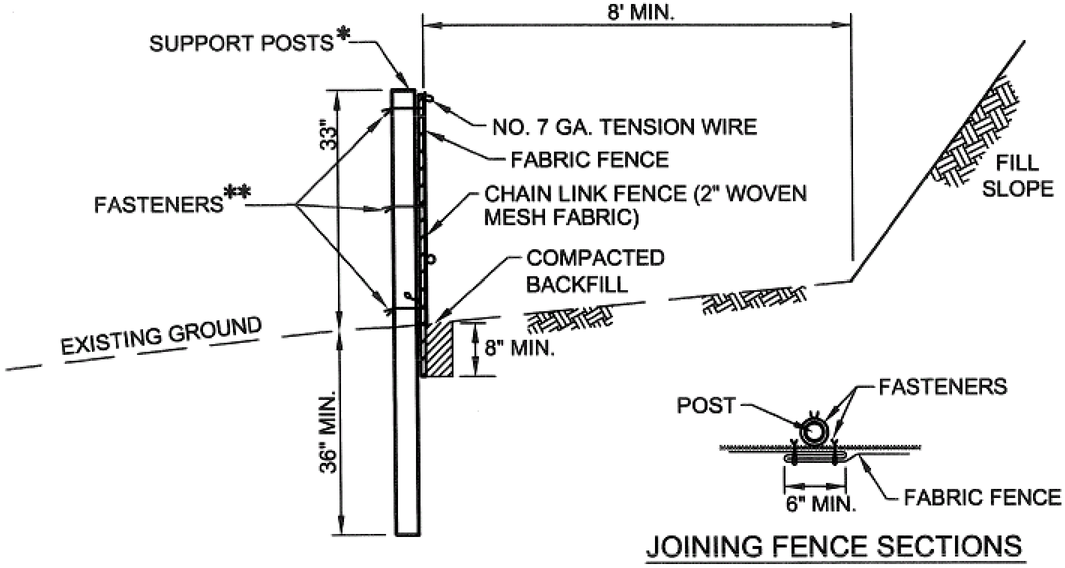
Silt fence shall be installed at existing level grade. Both ends of each fence section shall be extended at least 8 feet upslope at 45 degrees to the main fence alignment (Figure 4.1).

Sediment shall be removed where accumulations reach half the aboveground height of the fence.

Any section of silt fence which has been undermined or topped shall be immediately replaced with a rock filter outlet (Standard Construction Detail # 4-6).

Fence shall be removed and properly disposed of when tributary area is permanently stabilized.

STANDARD CONSTRUCTION DETAIL # 4-10
Super Silt Fence



* POSTS SPACED @ 10' MAX. USE 2 1/2" DIA. HEAVY DUTY GALVANIZED OR ALUMINUM POSTS.

** CHAIN LINK TO POST FASTENERS SPACED @ 14" MAX. USE NO. 9 GA. ALUMINUM WIRE OR NO. 9 GALVANIZED STEEL PRE-FORMED CLIPS. CHAIN LINK TO TENSION WIRE FASTENERS SPACED @ 60" MAX. USE NO. 13.5 GA. GALVANIZED STEEL WIRE. FABRIC TO CHAIN FASTENERS SPACED @ 24" MAX C. TO C.

PA DEP

Fabric shall have the minimum properties as shown in Table 4.3.

Filter fabric width shall be 42” minimum.

Posts shall be installed using a posthole drill.

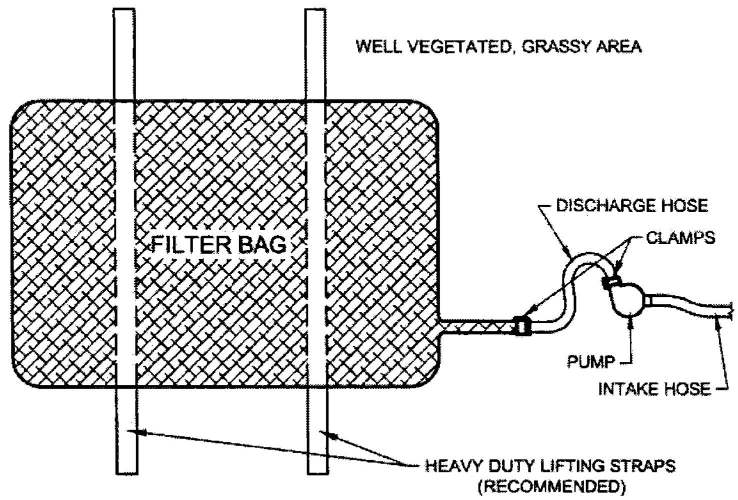
Chain link shall be galvanized No. 11.5 Ga. steel wire with 2 ¼” opening, No. 11 Ga. aluminum coated steel wire in accordance with ASTM-A-491, or galvanized No. 9 Ga. steel wire top and bottom with galvanized No. 11 Ga. steel intermediate wires. No. 7 gage tension wire to be installed horizontally through holes at top and bottom of chain-link fence or attached with hog rings at 5’ (max.) centers.

Silt fence shall be placed at existing level grade. Both ends of the fence shall be extended at least 8 feet upslope at 45 degrees to main barrier alignment (Figure 4.1).

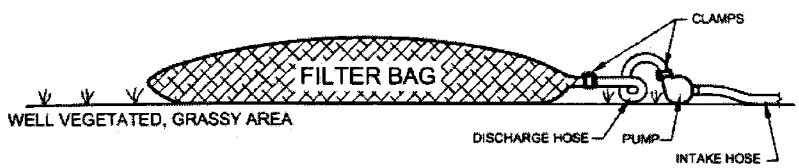
Sediment shall be removed when accumulations reach half the aboveground height of the fence.

Fence shall be removed and properly disposed of when tributary area is permanently stabilized.

STANDARD CONSTRUCTION DETAIL # 3-16
Pumped Water Filter Bag



PLAN VIEW



ELEVATION VIEW

PA DEP

Low volume filter bags shall be made from non-woven geotextile material sewn with high strength, double stitched "J" type seams. They shall be capable of trapping particles larger than 150 microns. High volume filter bags shall be made from woven geotextiles that meet the following standards:

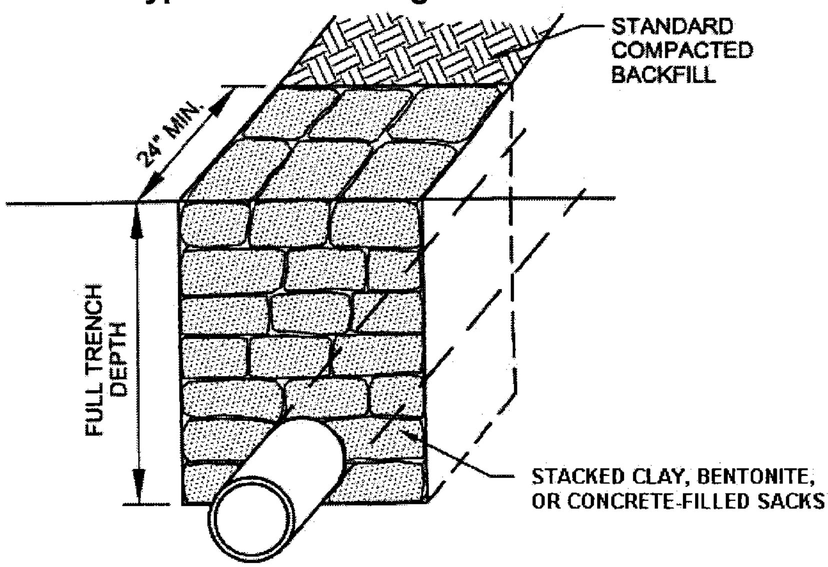
Property	Test Method	Minimum Standard
Avg. Wide Width Strength	ASTM D-4884	60 lb/in
Grab Tensile	ASTM D-4632	205 lb
Puncture	ASTM D-4833	110 lb
Mullen Burst	ASTM D-3786	350 psi
UV Resistance	ASTM D-4355	70%
AOS % Retained	ASTM D-4751	80 Sieve

A suitable means of accessing the bag with machinery required for disposal purposes shall be provided. Filter bags shall be replaced when they become ½ full of sediment. Spare bags shall be kept available for replacement of those that have failed or are filled. Bags shall be placed on straps to facilitate removal unless bags come with lifting straps already attached.

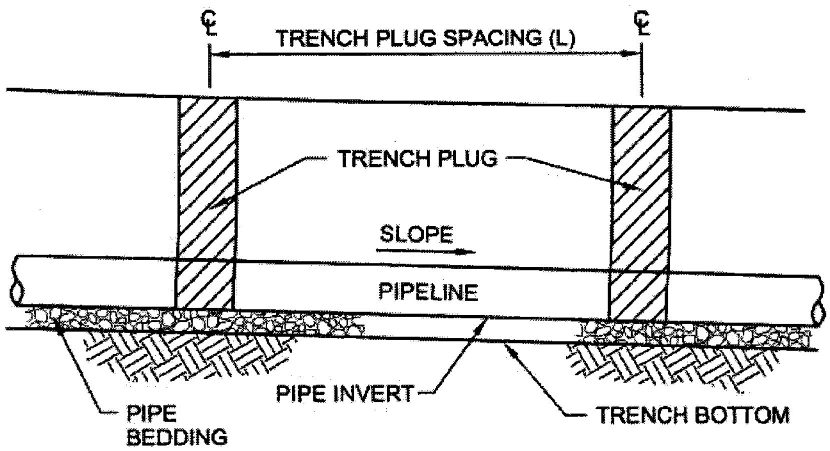
Bags shall be located in well-vegetated (grassy) area, and discharge onto stable, erosion resistant areas. Where this is not possible, a geotextile underlayment and flow path shall be provided. Bags may be placed on filter stone to increase discharge capacity. Bags shall not be placed on slopes greater than 5%. For slopes exceeding 5%, clean rock or other non-erodible and non-polluting material may be placed under the bag to reduce slope steepness.

No downslope sediment barrier is required for most installations. Compost berm or compost filter sock shall be installed below bags located in HQ or EV watersheds, within 50 feet of any receiving surface water or where grassy area is not available.

STANDARD CONSTRUCTION DETAIL # 13-4
Typical Trench Plug Installation



SECTION VIEW



ELEVATION

PA DEP

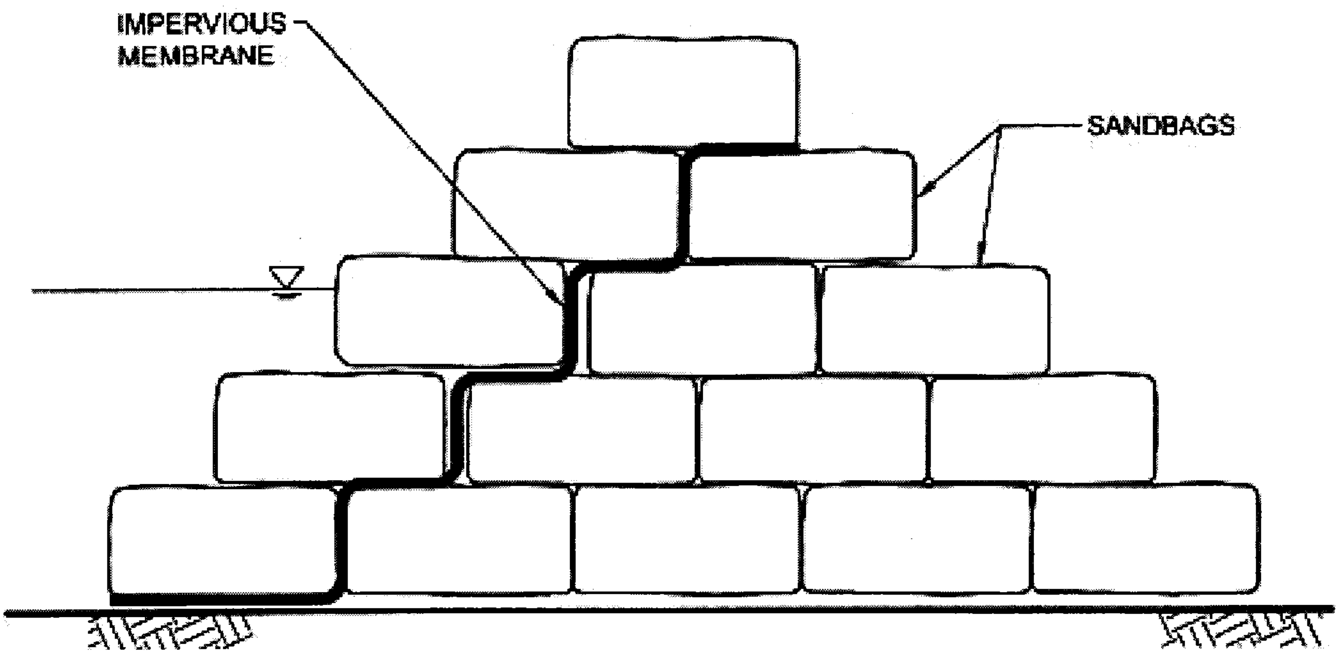
TABLE 13.1
Maximum Spacing and Materials for Trench Plugs

Trench Slope (%)	Spacing L (FT)	Plug Material
< 5	1,000	* Clay, Bentonite, or Concrete Filled Sacks
5 - 15	500	* Clay, Bentonite, or Concrete Filled Sacks
15 - 25	300	* Clay, Bentonite, or Concrete Filled Sacks
25 - 35	200	* Clay, Bentonite, or Concrete Filled Sacks
35 - 100	100	* Clay, Bentonite, or Concrete Filled Sacks
> 100	50	Cement Filled Bags (Wetted) or Mortared Stone

***TOPSOIL MAY NOT BE USED TO FILL SACKS.**

Impervious trench plugs are required for all stream, river, wetland, or other water body crossings.

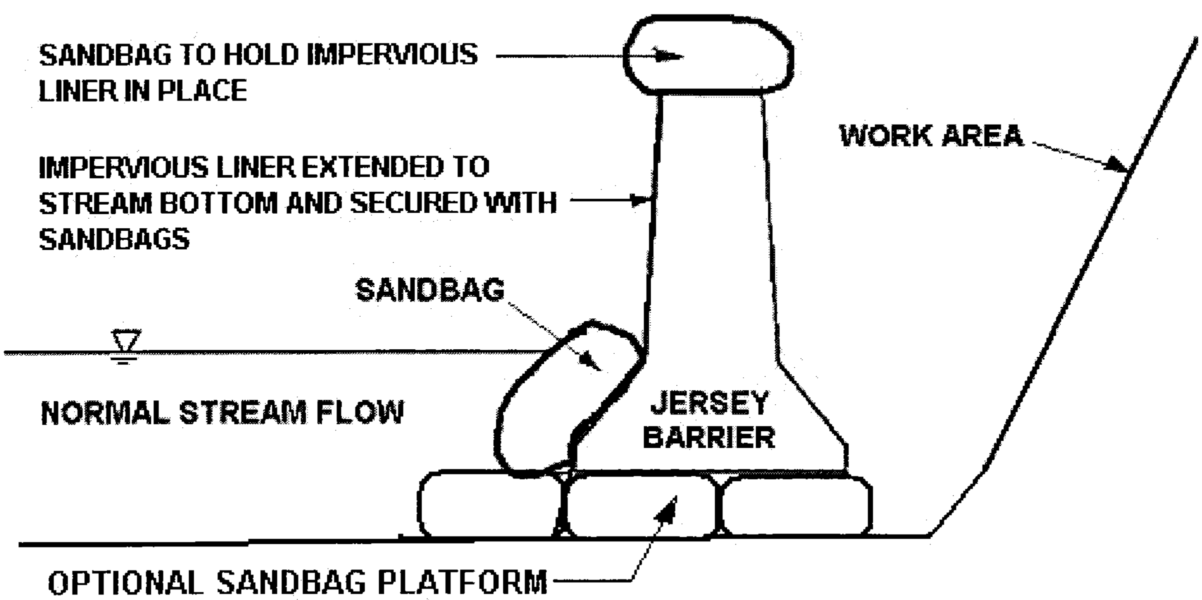
STANDARD CONSTRUCTION DETAIL #3-15
Sandbag Diversion Dam or Cofferdam



PA DEP

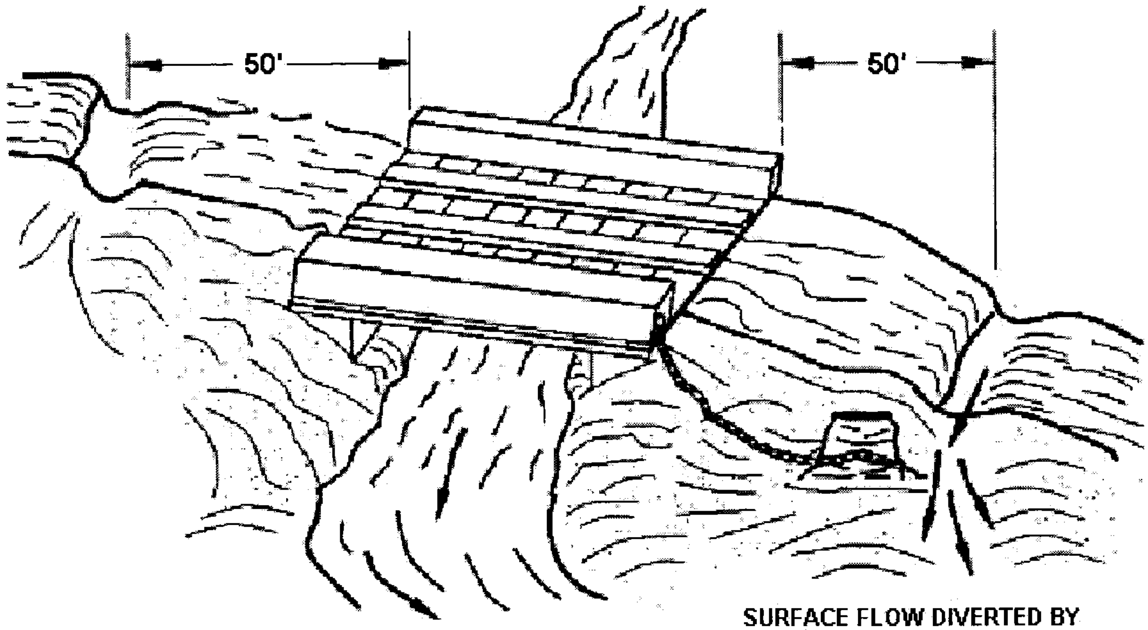
2 BAG MINIMUM HEIGHT ABOVE NORMAL BASE FLOW

FIGURE 3.13
Jersey Barrier Cofferdam – End View



PA DEP

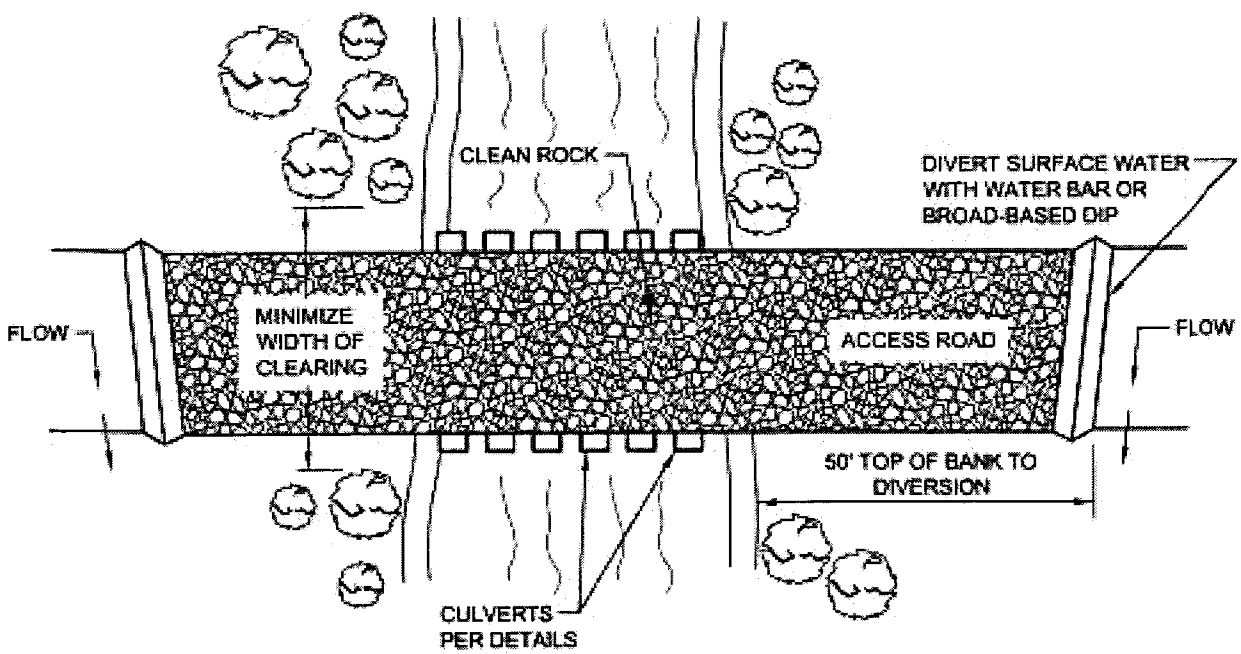
FIGURE 3.4
Temporary Bridge Stream Crossing



Adapted from Maryland DOE

Waterbars and broad-based dips shall discharge to sediment removal facilities.

STANDARD CONSTRUCTION DETAIL # 3-12
Temporary Stream Crossing - Plan View

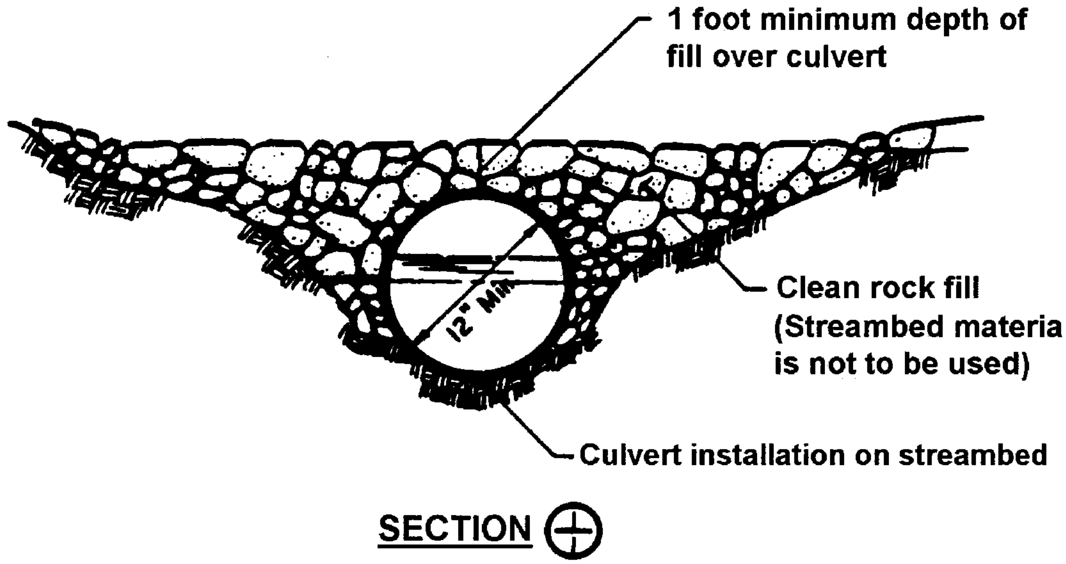


Adapted from Ohio EPA

Waterbars and broad-based dips shall discharge to sediment removal facility.
Clean rock shall conform to Chapter 105 permitting requirements.

Follow permit conditions regarding removal of crossing.

STANDARD CONSTRUCTION DETAIL # 3-13
Temporary Stream Crossing



PA DEP

Provide 50' stabilized access to crossing on both sides of stream channel (see Standard Construction Detail #3-12).

Pipes shall extend beyond the toe of the roadway.

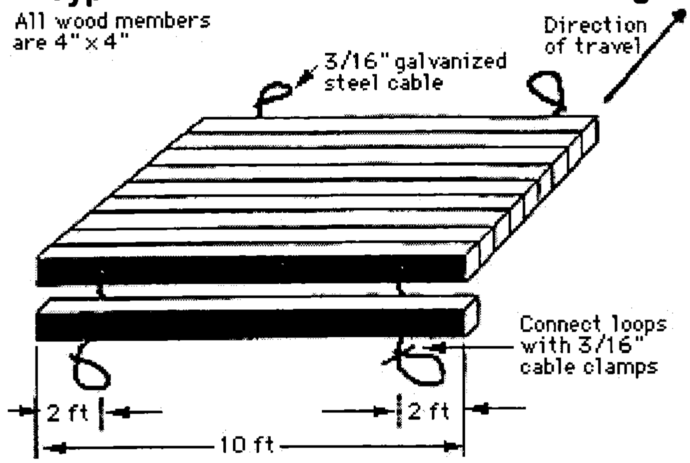
Runoff from the roadway shall be diverted off the roadway and into a sediment removal BMP before it reaches the rock approach to the crossing.

MAINTENANCE

1. **Temporary stream crossings shall be inspected on a daily basis.**
2. **Damaged crossings shall be repaired within 24 hours of the inspection and before any subsequent use.**
3. **Sediment deposits on the crossing or its approaches shall be removed within 24 hours of the inspection**

As soon as the temporary crossing is no longer needed, it shall be removed. All materials shall be disposed of properly and disturbed areas stabilized.

FIGURE 3.7
Typical Wood Mat for Wetland Crossing



University of Minnesota FS 07009

A geotextile underlayment shall be used under the wood mat.

EARTHWORK WITHIN STREAM CHANNELS

NOTE: Wherever the structures described in this section are installed, the appropriate Chapter 105 permits must be obtained from the Department. Designs must adhere to the conditions of those permits.

Whenever possible, work should be scheduled for low flow seasons. Base flows for minor stream channels are to be diverted past the work area. For major stream channels (normal flow width > 10 feet) base flow shall be diverted wherever possible. All such bypasses must be completed and stabilized prior to diverting flow. Where diversion is not possible or where it can be shown that the potential environmental damage would be greater with diverted flow, this requirement may be waived. In either case, the duration of the disturbance must be minimized. All disturbed areas within the channel must be stabilized prior to returning base flow to the portion of the channel affected by the earthwork (Chapter 15).

Any in-channel excavations should be done from top of bank wherever possible unless this would require removal of mature trees to access the channel. Where it is not possible to work from top of bank, a temporary crossing or causeway (Figure 3.8) may be used to provide a working pad for any equipment within the channel. Upon completion, the crossing or causeway must be removed and all channel entrances restored, as much as possible, to pre-construction configurations, and stabilized. If it can be shown that there would be less disturbance to the channel by not using work pads (e.g. certain stream restorations), work within a live stream channel may be approved by the Department on a case-by-case basis.

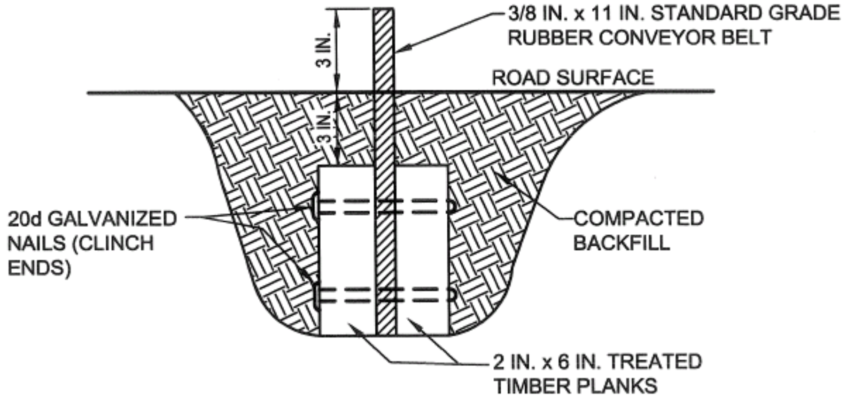
Except for pipeline & utility line projects (Chapter 13), all excavated channel materials that subsequently will be used as backfill are to be placed in a temporary stockpile located outside the channel floodway. A sediment barrier must be installed between the storage pile and the stream channel.

All excavated materials that will not be used on site shall be immediately removed to a disposal site having an approved E&S plan.

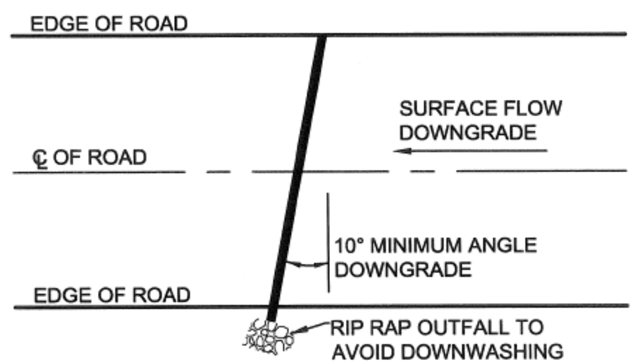
Any water pumped from excavated areas must be filtered prior to discharging into surface waters.

Suitable protection must be provided for the stream channel from any disturbed areas that have not yet achieved stabilization.

STANDARD CONSTRUCTION DETAIL #3-9
Water Deflector



TYPICAL CROSS-SECTION



TYPICAL PLAN VIEW

USDA Forest Service

Deflector shall be inspected weekly and after each runoff event.

Accumulated sediment shall be removed from deflector within 24 hours of inspection.

Belt shall be replaced when worn and no longer effective.

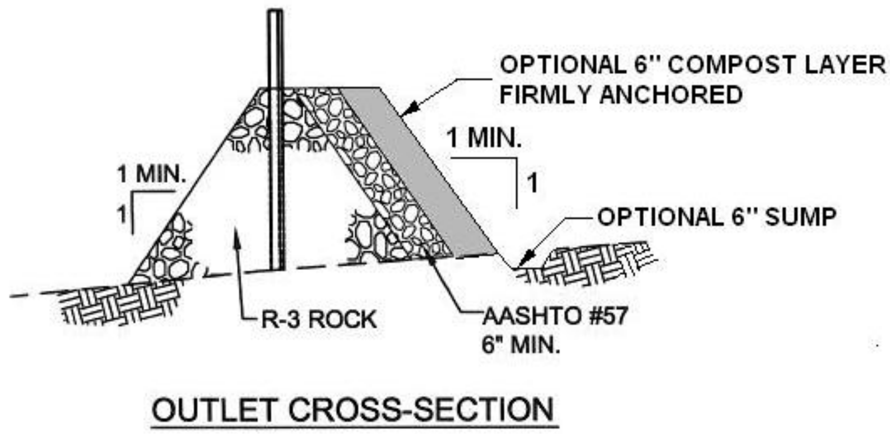
Maximum spacing of deflectors shall be as shown in Table 3.2.

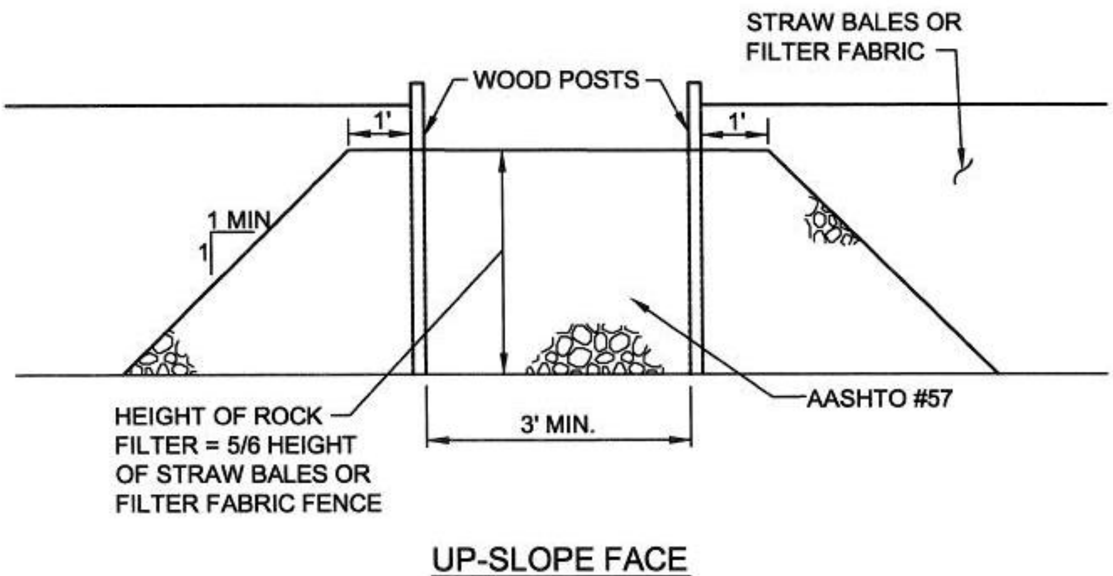
TABLE 3.2 – Maximum Spacing of Broad-based Dips, Open-top Culverts and Deflectors

Road Grade (Percent)	Spacing Between Dips, Culverts, or Deflectors (feet)
<2	300
3	235
4	200
5	180
6	165
7	155
8	150
9	145
10	140

USDA Forest Service

STANDARD CONSTRUCTION DETAIL # 4-6
Rock Filter Outlet





PA DEP

A rock filter outlet shall be installed where failure of a silt fence or straw bale barrier has occurred due to concentrated flow. Anchored compost layer shall be used on upslope face in HQ and EV watersheds.

Sediment shall be removed when accumulations reach 1/3 the height of the outlet.