Table 15. Crossing Method Determination Summary
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USACE District	Crossing #	Waterbody	Crossing Methods Evaluated	Evaluation Factors: Crossing Length	Pit Depth	Deep Stream	Maximum Steep Slope (%)	Maximum Average Slope (%)	Maximum Winch Hill Length (feet)	Karst Terrain Present	Sufficient Stockpile Storage Available	Total Cost ($)	Proposed Crossing Method	Crossing Method Decision Rationale
Huntington	A-001	W-A1a, S-A1a	Dry-Ditch Open-Cut	69	-	N	106	51	648	N	N	$178,577	Dry-Ditch Open-Cut	This crossing is situated on a long and steep slope on one side that would create logistically difficult construction conditions and provide insufficient area for a bore pit spoils. Additionally, the presence of existing utilities and a completed road crossing do not allow sufficient workspace for excavation of a bore pit and operation of conventional boring or tunneling equipment.
			Conventional Bore	69	28	N	106	51	648	N	N	$451,592		
Huntington	A-003	S-A3a	Dry-Ditch Open-Cut	47	-	N	71	49	932	N	N	$64,909	Dry-Ditch Open-Cut	This crossing is situated on a long and steep slope on one side that would involve logistically difficult construction conditions and provide insufficient area for a bore pit spoils. Furthermore, the cost to bore is unreasonably high relative to the proposed construction method.
			Conventional Bore	47	34	N	71	49	932	N	N	$754,544		
Huntington	A-005	S-A124	Dry-Ditch Open-Cut	203	-	N	59	44	1432	N	N	$188,752	Dry-Ditch Open-Cut	This one foot wide stream is situated on a long and steep slope that would involve logistically difficult construction conditions and would require an excessively deep bore pit for a trenchless crossing. An already completed stream crossing is located near this resource which further reduces the available work space and creates an insufficient area for a bore pit soil stockpile. Furthermore, the time to complete a trenchless crossing is nearly four times as long and the cost to bore is unreasonably high relative to the proposed construction method.
			Conventional Bore	203	48	N	59	44	1432	N	N	$3,194,292		
Huntington	A-006	W-A27-PFO, W-A27-PEM, S-A118	Dry-Ditch Open-Cut	95	-	N	74	62	1268	N	N	$90,372	Dry-Ditch Open-Cut	This crossing is located in a valley that has long and steep slopes on both sides which would require a technically and logistically challenging winching system. In addition, the deep bore pits would require additional areas to stockpile soils which may require additional tree clearing in known use Indiana Bat habitat. Furthermore, the cost to bore is unreasonably high relative to the proposed construction method.
			Conventional Bore	95	36	N	74	62	1268	N	N	$927,306		
Huntington	A-008	S-A120, S-A119, W-A34	Dry-Ditch Open-Cut	85	-	N	36	20	629	N	Y	$102,339	Conventional Bore	There are no significant constraints on available crossing methods or significant environmental impacts relevant to the available methods. The direct aquatic impact will be avoided/minimized by use of the conventional bore method.
			Conventional Bore	85	29	N	36	20	629	N	Y	$506,135		
Pittsburgh	A-009	W-B1a	Dry-Ditch Open-Cut	40	-	N	57	47	350	N	N	$28,000	Dry-Ditch Open-Cut	This small wetland is located on a steep slope would create logistically difficult construction conditions on both sides of the crossing and provide insufficient room for the spoils from the excessively deep bore pits. The bore duration is estimated to be twice as long and the cost to avoid the temporary impacts is unreasonably high relative to the proposed construction method.
			Conventional Bore	40	49	N	57	47	350	N	N	$2,786,247		
Pittsburgh	A-010/011	S-B2a, W-A40, S-B3a	Dry-Ditch Open-Cut	243	-	N	58	47	711	N	N	$198,323	Dry-Ditch Open-Cut	This crossing is located on a long and steep slope on one side that would create logistically difficult construction conditions and would require an excessively deep bore pit for a trenchless crossing. Furthermore, the estimated time to complete a trenchless crossing is nearly five times as long and the cost to avoid the temporary impacts is unreasonably high relative to the proposed construction method.
			Conventional Bore	243	49	N	58	47	711	N	N	$3,362,357		
Pittsburgh	A-012	S-A11a, S-A11a-Braid-1, S-A11a-Braid-2	Dry-Ditch Open-Cut	96	-	N	79	59	375	N	N	$114,692	Dry-Ditch Open-Cut	This crossing is located at the base of a steep slope that would involve logistically difficult construction conditions and would require an excessively deep bore pit for a trenchless crossing. Furthermore, the estimated time to complete a trenchless crossing is nearly four times as long and the cost to avoid the temporary impacts is unreasonably high relative to the proposed construction method.
			Conventional Bore	96	43	N	79	59	375	N	N	$2,617,901		
Pittsburgh	A-013	W-UU3	Dry-Ditch Open-Cut	30	-	N	38	7	0	N	Y	$21,000	Dry-Ditch Open-Cut	This narrow wetland (less than five feet wide at the pipeline crossing) would be excessively expensive to complete as a trenchless bore. In addition, the bore pits are of such depth (nearly 40-feet) that benching would be required, thereby increasing the amount of spoils created at the crossing and reducing the amount of available workspace.
			Conventional Bore	30	17	N	38	7	0	N	Y	$162,784		

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Pittsburgh	A-014	S-UU3	Dry-Ditch Open-Cut	73	-	N	55	45	808	N	N	$264,165	Dry-Ditch Open-Cut	This crossing is located adjacent to long and steep slope that would involve logistically difficult construction conditions, an extensive equipment winching system, and an excessively deep bore pit for a trenchless crossing.
			Conventional Bore	73	36	N	55	45	808	N	N	$864,870		
Pittsburgh	A-015	S-UU5, W-UU4	Dry-Ditch Open-Cut	190	-	N	48	32	412	N	Y	$148,124	Dry-Ditch Open-Cut	This crossing is located on long and steep slope that would involve logistically difficult construction conditions, an extensive equipment winching system, and an excessively deep bore pit (37') that would require benching for a trenchless crossing. Furthermore, the estimated time to complete a trenchless crossing is nearly twice as long and the cost to avoid the temporary impacts is unreasonably high relative to the proposed construction method.
			Conventional Bore	190	37	N	48	32	412	N	Y	$1,215,184		
Pittsburgh	A-016	W-K43, S-K73, S-K74, S-K75, W-K44	Dry-Ditch Open-Cut	286	-	N	58	36	453	N	N	$222,731	Dry-Ditch Open-Cut	This crossing is located in a valley that has long and steep slopes on both sides which would require an extensive equipment winching system. In addition, the deep bore pits would require benching, which increases the total volume of material to be excavated. The lack of sufficient space to stockpile the material further complicates a trenchless crossing. The estimated time to complete a trenchless crossing is nearly double and the cost is excessively expensive.
			Conventional Bore	286	36	N	58	36	453	N	N	$1,469,361		
Huntington	A-017	W-K45, S-K77	Dry-Ditch Open-Cut	38	-	N	70	35	645	N	N	$41,532	Dry-Ditch Open-Cut	This crossing is located adjacent to a long and steep slope that would involve logistically difficult construction conditions, a winching system that is beyond standard procedures and a deep bore pit for a trenchless crossing. Furthermore, the cost to bore is unreasonably high relative to the proposed construction method.
			Conventional Bore	38	28	N	70	35	645	N	N	$363,615		
Huntington	A-018	S-K67	Dry-Ditch Open-Cut	36	-	N	77	51	341	N	N	$60,206	Dry-Ditch Open-Cut	This crossing is located adjacent to a steep slope that would involve logistically difficult construction conditions, an extensive winching system and a deep bore pit for a trenchless crossing. In addition, the excessively deep bore pits (nearly 40 feet) would create a large volume of material to be excavated and stockpile. The lack of sufficient space to stockpile the material further complicates a trenchless crossing. The estimated time to complete a trenchless crossing is more than double and the cost is unreasonably high relative to the proposed construction method.
			Conventional Bore	36	39	N	77	51	341	N	N	$814,673		
Huntington	A-019A	S-K65	Dry-Ditch Open-Cut	37	-	N	64	49	148	N	Y	$55,234	Dry-Ditch Open-Cut	This crossing is located adjacent to a steep slope that would involve logistically difficult construction conditions and a deep bore pit for a trenchless crossing. In addition, the excessively deep bore pits (over 40 feet) would create a large volume of material to be excavated and stockpiled. The lack of sufficient space to stockpile the material further complicates a trenchless crossing. The estimated time to complete a trenchless crossing is more than four times longer than an open cut and the cost is unreasonably high relative to the proposed construction method.
			Conventional Bore	37	41	N	64	49	148	N	Y	$2,341,369		
Huntington	B-001	S-A110/K62, W-A23, S-A109	Dry-Ditch Open-Cut	238	-	N	73	33	0	N	Y	$194,600	Dry-Ditch Open-Cut	The estimated time to complete a trenchless crossing is nearly three times and the cost is excessively expensive. In addition, the bore pits are nearly 40-feet deep which requires benching, trench shoring, and sufficient room to create the bench and store the stockpiled material.
			Conventional Bore	238	39	N	73	33	0	N	Y	$1,387,946		
Huntington	B-001A	S-A111	Dry-Ditch Open-Cut	38	-	N	75	58	667	N	N	$77,982	Dry-Ditch Open-Cut	This crossing is located adjacent to a long and steep slope on one side that would involve logistically difficult construction conditions, an extensive winching system and a deep bore pit for a trenchless crossing. The proximity of adjacent resources reduces the available amount of room to store the excavated material. Furthermore, the time to complete the trenchless crossing is more than double and the cost to avoid the temporary impacts is unreasonably high relative to the proposed construction method.
			Conventional Bore	38	37	N	75	58	667	N	N	$783,810		
Pittsburgh	B-002	W-J40, S-K82, S-K94	Dry-Ditch Open-Cut	223	-	N	43	29	291	N	N	$228,434	Dry-Ditch Open-Cut	The pipeline is already installed through a portion of the wetland at this crossing. The layout of a conventional bore would require excavation of a bore pit unacceptably close to the installed pipe. Boring also would not avoid or minimize impacts to the resources because it would require excavation of a bore pit within the wetland.
			Conventional Bore	223	25	N	43	29	291	N	N	$861,237		

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Pittsburgh	B-003	S-J44	Dry-Ditch Open-Cut	46	-	N	70	44	1017	N	N	$50,537	Dry-Ditch Open-Cut	This stream is approximately five feet wide where the pipeline crosses. It is located a steep valley, with extremely long slopes that would create logistically difficult construction conditions, require extensive winching systems, and bore pits would be approximately 40 feet deep. The lack of sufficient space to stockpile the material further complicates a trenchless crossing. The estimated time to complete a trenchless crossing is three times longer than an open cut and the cost is excessively expensive.
			Conventional Bore	46	39	N	70	44	1017	N	N	$843,053		
Huntington	B-005	W-K33-PEM	Dry-Ditch Open-Cut	117	-	N	75	57	496	N	N	$81,900	Dry-Ditch Open-Cut	This crossing is located adjacent to a long and steep slope that would involve logistically difficult construction conditions, an extensive winching system and a deep bore pit (48-feet) for a trenchless crossing. In addition, the excessively deep bore pits would create a large volume of material to be excavated and stockpiled. The lack of sufficient space to stockpile the material further complicates a trenchless crossing. Furthermore, the cost to avoid the temporary impacts is unreasonably high relative to the proposed construction method.
			Conventional Bore	117	48	N	75	57	496	N	N	$2,950,226		
Pittsburgh	B-006	W-K31	Dry-Ditch Open-Cut	96	-	N	62	55	220	N	N	$67,200	Dry-Ditch Open-Cut	This crossing is situated on a steep slope that would involve logistically difficult construction conditions, deep bore pits (nearly 40-feet), and provide insufficient area for a bore pit soil stockpile. Furthermore, the time to complete the trenchless crossing is nearly double of an open cut and the cost to avoid the temporary impacts is unreasonably high relative to the proposed construction method.
			Conventional Bore	96	39	N	62	55	220	N	N	$984,952		
Pittsburgh	B-007	W-B46	Dry-Ditch Open-Cut	143	-	N	56	21	417	N	N	$100,100	Dry-Ditch Open-Cut	This crossing is situated on a long and steep slope that would involve logistically difficult construction conditions, extensive winching systems, deep bore pits, and provides insufficient area for a bore pit soil stockpile. Furthermore, the time to complete the trenchless crossing is double of an open cut and the cost to avoid the temporary impacts is unreasonably high relative to the proposed construction method.
			Conventional Bore	143	30	N	56	21	417	N	N	$953,913		
Pittsburgh	B-008	S-H180	Dry-Ditch Open-Cut	45	-	N	32	20	0	N	Y	$78,375	Dry-Ditch Open-Cut	The trenchless crossing would require bore pits that are 39-feet deep, which minimizes the available area to complete an efficient crossing. Furthermore, the time to complete the trenchless crossing is more than double of an open cut and the cost to avoid the temporary impacts is unreasonably high relative to the proposed construction method.
			Conventional Bore	45	39	N	32	20	0	N	Y	$840,215		
Pittsburgh	B-009	W-H112	Dry-Ditch Open-Cut	260	-	N	9	4	0	N	Y	$182,000	Dry-Ditch Open-Cut	The open cut method would result in a temporary impact to 0.02 acre of PEM. Avoiding/minimizing this minor impact through a conventional bore would require a 20 feet deep bore pit - possibly requiring the operator to work from a shallow bench within the pit. Furthermore, the conventional bore crossing cost to avoid the temporary impacts is unreasonably high relative to the proposed construction method and take nearly triple the amount of time to complete.
			Conventional Bore	260	20	N	9	4	0	N	Y	$920,569		
Huntington	B-010	S-I63	Dry-Ditch Open-Cut	74	-	N	100	59	341	N	N	$122,275	Dry-Ditch Open-Cut	This crossing is located in a valley that has long and steep slopes on both sides which would require an extensive equipment winching system and excessively deep bore pits. The available area to store the excess material is extremely limited due to the narrowed ROW and county road. Furthermore, the cost to avoid the temporary impacts is unreasonably high relative to the proposed construction method.
			Conventional Bore	74	52	N	100	59	341	N	N	$3,046,374		
Huntington	B-011	W-I15	Dry-Ditch Open-Cut	56	-	N	66	43	661	N	N	$39,200	Dry-Ditch Open-Cut	This crossing is situated on a long and steep slope that would involve logistically difficult construction conditions, extensive winching systems, deep bore pits, and provides insufficient area for a bore pit soil stockpile. Furthermore the cost to avoid the temporary impacts is unreasonably high relative to the proposed construction method.
			Conventional Bore	56	30	N	66	43	661	N	N	$707,008		
Huntington	B-012	W-H103, S-H160	Dry-Ditch Open-Cut	148	-	N	33	14	462	N	Y	$187,175	Conventional Bore	There are no significant constraints on available crossing methods or significant environmental impacts relevant to the available methods. The direct aquatic impact will be avoided/minimized by use of the conventional bore method. A minor temporary impact associated with the bore to maintain access will be required.
			Conventional Bore	148	24	N	33	14	462	N	Y	$639,254		

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				Crossing Length	Pit Depth	Deep Stream	Maximum Steep Slope (%)	Maximum Average Slope (%)	Maximum Winch Hill Length (feet)	Karst Terrain Present	Sufficient Stockpile Storage Available	Total Cost ($)		
Huntington	B-013	S-H153	Dry-Ditch Open-Cut	42	-	N	58	41	567	N	N	$82,922	Dry-Ditch Open-Cut	This crossing is situated in a valley with steep slopes on both sides of the resource. The topographical constraints complicate the limits of the winching system, creating a logistically difficult construction condition and deep bore pits. In addition there is insufficient area to store the bore pit stockpile in the immediate area. Furthermore the cost to avoid the temporary impacts is unreasonably high relative to the proposed construction method.
			Conventional Bore	42	36	N	58	41	567	N	N	$776,893		
Huntington	B-014A	S-H145	Dry-Ditch Open-Cut	32	-	N	76	39	520	N	N	$85,448	Dry-Ditch Open-Cut	This crossing is adjacent to a long and steep slope that would involve logistically difficult construction conditions, deep bore pits (nearly 40-feet), and provide insufficient area for a bore pit soil stockpile. Furthermore, the time to complete the trenchless crossing is nearly five times the duration of an open cut and the cost to avoid the temporary impacts is unreasonably high relative to the proposed construction method
			Conventional Bore	32	39	N	76	39	520	N	N	$803,321		
Huntington	B-014B	S-H165	Dry-Ditch Open-Cut	17	-	N	61	55	599	N	N	$35,892	Dry-Ditch Open-Cut	This small stream (less than 10-feet wide) is situated on a long and steep slope that would involve logistically difficult construction conditions, 31-feet deep bore pits, and provide insufficient area for a bore pit soil stockpile. Furthermore, the time to complete the trenchless crossing is nearly six times the duration of an open cut and the cost to avoid the temporary impacts is unreasonably high relative to the proposed construction method.
			Conventional Bore	17	31	N	61	55	599	N	N	$614,596		
Huntington	B-015A	S-CD16, S-VV13	Dry-Ditch Open-Cut	193	-	N	17	6	0	N	N	$206,271	Conventional Bore	There are no significant constraints on available crossing methods or significant environmental impacts relevant to the available methods. The direct aquatic impact will be avoided/minimized by use of the conventional bore method.
			Conventional Bore	193	25	N	17	6	0	N	N	$776,098		
Huntington	B-015B	S-VV12, W-CD16, W-VV8	Dry-Ditch Open-Cut	132	-	N	63	40	873	N	Y	$162,400	Dry-Ditch Open-Cut	This multiple resource crossing present several factors that support an open-cut crossing. The resources are located on a steep slope that is extremely long, which would require a winching system of nearly 900-feet. In addition, the bore pits would be 35-feet deep, resulting in an excessive amount of soil, with limited area for storage. The cost to avoid the temporary impacts is unreasonably high relative to the proposed construction method.
			Conventional Bore	132	35	N	63	40	873	N	Y	$1,014,042		
Huntington	B-016	S-UV11	Dry-Ditch Open-Cut	54	-	N	71	45	782	N	N	$90,653	Dry-Ditch Open-Cut	Stream S-UV11 is a perennial stream located adjacent to a steep slope that is extremely long, nearly 800 feet in length with an average slope exceed 45%. The bore pits are estimated to be over 20 feet which would require benching and additional area for spoil storage.
			Conventional Bore	54	23	N	71	45	782	N	N	$363,349		
Huntington	B-017	W-VV3-PEM, W-VV3-PFO, S-VV2	Dry-Ditch Open-Cut	145	-	N	40	32	439	N	N	$179,415	Dry-Ditch Open-Cut	This crossing is immediately adjacent to a mainline valve. Trenchless crossing methods are logistically difficult because they would require the pipe to be installed too deeply to facilitate connection to the valve site. An open cut crossing is necessary to facilitate connection to the mainline valve. Furthermore, the cost to avoid the temporary impacts is unreasonably high relative to the proposed construction method.
			Conventional Bore	145	30	N	40	32	439	N	N	$959,589		
Huntington	C-001	S-L60	Dry-Ditch Open-Cut	42	-	N	60	32	189	N	N	$134,876	Dry-Ditch Open-Cut	The pipeline has already been installed under Big Knawl Road and there is a fully restored steep hill adjacent to the pipe tie-in. Trenchless methods are technically and logistically difficult for this crossing because they would require the removal of the completed road bore and are not less environmentally damaging than this temporary stream impact because the steep hill adjacent to the crossing, which has been fully restored, would have to be re-disturbed to complete a bore. A minor temporary impact associated with the bore to maintain access will be required.
			Conventional Bore	42	16	N	60	32	189	N	N	$192,273		
Huntington	C-002	S-LL1	Dry-Ditch Open-Cut	66	-	N	57	48	420	N	N	$171,170	Dry-Ditch Open-Cut	This crossing is located adjacent to a steep slope that is extremely long, approximately 420-feet in length with an average slope exceeding 45%. The bore pits are estimated to be nearly 30 feet. These factors create logistically difficult construction conditions, complicated winching systems, and excessive spoils. Furthermore, the time to complete the trenchless crossing is nearly double the duration a.
			Conventional Bore	66	30	N	57	48	420	N	N	$735,388		

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Huntington	C-003	S-QR30	Dry-Ditch Open-Cut	47	-	N	79	52	609	N	N	$58,173	Dry-Ditch Open-Cut	This small stream (less than 10-feet wide) is situated in a valley with long and steep slopes on both approaches. The bore pits are projected to be nearly 50-feet deep, which creates logistically difficult construction conditions and insufficient area for a bore pit soil stockpile. Furthermore, the time to complete the trenchless crossing is five times the duration and the cost to avoid the temporary impacts is unreasonably high relative to the proposed construction method.
			Conventional Bore	47	50	N	79	52	609	N	N	$2,860,658		
Huntington	C-004	S-J70	Dry-Ditch Open-Cut	62	-	N	70	57	886	N	N	$149,548	Dry-Ditch Open-Cut	This stream is located in a valley with long and steep slopes on both approaches. The bore pits are projected to be nearly 50-feet deep, which creates logistically difficult construction conditions and insufficient area for a bore pit soil stockpile. Furthermore, and the cost to avoid the temporary impacts is unreasonably high relative to the proposed construction method.
			Conventional Bore	62	49	N	70	57	886	N	N	$2,848,682		
Huntington	C-005	S-H123	Dry-Ditch Open-Cut	130	-	N	36	22	431	N	N	$115,859	Dry-Ditch Open-Cut	This small stream (less than 10-feet wide) is located adjacent to a steep slope, creating an extremely difficult construction procedure due to the winching requirements, bore pit depths (nearly 50-feet deep), and lack of sufficient work space. Furthermore, the time to complete the trenchless crossing is nearly four times the duration of an open cut and the cost to avoid the temporary impacts is unreasonably high relative to the proposed construction method.
			Conventional Bore	130	48	N	36	22	431	N	N	$2,987,120		
Huntington	C-006	W-H90, S-H123	Dry-Ditch Open-Cut	135	-	N	63	37	413	N	N	$119,359	Dry-Ditch Open-Cut	These resources are located adjacent to a long and steep slopes. The bore pits are projected to be over 50-feet deep and the winch hill length is greater than 400 feet, which creates logistically difficult construction conditions and insufficient area for a bore pit soil stockpile. Furthermore, the cost to avoid the temporary impacts is unreasonably high relative to the proposed construction method and the construction time is greater than six times an open cut.
			Conventional Bore	135	54	N	63	37	413	N	N	$3,328,582		
Huntington	C-007	S-H117	Dry-Ditch Open-Cut	146	-	N	87	66	571	N	N	$159,225	Dry-Ditch Open-Cut	This stream is located in a valley with steep slopes on both approaches. The steep slopes, extremely deep bore pits (67-feet), extreme winch hill conditions and lack of sufficient work space create a situation that is conducive to an open cut. Furthermore, the time to complete the trenchless crossing is nearly three times the duration of an open cut and the cost to avoid the temporary impacts is unreasonably high relative to the proposed construction method.
			Conventional Bore	146	67	N	87	66	571	N	N	$4,068,891		
Huntington	C-008	S-L46	Dry-Ditch Open-Cut	95	-	N	47	40	617	N	N	$119,663	Dry-Ditch Open-Cut	This stream is located in a valley with steep slopes on both approaches. The steep slopes, extremely deep bore pits (65-feet), extreme winch hill conditions and lack of sufficient work space create a situation that is conducive to an open cut. Furthermore, the time to complete the trenchless crossing is more than double the duration of an open cut and the cost to avoid the temporary impacts is unreasonably high relative to the proposed construction method.
			Conventional Bore	95	65	N	47	40	617	N	N	$3,815,063		
Huntington	C-009	S-L44	Dry-Ditch Open-Cut	57	-	N	38	27	52	N	Y	$75,133	Dry-Ditch Open-Cut	Avoiding/minimizing this minor impact through a conventional bore would require a deep bore pit - creating excessive spoil piles, with limited area for storage. Furthermore, the cost to avoid the temporary impacts is unreasonably high relative to the proposed construction method.
			Conventional Bore	57	36	N	38	27	52	N	Y	$819,463		
Huntington	C-010	S-I57	Dry-Ditch Open-Cut	78	-	N	51	34	690	N	N	$160,343	Dry-Ditch Open-Cut	This stream is located on a steep slope. The steep slope, extremely deep bore pits (49-feet), extreme winch hill conditions and lack of sufficient work space create a situation that is conducive to an open cut. Furthermore, the cost to avoid the temporary impacts is unreasonably high relative to the proposed construction method.
			Conventional Bore	78	49	N	51	34	690	N	N	$2,894,090		
Huntington	C-011	S-A96/A103	Dry-Ditch Open-Cut	80	-	N	43	38	201	N	N	$75,460	Dry-Ditch Open-Cut	This small stream (less than 10-feet wide) is located on a steep slope, creating an extremely difficult construction procedure due to bore pit depths (nearly 40-feet deep), steep slopes, and lack of sufficient work space. Furthermore, the time to complete the trenchless crossing is nearly three times the duration of an open cut and the cost to avoid the temporary impacts is unreasonably high relative to the proposed construction method.
			Conventional Bore	80	37	N	43	38	201	N	N	$903,006		

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USACE District	Crossing #	Waterbody	Crossing Methods Evaluated	Evaluation Factors									Proposed Crossing Method	Crossing Method Decision Rationale
				Crossing Length	Pit Depth	Deep Stream	Maximum Steep Slope (%)	Maximum Average Slope (%)	Maximum Winch Hill Length (feet)	Karst Terrain Present	Sufficient Stockpile Storage Available	Total Cost ($)		
Huntington	C-012	S-A97, S-A98	Dry-Ditch Open-Cut	121	-	N	41	35	334	N	N	$133,056	Dry-Ditch Open-Cut	These small streams are less than 10-feet wide and are located on a steep slope, creating an extremely difficult construction procedure due to bore pit depths (64-feet deep), steep slopes, and lack of sufficient work space. Furthermore, the time to complete the trenchless crossing is nearly 5 times the duration of an open cut and the cost to avoid the temporary impacts is unreasonably high relative to the proposed construction method.
			Conventional Bore	121	64	N	41	35	334	N	N	$3,834,305		
Huntington	C-013A	S-A100	Dry-Ditch Open-Cut	124	-	Y	42	22	460	N	N	$366,800	Conventional Bore	There are multiple complicating factors at this crossing location that necessitated the development of a unique solution. The Left Fork Holly River at this location is both wide and deep, and it is bounded on one side by a steep slope. Dealing with high water and unfavorable flow conditions, combined with the need to use winched equipment on one side of the river, make an open cut crossing at this location extraordinarily challenging. Mountain Valley's engineering and construction staff developed a plan to complete this crossing with a conventional bore.
			Conventional Bore	124	24	Y	42	22	460	N	N	$571,142		
Huntington	C-013B	S-E78/E82/R1	Dry-Ditch Open-Cut	84	-	N	27	7	0	N	Y	$340,499	Dry-Ditch Open-Cut	The stream is located next to a steep slope and would require a bore pit exceeding 20 feet which creates excessive spoils in a limited area for storage. The duration of the trenchless crossing is nearly three times longer than the open-cut process, thereby increasing the noise, aesthetic, and other impacts on nearby persons. Reducing the time at the crossing and permanently stabilizing this area will reduce the potential for sedimentation and erosion along the hillside.
			Conventional Bore	84	21	N	27	7	0	N	Y	$430,219		
Huntington	C-015	S-KK2, S-KK3b, S-KK4b	Dry-Ditch Open-Cut	220	-	N	50	30	396	N	N	$168,097	Dry-Ditch Open-Cut	The open cut method would result in a temporary impacts to three small UNTs to Left Fork Holly River, each less than three feet wide. Avoiding/minimizing these minor impacts through a conventional bore would require a relatively deep bore pit of nearly 40 feet on the edge of a steep slope, thereby requiring the excavation of an interim ramp and bench and dramatically increasing the space occupied by the bore pit and spoil pile. The construction time for the bore is estimated to be five times as long as the open cut and the cost to bore is unreasonably high relative to the proposed construction method.
			Conventional Bore	220	38	N	50	30	396	N	N	$1,318,593		
Huntington	C-018	S-F40	Dry-Ditch Open-Cut	92	-	N	42	24	11	N	N	$165,892	Conventional Bore	There are no significant constraints on available crossing methods or significant environmental impacts relevant to the available methods. The direct aquatic impact will be avoided/minimized by use of the conventional bore method. A minor temporary impact associated with the bore to maintain access will be required.
			Conventional Bore	92	29	N	42	24	11	N	N	$526,000		
Huntington	C-019	W-KK3	Dry-Ditch Open-Cut	51	-	N	60	26	296	N	N	$35,700	Dry-Ditch Open-Cut	Avoiding/minimizing this minor impact through a conventional bore would require an extensive winching system on a long steep slope in an already reduced area of work. In addition the cost to bore is unreasonably high relative to the proposed construction method.
			Conventional Bore	51	16	N	60	26	296	N	N	$217,815		
Huntington	C-020	S-F43	Dry-Ditch Open-Cut	74	-	N	45	28	53	N	N	$100,144	Dry-Ditch Open-Cut	A trenchless crossing on this hillside would require bore pits that are greater than thirty feet deep, which necessitates the use of a bench and interim ramp to access the bore pit. The construction time for the bore is nearly twice as long as the open cut and the cost to bore is unreasonably high relative to the proposed construction method.
			Conventional Bore	74	32	N	45	28	53	N	N	$794,631		
Huntington	C-021	S-E67	Dry-Ditch Open-Cut	147	-	N	62	45	284	N	N	$426,366	Dry-Ditch Open-Cut	The open cut method would result in a temporary impact Right Fork Holly River. Avoiding/minimizing these minor impacts through a conventional bore would require a relatively deep bore pit of nearly 30 feet on the edge of a long steep slope and the excavation of an interim ramp/bench. The additional equipment and excess spoil materials will greatly limit the available space in a work area that has already been minimized. The construction time for the bore is nearly three times as long as the open cut.
			Conventional Bore	147	34	N	62	45	284	N	N	$1,038,342		
Huntington	C-022	S-E68	Dry-Ditch Open-Cut	296	-	Y	47	12	63	N	Y	$860,247	Guided Conventional Bore	The Elk River will be crossed using Microtunnel trenchless methodology. While Mountain Valley will typically avoid crossings with bore pits of this depth, several logistical constraints complicate the open cut methodology. There are numerous large boulders within the proposed crossing - removing and restoring these to preconstruction contours would be extremely difficult to accomplish. In addition, the stream depth complicates the constructability since a larger instream diversion would be required thereby reducing the available space in a work area that has already been minimized. The Elk River is also classified by the WVDNR as Group 1 mussel stream. While mussel survey and relocation efforts were completed in 2019, completing a trenchless crossing will further minimize any potential impacts to mussel species.
			Guided Conventional Bore	296	49	Y	47	12	63	N	Y	$3,112,112		

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Huntington	C-023	S-E71	Dry-Ditch Open-Cut	84	-	N	26	18	0	N	Y	$66,476	Dry-Ditch Open-Cut	This small UNT to the Elk River (less than five feet wide) would require a bore pit that is a minimum of 20 feet deep. Due to this depth, it is likely that the use of a bench and interim access ramp would be required which would create a large volume of material to be excavated and stockpile. The lack of sufficient space to stockpile the material further complicates a trenchless crossing. Furthermore, the cost to bore is unreasonably high relative to the proposed construction method.
			Conventional Bore	84	20	N	26	18	0	N	Y	$421,084		
Huntington	C-024	S-H111, S-H114, S-H112	Dry-Ditch Open-Cut	272	-	N	36	12	10	N	N	$221,802	Conventional Bore	There are no significant constraints on available crossing methods or significant environmental impacts relevant to the available methods. The direct aquatic impact will be avoided/minimized by use of the conventional bore method. A minor temporary impact associated with the bore to maintain access will be required.
			Conventional Bore	272	18	N	36	12	10	N	N	$854,144		
Huntington	C-025	S-H113	Dry-Ditch Open-Cut	53	-	N	14	9	0	N	Y	$82,656	Dry-Ditch Open-Cut	This UNT to the Elk River is located in an area that would require a bore pit depth of nearly 30 feet. The excavation to this depth would require the use of a bench and interim access ramp would be required which would create a large volume of material to be excavated and stockpile. The lack of sufficient space to stockpile the material in a work area that has already been minimized further complicates a trenchless crossing. Furthermore, the cost to bore is unreasonably high relative to the proposed construction method.
			Conventional Bore	53	29	N	14	9	0	N	Y	$415,319		
Huntington	C-026	W-H75	Dry-Ditch Open-Cut	45	-	N	59	47	369	N	N	$31,500	Dry-Ditch Open-Cut	Avoiding/minimizing this minor impact through a conventional bore would require a relatively deep bore pit, with an excavator operating from a bench within the pit, at the edge of a steep slope. Furthermore, the cost to avoid the temporary impacts is unreasonably high relative to the proposed construction method.
			Conventional Bore	45	29	N	59	47	369	N	N	$392,615		
Huntington	C-027	W-H86	Dry-Ditch Open-Cut	78	-	N	13	9	0	N	Y	$54,600	Dry-Ditch Open-Cut	The open cut method would result in a temporary impact of approximately 0.001 acre of a PEM wetland. Avoiding/minimizing this minor impact through a conventional bore is unreasonably high relative to the proposed construction method.
			Conventional Bore	78	16	N	13	9	0	N	Y	$294,440		
Huntington	C-028	S-H110	Dry-Ditch Open-Cut	267	-	N	12	9	0	N	Y	$251,373	Conventional Bore	There are no significant constraints on available crossing methods or significant environmental impacts relevant to the available methods. The direct aquatic impact will be avoided/minimized by use of the conventional bore method. A minor temporary impact associated with the bore to maintain access will be required.
			Conventional Bore	267	22	N	12	9	0	N	Y	$958,705		
Huntington	C-029	S-T29	Dry-Ditch Open-Cut	78	-	N	32	13	1903	N	N	$162,380	Dry-Ditch Open-Cut	The stream (Houston Run) is located in a valley with extremely steep and long approaches. Avoiding/minimizing this minor impact through a conventional bore would require a deep bore pit of nearly 20 feet at the edge of long steep slopes. The additional equipment and excess spoil materials will greatly limit the available space in a work area that has already been minimized, which increases the construction difficulty.
			Conventional Bore	78	17	N	32	13	1903	N	N	$299,008		
Huntington	C-030	S-A83/A91	Dry-Ditch Open-Cut	72	-	N	56	39	866	N	N	$138,108	Dry-Ditch Open-Cut	This UNT to Camp Creek is adjacent to a steep long slope . A trenchless crossing on this hillside would require bore pits that are nearly 50-feet deep which would necessitate the use of a bench and interim ramp to access the bore pit and a winching system that is technically and logistically difficult. The construction time for the bore is nearly three times as long as the open cut and the cost to bore is unreasonably high relative to the proposed construction method.
			Conventional Bore	72	47	N	56	39	866	N	N	$2,767,971		
Huntington	C-031	S-A93, S-A92	Dry-Ditch Open-Cut	120	-	N	78	39	1190	N	N	$121,741	Dry-Ditch Open-Cut	These two very small UNTs to Camp Creek are located on a long steep slope. Both streams are less than 10 feet wide. A trenchless crossing on this hillside would require bore pits that are over 60-feet deep which would generate a significant amount of spoils and require a significant winching system to be located on the reduced LOD. The construction time for the bore is nearly twice as long as the open cut and the cost to bore is unreasonably high relative to the proposed construction method.
			Conventional Bore	120	63	N	78	39	1190	N	N	$3,776,922		

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Huntington	C-032	S-H108, W-H67, W-H66, S-H105	Dry-Ditch Open-Cut	367	-	N	57	34	1371	N	N	$307,728	Dry-Ditch Open-Cut	Avoiding/minimizing these minor impacts through a conventional bore would require a relatively deep bore pit of nearly 40 feet on the edge of a very long and steep slope, thereby requiring and extensive winching system and the excavation of an interim ramp and bench and dramatically increasing the space occupied by the bore pit and spoil pile. The excess spoils and winching system would need to be located on the already reduced LOD. The cost to bore is unreasonably high relative to the proposed construction method.
			Conventional Bore	367	36	N	57	34	1371	N	N	$1,699,237		
Huntington	C-033	S-H107	Dry-Ditch Open-Cut	45	-	N	7	3	0	N	Y	$39,885	Dry-Ditch Open-Cut	This crossing is immediately adjacent to a mainline valve. Trenchless crossing methods are logistically difficult due to the connection to the valve site. An open cut crossing is necessary to facilitate the connection to the mainline valve.
			Conventional Bore	45	13	N	7	3	0	N	Y	$187,085		
Huntington	C-034	W-H64-PEM, W-H64-PEM-2, W-H64-PSS, S-H104	Dry-Ditch Open-Cut	172	-	N	48	20	0	N	Y	$173,907	Dry-Ditch Open-Cut	This crossing is adjacent to a mainline valve. Trenchless crossing methods are logistically difficult because they would require the pipe to be installed too deeply to facilitate connection to the valve site. An open cut crossing is necessary to facilitate connection to the mainline valve.
			Conventional Bore	172	20	N	48	20	0	N	Y	$670,827		
Huntington	C-035	W-H60, W-H61	Dry-Ditch Open-Cut	312	-	N	20	8	0	N	Y	$218,400	Conventional Bore	There are no significant constraints on available crossing methods or significant environmental impacts relevant to the available methods. The direct aquatic impact will be avoided/minimized by use of the conventional bore method. A minor temporary impact associated with the bore to maintain access will be required.
			Conventional Bore	312	16	N	20	8	0	N	Y	$958,528		
Huntington	C-036	W-B39	Dry-Ditch Open-Cut	101	-	N	36	23	288	N	N	$70,700	Dry-Ditch Open-Cut	Avoiding/minimizing this minor impact through a conventional bore would require a deep bore pit - creating excessive spoil piles, with limited area for storage. Furthermore, the cost to bore is unreasonably high relative to the proposed construction method.
			Conventional Bore	101	24	N	36	23	288	N	N	$505,869		
Huntington	C-037	W-B31	Dry-Ditch Open-Cut	99	-	N	36	31	1103	N	Y	$69,300	Dry-Ditch Open-Cut	Avoiding/minimizing this minor impact through a conventional bore would require a deep bore pit on an extremely long and steep slope which would create excessive spoil piles in a topographical setting that requires an extensive winching system, all while being located within an already reduced LOD. Furthermore, the cost to bore is unreasonably high relative to the proposed construction method.
			Conventional Bore	99	25	N	36	31	1103	N	Y	$509,328		
Huntington	C-038	S-B34, S-B35, S-B36, S-B37, S-B38, W-B35, S-B42, S-B39b, S-B39a/B46, S-B45	Dry-Ditch Open-Cut	339	-	N	54	32	54	N	N	$345,189	Dry-Ditch Open-Cut	These crossings are located along steep slopes and would require the installation of bore pits nearly 40 feet deep requiring the excavation of an interim ramp and bench and dramatically increasing the space occupied by the bore pit and spoil pile. The bore pits would need to be located on a steep slope that would require a logistically difficult winching process. The duration of the trenchless crossing is nearly five times longer than the open-cut process, thereby increasing the noise, aesthetic, and other impacts on nearby persons. Reducing the time at the crossing and permanently stabilizing this area will reduce the potential for sedimentation and erosion along the hillside.
			Conventional Bore	339	38	N	54	32	54	N	N	$1,656,313		
Huntington	C-039	S-O4	Dry-Ditch Open-Cut	79	-	N	54	35	1723	N	N	$137,791	Dry-Ditch Open-Cut	This crossing is situated on a long steep slope leading into the resource. The topographical constraints would create an extreme winching system, creating a logistically difficult construction condition and deep bore pits. In addition there is insufficient area to store the bore pit stockpile in the immediate area. Furthermore, the cost to bore is unreasonably high relative to the proposed construction method.
			Conventional Bore	79	33	N	54	35	1723	N	N	$827,090		
Huntington	D-002	S-F36b	Dry-Ditch Open-Cut	38	-	N	27	11	0	N	Y	$97,221	Dry-Ditch Open-Cut	A trenchless crossing method at this location could not be completed without excavating a bore pit within a landowner's driveway and blocking access to their home. This situation would continue for several weeks. Accordingly, a trenchless crossing of this resource has been deemed logistically impracticable. Additionally, boring is not "appropriate and practicable" for this crossing of a perennial UNT to Birch River because the temporary impacts to be avoided are minor, especially when considered in light of the significant adverse impacts on the homeowner.
			Conventional Bore	38	26	N	27	11	0	N	Y	$345,345		

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				Crossing Length	Pit Depth	Deep Stream	Maximum Steep Slope (%)	Maximum Average Slope (%)	Maximum Winch Hill Length (feet)	Karst Terrain Present	Sufficient Stockpile Storage Available	Total Cost ($)		
Huntington	D-004	S-B32, W-B30	Dry-Ditch Open-Cut	59	-	N	39	26	188	N	N	$74,406	Conventional Bore	There are no significant constraints on available crossing methods or significant environmental impacts relevant to the available methods. The direct aquatic impact will be avoided/minimized by use of the conventional bore method. A minor temporary impact associated with the bore to maintain access will be required.
			Conventional Bore	59	20	N	39	26	188	N	N	$350,135		
Huntington	D-005	W-B28, S-B29	Dry-Ditch Open-Cut	112	-	N	52	40	262	N	N	$103,401	Dry-Ditch Open-Cut	This crossing is located on a slope that would require bore pits greater than 30 feet deep which would create excessive spoil piles, all while being located within an already reduced LOD. Furthermore, the cost to bore is unreasonably high relative to the proposed construction method.
			Conventional Bore	112	34	N	52	40	262	N	N	$939,013		
Huntington	D-006	S-E50, W-E21	Dry-Ditch Open-Cut	50	-	N	35	32	197	N	N	$57,357	Dry-Ditch Open-Cut	This crossing is located on a slope that would require bore pits that are 30 feet deep which would create excessive spoil piles, all while being located within an already reduced LOD. Furthermore, the time to bore the resources is nearly three times the duration of the open cut and the cost to bore is unreasonably high relative to the proposed construction method.
			Conventional Bore	50	30	N	35	32	197	N	N	$689,980		
Huntington	D-007	S-E50, W-E18-PSS, W-E18-PEM	Dry-Ditch Open-Cut	54	-	N	49	39	136	N	N	$60,157	Dry-Ditch Open-Cut	This crossing is located on a slope that would require bore pits that are nearly 30 feet deep which would create excessive spoil piles, all while being located within an already reduced LOD. Because the pipeline ROW must remain free of woody vegetation to protect the pipe coating, a conversion impact is unavoidable. Furthermore, the time to bore the resources is nearly double and the cost to bore is unreasonably high relative to the proposed construction method.
			Conventional Bore	54	26	N	49	39	136	N	N	$390,753		
Huntington	D-008	S-E49	Dry-Ditch Open-Cut	29	-	N	44	31	74	N	N	$23,805	Dry-Ditch Open-Cut	The UNT to Gauley River is approximately one foot in width, creating less than 0.01 acre of temporary impact. This crossing is located on a slope that would require bore pits that are nearly 30 feet deep which would create excessive spoil piles, all while being located within an already reduced LOD. Furthermore, the time to bore the resources is nearly double and the cost to bore is unreasonably high relative to the proposed construction method.
			Conventional Bore	29	26	N	44	31	74	N	N	$319,803		
Huntington	D-010	S-E46	Dry-Ditch Open-Cut	59	-	N	35	27	371	N	N	$151,288	Conventional Bore	There are no significant constraints on available crossing methods or significant environmental impacts relevant to the available methods. The direct aquatic impact will be avoided/minimized by use of the conventional bore method. A minor temporary impact associated with the bore to maintain access will be required.
			Conventional Bore	59	27	N	35	27	371	N	N	$414,078		
Huntington	D-011	W-F12, W-F13, W-F15	Dry-Ditch Open-Cut	174	-	N	7	4	0	N	Y	$121,800	Conventional Bore	There are no significant constraints on available crossing methods or significant environmental impacts relevant to the available methods. The direct aquatic impact will be avoided/minimized by use of the conventional bore method. A minor temporary impact associated with the bore to maintain access will be required.
			Conventional Bore	174	15	N	7	4	0	N	Y	$562,319		
Huntington	D-012	S-F20, W-F11	Dry-Ditch Open-Cut	104	-	N	8	4	0	N	Y	$109,699	Conventional Bore	There are no significant constraints on available crossing methods or significant environmental impacts relevant to the available methods. The direct aquatic impact will be avoided/minimized by use of the conventional bore method. A minor temporary impact associated with the bore to maintain access will be required.
			Conventional Bore	104	19	N	8	4	0	N	Y	$381,930		
Huntington	D-013	W-K23	Dry-Ditch Open-Cut	77	-	N	42	26	32	N	Y	$53,900	Dry-Ditch Open-Cut	This crossing is located adjacent to a slope that would require bore pits that are nearly 20 feet deep which would create excessive spoil piles, all while being located within an already reduced LOD. Furthermore, the cost to bore is unreasonably high relative to the proposed construction method.
			Conventional Bore	77	17	N	42	26	32	N	Y	$296,170		

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Huntington	D-014	S-IJ57, W-IJ51	Dry-Ditch Open-Cut	37	-	N	54	32	92	N	N	$38,154	Dry-Ditch Open-Cut	The open cut would result in approximately 0.05 acre of temporary impacts to the wetland and stream system. This crossing is located adjacent to a slope that would require bore pits that are over 30 feet deep requiring the excavation of an interim ramp and bench and dramatically increasing the space occupied by the bore pit and spoil pile. Furthermore, the cost to bore is unreasonably high relative to the proposed construction method and is estimated to take twice as long.
			Conventional Bore	37	33	N	54	32	92	N	N	$707,895		
Huntington	D-015	W-IJ50	Dry-Ditch Open-Cut	48	-	N	24	17	0	N	Y	$33,600	Dry-Ditch Open-Cut	This crossing is located on a slope that would require bore pits that are nearly 20 feet deep which would create excessive spoil piles, all while being located within an already reduced LOD. Furthermore, the time to complete the bore is nearly double and the cost to bore is unreasonably high relative to the proposed construction method.
			Conventional Bore	48	19	N	24	17	0	N	Y	$223,003		
Huntington	D-016	S-IJ60	Dry-Ditch Open-Cut	40	-	N	62	45	119	N	N	$48,516	Dry-Ditch Open-Cut	The crossing of this small UNT to Rockcamp Run (less than 10 feet in width) open cut would result in less than 0.02 acre of temporary impact. This crossing is located adjacent to a steep slope that would require bore pits that are over 40 feet deep which would create excessive spoil piles, all while being located within an already reduced LOD. Furthermore, the time to complete the bore is nearly six times the open cut method and the cost to bore is unreasonably high relative to the proposed construction method.
			Conventional Bore	40	42	N	62	45	119	N	N	$2,404,428		
Huntington	D-017	W-IJ55	Dry-Ditch Open-Cut	49	-	N	40	23	0	N	Y	$34,300	Dry-Ditch Open-Cut	The crossing of the small PEM system would result in approximately 0.02 acre of temporary impacts. This crossing is located on a slope that would require bore pits that are over 30 feet deep which would create excessive spoil piles, all while being located within an already reduced LOD. Furthermore, the time to complete the bore is nearly double the time of the open cut method and the cost to bore is unreasonably high relative to the proposed construction method.
			Conventional Bore	49	32	N	40	23	0	N	Y	$723,681		
Huntington	D-018	S-IJ62	Dry-Ditch Open-Cut	18	-	N	54	28	74	N	N	$20,473	Dry-Ditch Open-Cut	The crossing of this small UNT to Cherry Run (less than 5 feet in width) open cut would result in less than 0.01 acre of temporary impact. This crossing is located adjacent to a steep slope that would require bore pits that are nearly 30 feet deep which would create excessive spoil piles, all while being located within an already reduced LOD. Furthermore, the time to complete the bore is nearly double the time of the open cut method and the cost to bore is unreasonably high relative to the proposed construction method.
			Conventional Bore	18	32	N	54	28	74	N	N	$635,704		
Huntington	D-019	S-B28, W-B27	Dry-Ditch Open-Cut	47	-	N	6	3	0	N	Y	$70,318	Conventional Bore	There are no significant constraints on available crossing methods or significant environmental impacts relevant to the available methods. The direct aquatic impact will be avoided/minimized by use of the conventional bore method. A minor temporary impact associated with the bore to maintain access will be required.
			Conventional Bore	47	18	N	6	3	0	N	Y	$215,597		
Huntington	D-020	W-FF6-PEM, W-FF6-PSS	Dry-Ditch Open-Cut	158	-	N	22	11	0	N	Y	$110,600	Conventional Bore	There are no significant constraints on available crossing methods or significant environmental impacts relevant to the available methods. The direct aquatic impact will be avoided/minimized by use of the conventional bore method. A minor temporary impact associated with the bore to maintain access will be required.
			Conventional Bore	158	19	N	22	11	0	N	Y	$535,181		
Huntington	D-021	W-FF3	Dry-Ditch Open-Cut	37	-	N	23	11	0	N	Y	$25,900	Dry-Ditch Open-Cut	The crossing of the small PEM system would result in approximately 0.04 acre of temporary impacts. Furthermore, the cost to bore is unreasonably high relative to the proposed construction method.
			Conventional Bore	37	14	N	23	11	0	N	Y	$168,948		
Huntington	D-022	S-J32	Dry-Ditch Open-Cut	117	-	N	28	19	10	N	N	$207,247	Conventional Bore	There are no significant constraints on available crossing methods or significant environmental impacts relevant to the available methods. The direct aquatic impact will be avoided/minimized by use of the conventional bore method. A minor temporary impact associated with the bore to maintain access will be required.
			Conventional Bore	117	23	N	28	19	10	N	N	$542,142		

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USACE District	Crossing #	Waterbody	Crossing Methods Evaluated	Evaluation Factors									Proposed Crossing Method	Crossing Method Decision Rationale
				Crossing Length	Pit Depth	Deep Stream	Maximum Steep Slope (%)	Maximum Average Slope (%)	Maximum Winch Hill Length (feet)	Karst Terrain Present	Sufficient Stockpile Storage Available	Total Cost ($)		
Huntington	D-023	S-A76, W-FF4	Dry-Ditch Open-Cut	43	-	N	35	16	21	N	N	$51,257	Dry-Ditch Open-Cut	The crossing of the small PEM system and UNT to Big Beaver Creek would result in less than 0.02 acre of temporary impacts. The stream is less than ten feet in width. The bore pits associated with this crossing are 20 feet deep, which may require the use of a ramp and benching thereby creating excessive spoil piles, all while being located within an already reduced LOD. Furthermore, the cost to bore is unreasonably high relative to the proposed construction method.
			Conventional Bore	43	20	N	35	16	21	N	N	$304,727		
Huntington	D-024	W-A17	Dry-Ditch Open-Cut	79	-	N	16	9	0	N	Y	$55,300	Dry-Ditch Open-Cut	The duration of the trenchless crossing would take longer to complete than the open-cut process, thereby increasing the noise, aesthetic, and other impacts on nearby persons. Reducing the time at the crossing and permanently stabilizing this area will reduce the potential for sedimentation and erosion along the hillside. In addition, the cost to bore is unreasonably high relative to the proposed construction method.
			Conventional Bore	79	15	N	16	9	0	N	Y	$292,711		
Huntington	D-025	S-A75	Dry-Ditch Open-Cut	25	-	N	31	13	0	N	Y	$47,961	Dry-Ditch Open-Cut	Stream S-A75 is an UNT to Big Beaver Creek and would have approximately 0.02 acre of temporary impact. The resource is located adjacent to a slope that would require a bore pit exceeding 20 feet. Bore pits of this depth require an interim ramp and benching to successfully reach the required depth. The deep excavation will create an excessive amount of spoil material that will be difficult to store within the already reduced LOD. In addition, the cost to bore is unreasonably high relative to the proposed construction method.
			Conventional Bore	25	22	N	31	13	0	N	Y	$271,913		
Huntington	D-026	S-A74	Dry-Ditch Open-Cut	29	-	N	31	14	0	N	Y	$32,194	Dry-Ditch Open-Cut	An open cut crossing would create approximately 0.007 acre of temporary impact. However the resource is located on a slope that would require a bore pit nearing 20 feet. Bore pits of this depth may require an interim ramp and benching to successfully reach the required depth. The deep excavation will create an excessive amount of spoil material that will be difficult to store within the already reduced LOD. In addition, the cost to bore is unreasonably high relative to the proposed construction method.
			Conventional Bore	29	19	N	31	14	0	N	Y	$169,081		
Huntington	D-027	S-A73, W-A15	Dry-Ditch Open-Cut	59	-	N	18	13	0	N	Y	$64,472	Dry-Ditch Open-Cut	The open cut would result in approximately 0.10 acre of temporary impacts to the wetland and stream. This crossing is located on a slope requiring bore pits that are over 20 feet deep which necessitate the use of a ramp and benching, resulting in excessive spoil piles, all while being located within an already reduced LOD. Because the pipeline ROW must remain free of woody vegetation to protect the pipe coating, a conversion impact to the wetland is unavoidable. Furthermore, the cost to bore is unreasonably high relative to the proposed construction method.
			Conventional Bore	59	23	N	18	13	0	N	Y	$377,539		
Huntington	D-028	W-A14, S-A72, S-A71, S-A71-Braid	Dry-Ditch Open-Cut	92	-	N	35	25	20	N	N	$94,208	Conventional Bore	There are no significant constraints on available crossing methods or significant environmental impacts relevant to the available methods. The direct aquatic impact will be avoided/minimized by use of the conventional bore method. A minor temporary impact associated with the bore to maintain access will be required.
			Conventional Bore	92	22	N	35	25	20	N	N	$462,058		
Huntington	D-029	S-A67	Dry-Ditch Open-Cut	24	-	N	40	27	50	N	N	$37,518	Dry-Ditch Open-Cut	Crossings D-029 and D-30 are immediately adjacent to each other and have been evaluated in concert. A trenchless crossing method at this location could not be completed without excavating a bore pit within a landowner's driveway and blocking access to their home. This situation would continue for several weeks. Accordingly, a trenchless crossing of these resources has been deemed logistically impracticable. Additionally, boring is not "appropriate and practicable" for these crossings (a small perennial and intermittent UNT to Big Beaver Creek) because the temporary impacts to be avoided are minor, especially when considered in light of the significant adverse impacts on the homeowner. Furthermore, the cost to avoid the temporary impacts is unreasonably high relative to the proposed construction method.
			Conventional Bore	24	23	N	40	27	50	N	N	$278,209		
Huntington	D-030	S-A69	Dry-Ditch Open-Cut	53	-	N	30	24	0	N	Y	$62,886	Dry-Ditch Open-Cut	Crossings D-029 and D-30 are immediately adjacent to each other and have been evaluated in concert. A trenchless crossing method at this location could not be completed without excavating a bore pit within a landowner's driveway and blocking access to their home. This situation would continue for several weeks. Accordingly, a trenchless crossing of these resources has been deemed logistically impracticable. Additionally, boring is not "appropriate and practicable" for these crossings (a small perennial and intermittent UNT to Big Beaver Creek) because the temporary impacts to be avoided are minor, especially when considered in light of the significant adverse impacts on the homeowner. Furthermore, the cost to avoid the temporary impacts is unreasonably high relative to the proposed construction method.
			Conventional Bore	53	23	N	30	24	0	N	Y	$360,511		
Huntington	D-031	W-H53, S-H99	Dry-Ditch Open-Cut	37	-	N	24	14	11	N	N	$40,220	Dry-Ditch Open-Cut	The open cut would result in approximately 0.01 acre of temporary impacts to the wetland and stream. The stream is extremely small, less than five feet in width and the wetland barely enters the LOD. However, the trenchless crossing would require bore pits that are approximately 20 feet deep. Bore pits of this depth may necessitate the use of a ramp and benching, resulting in excessive spoil piles that would need to be located within an already reduced LOD. The minimized LOD is insufficient to stockpile the material. Furthermore, the cost to bore is unreasonably high relative to the proposed construction method.
			Conventional Bore	37	20	N	24	14	11	N	N	$287,699		

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				Crossing Length	Pit Depth	Deep Stream	Maximum Steep Slope (%)	Maximum Average Slope (%)	Maximum Winch Hill Length (feet)	Karst Terrain Present	Sufficient Stockpile Storage Available	Total Cost ($)		
Huntington	D-032	S-A65	Dry-Ditch Open-Cut	99	-	N	58	45	441	N	N	$321,268	Dry-Ditch Open-Cut	The crossing of Big Beaver Creek using a trenchless method would require bore pits up to 40-feet deep. The crossing is also located adjacent to a long steep slope. The combination of deep bore pits and steep slopes would require excessive excavation, the need for significant stock pile storage, and a using an extensive winching system. Furthermore, the time to complete the bore is nearly six times the open cut method and the cost to bore is unreasonably high relative to the proposed construction method.
			Conventional Bore	99	40	N	58	45	441	N	N	$2,462,779		
Huntington	D-034	S-N15	Dry-Ditch Open-Cut	40	-	N	39	33	132	N	N	$70,014	Conventional Bore	There are no significant constraints on available crossing methods or significant environmental impacts relevant to the available methods. The direct aquatic impact will be avoided/minimized by use of the conventional bore method. A minor temporary impact associated with the bore to maintain access will be required.
			Conventional Bore	40	23	N	39	33	132	N	N	$323,617		
Huntington	D-035	S-N14	Dry-Ditch Open-Cut	44	-	N	12	6	0	N	Y	$65,040	Conventional Bore	There are no significant constraints on available crossing methods or significant environmental impacts relevant to the available methods. The direct aquatic impact will be avoided/minimized by use of the conventional bore method. A minor temporary impact associated with the bore to maintain access will be required.
			Conventional Bore	44	17	N	12	6	0	N	Y	$202,516		
Huntington	D-036	S-I43, W-I7	Dry-Ditch Open-Cut	73	-	N	26	16	0	N	Y	$87,745	Conventional Bore	There are no significant constraints on available crossing methods or significant environmental impacts relevant to the available methods. The direct aquatic impact will be avoided/minimized by use of the conventional bore method. A minor temporary impact associated with the bore to maintain access will be required.
			Conventional Bore	73	20	N	26	16	0	N	Y	$389,867		
Huntington	D-037	S-I44	Dry-Ditch Open-Cut	32	-	N	28	19	0	N	Y	$52,288	Conventional Bore	There are no significant constraints on available crossing methods or significant environmental impacts relevant to the available methods. The direct aquatic impact will be avoided/minimized by use of the conventional bore method. A minor temporary impact associated with the bore to maintain access will be required.
			Conventional Bore	32	19	N	28	19	0	N	Y	$177,595		
Huntington	D-038	S-I45	Dry-Ditch Open-Cut	20	-	N	51	21	10	N	N	$33,704	Conventional Bore	There are no significant constraints on available crossing methods or significant environmental impacts relevant to the available methods. The direct aquatic impact will be avoided/minimized by use of the conventional bore method. A minor temporary impact associated with the bore to maintain access will be required.
			Conventional Bore	20	19	N	51	21	10	N	N	$143,539		
Huntington	D-039	S-I47	Dry-Ditch Open-Cut	27	-	N	15	12	0	N	Y	$24,803	Dry-Ditch Open-Cut	Stream S-I47 is an UNT to Gauley River and is very small - less than five feet in width. The temporary impact associated with an open cut is less than 0.01 acre. The cost to bore is unreasonably high relative to the proposed construction method.
			Conventional Bore	27	14	N	15	12	0	N	Y	$140,568		
Huntington	D-040	S-I48	Dry-Ditch Open-Cut	35	-	N	33	16	41	N	N	$59,850	Conventional Bore	There are no significant constraints on available crossing methods or significant environmental impacts relevant to the available methods. The direct aquatic impact will be avoided/minimized by use of the conventional bore method. A minor temporary impact associated with the bore to maintain access will be required.
			Conventional Bore	35	14	N	33	16	41	N	N	$163,272		
Huntington	D-041	S-J29	Dry-Ditch Open-Cut	420	-	N	54	0	1732	N	Y	$1,389,500	Dry-Ditch Open-Cut	Mountain Valley has committed to the USFWS that the Gauley River would be bored to prevent possible impacts to potential Candy Darter habitat.
			Microtunnel	420	57	N	54	0	1732	N	Y	$7,309,091		

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USACE District	Crossing #	Waterbody	Crossing Methods Evaluated	Evaluation Factors									Proposed Crossing Method	Crossing Method Decision Rationale
				Crossing Length	Pit Depth	Deep Stream	Maximum Steep Slope (%)	Maximum Average Slope (%)	Maximum Winch Hill Length (feet)	Karst Terrain Present	Sufficient Stockpile Storage Available	Total Cost ($)		
Huntington	D-042	W-J8, S-J28	Dry-Ditch Open-Cut	87	-	N	43	27	306	N	N	$78,505	Dry-Ditch Open-Cut	The open cut would result in approximately 0.06 acre of temporary impacts to the wetland and stream. This crossing is located on a slope that would require bore pits that are nearly 30 feet deep which would create excessive spoil piles and require multiple winching equipment, all while being located within an already reduced LOD. Because the pipeline ROW must remain free of woody vegetation to protect the pipe coating, a conversion impact to the wetland is unavoidable. Furthermore, the time to bore the resources is double and the cost to bore is unreasonably high relative to the proposed construction method.
			Conventional Bore	87	26	N	43	27	306	N	N	$484,406		
Huntington	D-043	S-J25	Dry-Ditch Open-Cut	73	-	N	29	18	0	N	Y	$69,641	Dry-Ditch Open-Cut	The temporary impact associated with an open cut is less than 0.01 acre. However, the trenchless crossing would require bore pits that are approximately 20 feet deep. Bore pits of this depth may necessitate the use of a ramp and benching, resulting in excessive spoil piles that would need to be located within an already reduced LOD. The minimized LOD is insufficient to stockpile the material. Furthermore, the cost to bore is unreasonably high relative to the proposed construction method.
			Conventional Bore	73	21	N	29	18	0	N	Y	$399,001		
Huntington	D-044	S-J24	Dry-Ditch Open-Cut	73	-	N	31	9	0	N	Y	$103,246	Dry-Ditch Open-Cut	This area has been subject to frequent flooding from adjacent streams, which previously caused Mountain Valley to relocate a mainline valve to a different location. These conditions present an unacceptable risk for crews and equipment completing a bore at this location over an extended duration. Completing this crossing of a small UNT to Little Laurel Creek with an open cut minimizes the time construction crews and equipment must be onsite, thereby greatly reducing risks to the safety of the crew, the environment, and the success of the crossing installation.
			Conventional Bore	73	17	N	31	9	0	N	Y	$284,818		
Huntington	D-045	S-J23-EPH	Dry-Ditch Open-Cut	25	-	N	23	14	0	N	Y	$20,978	Dry-Ditch Open-Cut	Stream S-J23 is an UNT to Little Laurel Creek and is very small - less than two feet in width. The temporary impact associated with an open cut is less than 0.01 acre. However, the trenchless crossing would require bore pits that are approximately 20 feet deep. Bore pits of this depth may necessitate the use of a ramp and benching, resulting in excessive spoil piles that would need to be located within an already reduced LOD. The minimized LOD is insufficient to stockpile the material. Furthermore, the cost to bore is unreasonably high relative to the proposed construction method.
			Conventional Bore	25	17	N	23	14	0	N	Y	$148,594		
Huntington	D-046	S-J22, W-J7	Dry-Ditch Open-Cut	58	-	N	23	18	0	N	Y	$52,396	Dry-Ditch Open-Cut	The trenchless crossing would require bore pits that are approximately 20 feet deep. Bore pits of this depth may necessitate the use of a ramp and benching, resulting in excessive spoil piles that would need to be located within an already reduced LOD. The minimized LOD is insufficient to stockpile the material. Because the pipeline ROW must remain free of woody vegetation to protect the pipe coating, a conversion impact is unavoidable. Furthermore, the cost to bore is unreasonably high relative to the proposed construction method.
			Conventional Bore	58	21	N	23	18	0	N	Y	$356,431		
Huntington	D-047	S-N10, S-N10-Braid	Dry-Ditch Open-Cut	84	-	N	25	18	0	N	Y	$78,469	Dry-Ditch Open-Cut	The resources are very small (less than five feet in width) UNT to Skelt Run. The trenchless crossing would require bore pits that are approximately 20 feet deep. Bore pits of this depth may necessitate the use of a ramp and benching, resulting in excessive spoil piles that would need to be located within an already reduced LOD. The minimized LOD is insufficient to stockpile the material. Furthermore, the cost to bore is unreasonably high relative to the proposed construction method.
			Conventional Bore	84	20	N	25	18	0	N	Y	$421,084		
Huntington	D-048	S-EE1	Dry-Ditch Open-Cut	30	-	N	17	11	0	N	Y	$33,872	Conventional Bore	There are no significant constraints on available crossing methods or significant environmental impacts relevant to the available methods. The direct aquatic impact will be avoided/minimized by use of the conventional bore method. A minor temporary impact associated with the bore to maintain access will be required.
			Conventional Bore	30	15	N	17	11	0	N	Y	$153,650		
Huntington	D-049	S-N13	Dry-Ditch Open-Cut	27	-	N	38	18	0	N	Y	$26,485	Dry-Ditch Open-Cut	The stream is a very small (less than five feet in width) UNT to Skelt Run. The trenchless crossing would require bore pits that are approximately 20 feet deep. Bore pits of this depth may necessitate the use of a ramp and benching, resulting in excessive spoil piles that would need to be located within an already reduced LOD. The minimized LOD is insufficient to stockpile the material. Furthermore, the cost to bore is unreasonably high relative to the proposed construction method.
			Conventional Bore	27	18	N	38	18	0	N	Y	$158,838		
Huntington	D-050	S-L41	Dry-Ditch Open-Cut	88	-	N	77	63	644	N	N	$132,036	Dry-Ditch Open-Cut	The crossing of the Jims Creek (S-L41) using a trenchless method would require bore pits that are nearly 60 feet deep. In addition, the crossing is at the base of an extremely long and steep approach. Avoiding/minimizing this minor impact through a conventional bore would require a deep bore pit which would create excessive spoil piles in a topographical setting that would require a technically and logistically difficult winching system, all while being located within an already reduced LOD. Furthermore, the cost to bore is unreasonably high relative to the proposed construction method and would take more than twice as long to complete.
			Conventional Bore	88	58	N	77	63	644	N	N	$3,413,379		

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USACE District	Crossing #	Waterbody	Crossing Methods Evaluated	Evaluation Factors: Crossing Length	Pit Depth	Deep Stream	Maximum Steep Slope (%)	Maximum Average Slope (%)	Maximum Winch Hill Length (feet)	Karst Terrain Present	Sufficient Stockpile Storage Available	Total Cost ($)	Proposed Crossing Method	Crossing Method Decision Rationale
Huntington	D-051	S-L38	Dry-Ditch Open-Cut	66	-	N	34	29	21	N	N	$56,701	Dry-Ditch Open-Cut	Stream S-L38 is an UNT to Riley Branch and is very small - less than five feet in width. The crossing is located adjacent to a steep slope. The temporary impact associated with an open cut is less than 0.01 acre. The trenchless crossing would require bore pits that are approximately 30 feet deep. Avoiding/minimizing this minor impact through a conventional bore would require a deep bore pit which would create excessive spoil piles in a topographical setting that would require a technically and logistically difficult winching system, all while being located within an already reduced LOD. Furthermore, the cost to bore is unreasonably high relative to the proposed construction method.
			Conventional Bore	66	32	N	34	29	21	N	N	$771,927		
Huntington	D-052	S-L35	Dry-Ditch Open-Cut	28	-	N	29	21	10	N	N	$34,350	Dry-Ditch Open-Cut	S-L35 is Riley Branch is less than four feet wide through the project area. Crossing #D-052, 053, and 054 are discussed together since the requirements associated with a trenchless crossing are applicable to all three crossings. Each of these crossings would require a bore pit exceeding 20 feet, with D-054 exceeding 30 feet. Bore pits of this depth result in a significant amount of excavated material that must be stockpiled. The excess material is not only associated with the depth of the bore, but also the access ramps and associated benching that would be required to reach depths greater than 20 feet. Each of these crossings is also located near a steep slope which reduces the available area to stockpile soils without compromising worker safety. In addition to the deep bore pits and limited operating room, the costs to bore these crossings is unreasonably high relative to the proposed construction method.
			Conventional Bore	28	21	N	29	21	10	N	N	$271,292		
Huntington	D-053	S-L35	Dry-Ditch Open-Cut	42	-	N	30	16	0	N	Y	$46,900	Dry-Ditch Open-Cut	S-L35 is Riley Branch is less than four feet wide through the project area. Crossing #D-052, 053, and 054 are discussed together since the requirements associated with a trenchless crossing are applicable to all three crossings. Each of these crossings would require a bore pit exceeding 20 feet, with D-054 exceeding 30 feet. Bore pits of this depth result in a significant amount of excavated material that must be stockpiled. The excess material is not only associated with the depth of the bore, but also the access ramps and associated benching that would be required to reach depths greater than 20 feet. Each of these crossings is also located near a steep slope which reduces the available area to stockpile soils without compromising worker safety. In addition to the deep bore pits and limited operating room, the costs to bore these crossings is unreasonably high relative to the proposed construction method.
			Conventional Bore	42	21	N	30	16	0	N	Y	$311,024		
Huntington	D-054	S-L35	Dry-Ditch Open-Cut	51	-	N	32	25	20	N	N	$53,200	Dry-Ditch Open-Cut	S-L35 is Riley Branch is less than four feet wide through the project area. Crossing #D-052, 053, and 054 are discussed together since the requirements associated with a trenchless crossing are applicable to all three crossings. Each of these crossings would require a bore pit exceeding 20 feet, with D-054 exceeding 30 feet. Bore pits of this depth result in a significant amount of excavated material that must be stockpiled. The excess material is not only associated with the depth of the bore, but also the access ramps and associated benching that would be required to reach depths greater than 20 feet. Each of these crossings is also located near a steep slope which reduces the available area to stockpile soils without compromising worker safety. In addition to the deep bore pits and limited operating room, the costs to bore these crossings is unreasonably high relative to the proposed construction method.
			Conventional Bore	51	33	N	32	25	20	N	N	$747,627		
Huntington	D-055	S-I37	Dry-Ditch Open-Cut	36	-	N	38	25	32	N	Y	$46,550	Dry-Ditch Open-Cut	This resource is an extremely small UNT to Hominy Creek. The width of the stream is less than 10 feet. Due to the location on steep slopes, the bore pits for this stream are nearly 20 feet in depth. Avoiding/minimizing this minor impact through a conventional bore would create excessively deep bore pits and spoil piles. Furthermore the cost to bore is unreasonably high relative to the proposed construction method.
			Conventional Bore	36	20	N	38	25	32	N	Y	$284,861		
Huntington	D-056	S-I38, S-I39	Dry-Ditch Open-Cut	142	-	N	63	45	436	N	N	$126,985	Dry-Ditch Open-Cut	Both of these resources are UNT to Hominy Creek and each is less than 10 feet in width. Due to the location on steep slopes, the bore pits for this crossing are nearly 50 feet in depth. Avoiding/minimizing this minor impact through a conventional bore would require a deep bore pit which would create excessive spoil piles in a topographical setting that would require a technically and logistically difficult winching system, all while being located within an already reduced LOD. Furthermore, the cost to bore is unreasonably high relative to the proposed construction method.
			Conventional Bore	142	47	N	63	45	436	N	N	$2,966,630		
Huntington	D-057	S-I40	Dry-Ditch Open-Cut	24	-	N	59	27	104	N	N	$39,183	Dry-Ditch Open-Cut	Stream S-I40 is an UNT to Hominy Creek and is very small - less than ten feet in width. The trenchless crossing would require bore pits that are more than 20 feet deep. Avoiding/minimizing this minor impact through a conventional bore would require a deep bore pit near a steep slope which would create excessive spoil piles in an already reduced LOD. Furthermore, the cost to bore is unreasonably high relative to the proposed construction method.
			Conventional Bore	24	26	N	59	27	104	N	N	$305,614		
Huntington	D-058	W-I11a, S-I41	Dry-Ditch Open-Cut	47	-	N	42	10	489	N	Y	$62,159	Dry-Ditch Open-Cut	D-058 and D-059 are adjacent crossings are discussed together due to their proximity. These crossings present multiple confounding constructability challenges that limit the available options and necessitated the development of a unique solution. The access to the location of these crossings is severely limited by long steep slopes, and there is insufficient suitable workspace available for construction equipment and spoil piles necessary to complete a trenchless crossing. A minor temporary impact associated with the bore to maintain access will be required.
			Conventional Bore	47	13	N	42	10	489	N	Y	$192,761		
Huntington	D-059	S-I36	Dry-Ditch Open-Cut	116	-	Y	16	7	840	N	N	$279,787	Dry-Ditch Open-Cut	D-058 and D-059 are adjacent crossings are discussed together due to their proximity. These crossings present multiple confounding constructability challenges that limit the available options and necessitated the development of a unique solution. The access to the location of these crossings is severely limited by long steep slopes, and there is insufficient suitable workspace

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Huntington	D-059	S-I30	Conventional Bore	116	26	Y	16	7	840	N	N	$566,708	Dry-Ditch Open-Cut	The access to the location of these crossings is severely limited by long steep slopes, and there is insufficient suitable workspace available for construction equipment and spoil piles necessary to complete a trenchless crossing. A minor temporary impact associated with the bore to maintain access will be required.
Huntington	D-061	S-I31	Dry-Ditch Open-Cut	25	-	N	38	32	424	N	N	$26,015	Dry-Ditch Open-Cut	The bore pits for this crossing are greater than 20 feet in depth and the crossing is located on a long steep slope. Avoiding/minimizing this minor impact through a conventional bore would require a deep bore pit which would create excessive spoil piles in a topographical setting that would require a technically and logistically difficult winching system, all while being located within an already reduced LOD. Furthermore, the cost to bore is unreasonably high relative to the proposed construction method.
			Conventional Bore	25	22	N	38	32	424	N	N	$271,913		
Huntington	E-001	S-H88	Dry-Ditch Open-Cut	37	-	N	45	35	122	N	N	$167,104	Dry-Ditch Open-Cut	A trenchless crossing method at this location could not be completed without excavating a bore pit within proximity to a landowner private drive. Completing an open cut in this location greatly reduces the construction duration and access can be maintained using road plates. A trenchless crossing of this resource has been deemed logistically impracticable due to the need to maintain the landowner's access over an extended duration and the safety risk of operating heavy equipment for an extended time with a private landowner in close proximity and traversing the site.
			Conventional Bore	37	32	N	45	35	122	N	N	$689,625		
Huntington	E-002	S-H71, W-H33, W-H35	Dry-Ditch Open-Cut	150	-	N	75	46	282	N	N	$157,500	Dry-Ditch Open-Cut	This group of resources are located adjacent to a steep slope with bore pits to be 80 feet deep. Avoiding/minimizing this minor impact through a conventional bore would create extremely excessive spoil piles in a topographical setting that would require a technically and logistically difficult winching system, all while being located within an already reduced LOD. Furthermore, the cost to bore is unreasonably high relative to the proposed construction method.
			Conventional Bore	150	80	N	75	46	282	N	N	$4,789,334		
Huntington	E-003	S-H67	Dry-Ditch Open-Cut	30	-	N	39	24	31	N	N	$60,392	Dry-Ditch Open-Cut	The trenchless crossing would require bore pits that are more than 20 feet deep. Avoiding/minimizing this minor impact (approximately 0.02 acre) through a conventional bore would require a deep bore pit creating excessive spoil piles in an already reduced LOD. Furthermore, the cost to bore is unreasonably high relative to the proposed construction method.
			Conventional Bore	30	24	N	39	24	31	N	N	$304,372		
Huntington	E-004	S-H64, W-H31	Dry-Ditch Open-Cut	54	-	N	26	10	0	N	Y	$52,782	Dry-Ditch Open-Cut	The trenchless crossing would require bore pits that are more than 20 feet deep. Avoiding/minimizing this minor impact (approximately 0.03 acre) through a conventional bore would require a deep bore pit creating excessive spoil piles in an already reduced LOD. Furthermore, the cost to bore is unreasonably high relative to the proposed construction method.
			Conventional Bore	54	24	N	26	10	0	N	Y	$372,484		
Huntington	E-005	S-V3	Dry-Ditch Open-Cut	56	-	N	47	26	342	N	N	$240,231	Conventional Bore	There are no significant constraints on available crossing methods or significant environmental impacts relevant to the available methods. The direct aquatic impact will be avoided/minimized by use of the conventional bore method. A minor temporary impact associated with the bore to maintain access will be required.
			Conventional Bore	56	23	N	47	26	342	N	N	$369,025		
Huntington	E-006	W-EF31, S-EF41	Dry-Ditch Open-Cut	55	-	N	20	9	0	N	Y	$44,212	Dry-Ditch Open-Cut	The trenchless crossing would require bore pits that are more than 20 feet deep, which would necessitate benching and stockpiling significant amounts of spoil material. Furthermore, the cost to bore is unreasonably high relative to the proposed construction method.
			Conventional Bore	55	21	N	20	9	0	N	Y	$347,918		
Huntington	E-009	W-M18	Dry-Ditch Open-Cut	223	-	N	35	10	0	N	Y	$156,100	Conventional Bore	There are no significant constraints on available crossing methods or significant environmental impacts relevant to the available methods. The direct aquatic impact will be avoided/minimized by use of the conventional bore method. A minor temporary impact associated with the bore to maintain access will be required.
			Conventional Bore	223	17	N	35	10	0	N	Y	$710,515		
Huntington	E-010	W-M22, W-M23	Dry-Ditch Open-Cut	86	-	N	26	16	0	N	Y	$60,200	Dry-Ditch Open-Cut	The trenchless crossing would require bore pits that are nearly 20 feet deep, which may necessitate benching and stockpiling significant amounts of spoil material. Because the pipeline ROW must remain free of woody vegetation to protect the pipe

USACE District	Crossing #	Waterbody	Crossing Methods Evaluated	Evaluation Factors: Crossing Length	Pit Depth	Deep Stream	Maximum Steep Slope (%)	Maximum Average Slope (%)	Maximum Winch Hill Length (feet)	Karst Terrain Present	Sufficient Stockpile Storage Available	Total Cost ($)	Proposed Crossing Method	Crossing Method Decision Rationale
Huntington	E-010	W-M22, W-M23	Conventional Bore	86	17	N	26	16	0	N	Y	$321,711	Dry-Ditch Open-Cut	coating, a conversion impact is unavoidable. Furthermore, the cost to bore is unreasonably high relative to the proposed construction method and would take twice as long to complete.
Huntington	E-011	W-J6	Dry-Ditch Open-Cut	101	-	N	26	10	0	N	Y	$70,700	Dry-Ditch Open-Cut	The trenchless crossing would require bore pits that are nearly 20 feet deep, which may necessitate benching and stockpiling significant amounts of spoil material. Because the pipeline ROW must remain free of woody vegetation to protect the pipe coating, a conversion impact is unavoidable. Furthermore, the cost to bore is unreasonably high relative to the proposed construction method .
			Conventional Bore	101	15	N	26	10	0	N	Y	$355,146		
Huntington	E-012	S-J20	Dry-Ditch Open-Cut	255	-	N	43	16	327	N	N	$298,496	Conventional Bore	FERC has approved the variance for this crossing which will be completed during the boring of the adjacent rail line.
			Conventional Bore	255	37	N	43	16	327	N	N	$1,399,653		
Huntington	E-013	S-I25	Dry-Ditch Open-Cut	89	-	N	34	24	10	N	N	$79,837	Dry-Ditch Open-Cut	Stream S-I25 is an UNT to Meadow Creek and is very small - less than ten feet in width. The trenchless crossing would require bore pits that are more than 20 feet deep. Avoiding/minimizing this minor impact through a conventional bore would require a deep bore pit which would create excessive spoil piles in an already reduced LOD. Furthermore, the cost to bore is unreasonably high relative to the proposed construction method.
			Conventional Bore	89	26	N	34	24	10	N	N	$490,082		
Huntington	E-014	S-I26	Dry-Ditch Open-Cut	26	-	N	31	20	10	N	N	$33,826	Dry-Ditch Open-Cut	Stream S-I26 is an UNT to Meadow Creek and is very small - less than ten feet in width. The trenchless crossing would require bore pits that are more than 20 feet deep. Avoiding/minimizing this minor impact through a conventional bore would require a deep bore pit which would create excessive spoil piles in an already reduced LOD. Furthermore, the cost to bore is unreasonably high relative to the proposed construction method.
			Conventional Bore	26	20	N	31	20	10	N	N	$256,481		
Huntington	E-015	S-I27	Dry-Ditch Open-Cut	41	-	N	17	13	0	N	Y	$46,828	Conventional Bore	There are no significant constraints on available crossing methods or significant environmental impacts relevant to the available methods. The direct aquatic impact will be avoided/minimized by use of the conventional bore method. A minor temporary impact associated with the bore to maintain access will be required. A minor temporary impact associated with the bore to maintain access will be required.
			Conventional Bore	41	18	N	17	13	0	N	Y	$198,570		
Huntington	E-016	W-HS1	Dry-Ditch Open-Cut	41	-	N	54	33	724	N	N	$28,700	Dry-Ditch Open-Cut	The bore pits for this crossing are greater than 30 feet in depth . Avoiding/minimizing this minor impact through a conventional bore would require a deep bore pit on an extremely long and steep slope which would create excessive spoil piles in a topographical setting that would require a technically and logistically difficult winching system, all while being located within an already reduced LOD. Furthermore, the cost to bore is unreasonably high relative to the proposed construction method.
			Conventional Bore	41	32	N	54	33	724	N	N	$700,977		
Huntington	E-017	W-QR2	Dry-Ditch Open-Cut	322	-	N	10	8	0	N	Y	$225,400	Dry-Ditch Open-Cut	A trenchless crossing in this location would require bore pits that are nearly thirty feet deep, which necessitates the use of a bench and interim ramp to access the bore pit. Avoiding/minimizing this minor impact through a conventional bore would create excessive spoil piles in an already reduced LOD. Furthermore, the cost to bore is unreasonably high relative to the proposed construction method.
			Conventional Bore	322	27	N	10	8	0	N	Y	$1,160,467		
Huntington	E-018	S-L26, W-L16	Dry-Ditch Open-Cut	42	-	N	27	9	0	N	Y	$42,210	Dry-Ditch Open-Cut	This crossing is immediately adjacent to a mainline valve. Trenchless crossing methods are logistically difficult because they would require the pipe to be installed too deeply to facilitate connection to the valve site. An open cut crossing is necessary to facilitate connection to the mainline valve. Furthermore, using a conventional bore method to avoid a temporary impact to this small intermittent stream and wetland would be unreasonably high relative to the proposed construction method.
			Conventional Bore	42	23	N	27	9	0	N	Y	$329,293		
Huntington	E-019	S-L27	Dry-Ditch Open-Cut	90	-	N	18	11	0	N	Y	$70,012	Dry-Ditch Open-Cut	There are no significant constraints on available crossing methods or significant environmental impacts relevant to the available methods. The direct aquatic impact will be avoided/minimized by use of the conventional bore method. A minor temporary impact

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USACE District	Crossing #	Waterbody	Crossing Methods Evaluated	Evaluation Factors									Proposed Crossing Method	Crossing Method Decision Rationale
				Crossing Length	Pit Depth	Deep Stream	Maximum Steep Slope (%)	Maximum Average Slope (%)	Maximum Winch Hill Length (feet)	Karst Terrain Present	Sufficient Stockpile Storage Available	Total Cost ($)		
Huntington	E-019	S-L27	Conventional Bore	90	19	N	18	11	0	N	Y	$342,198	Dry-Ditch Open-Cut	methods. The direct aquatic impact will be avoided/minimized by use of the conventional bore method. A minor temporary impact associated with the bore to maintain access will be required.
Huntington	E-020	S-L30, W-L19, W-L12, W-L13, S-L22	Dry-Ditch Open-Cut	315	-	N	77	46	1723	N	N	$325,500	Dry-Ditch Open-Cut	Due to the location on steep slopes, the bore pits for this crossing are greater than sixty feet in depth which would create extremely excessive spoil piles in a topographical setting that would require a technically and logistically difficult winching system, all while being located within an already reduced LOD. Furthermore, the cost to bore is unreasonably high relative to the proposed construction method and would take nearly 60 days as long to complete.
			Conventional Bore	315	62	N	77	46	1723	N	N	$4,275,783		
Huntington	E-021	W-L11, S-L20	Dry-Ditch Open-Cut	53	-	N	76	43	765	N	N	$54,697	Dry-Ditch Open-Cut	Due to the location, the bore pits for this crossing are greater than thirty feet in depth. Avoiding/minimizing this minor impact (approximately 0.03 acre) through a conventional bore would require a deep bore pit which would create excessive spoil piles in a topographical setting that would require a technically and logistically difficult winching system, all while being located within an already reduced LOD. Furthermore, the cost to bore is unreasonably high relative to the proposed construction method.
			Conventional Bore	53	31	N	76	43	765	N	N	$716,764		
Huntington	E-022	W-L4, S-L10, S-L11, W-L2	Dry-Ditch Open-Cut	92	-	N	32	20	0	N	Y	$85,538	Dry-Ditch Open-Cut	A trenchless crossing in this location would require bore pits that are greater than twenty feet deep, which necessitates the use of a bench and interim ramp to access the bore pit. Avoiding/minimizing this minor impact through a conventional bore would create excessive spoil piles in an already reduced LOD. Furthermore, the cost to bore is unreasonably high relative to the proposed construction method.
			Conventional Bore	92	25	N	32	20	0	N	Y	$489,462		
Huntington	E-023	S-I21, S-I22	Dry-Ditch Open-Cut	70	-	N	37	28	249	N	N	$66,994	Dry-Ditch Open-Cut	A trenchless crossing in this location would require bore pits that are greater than twenty feet deep, which necessitates the use of a bench and interim ramp to access the bore pit. Avoiding/minimizing this minor impact through a conventional bore would create excessive spoil piles in an already reduced LOD. Furthermore, the cost to bore is unreasonably high relative to the proposed construction method.
			Conventional Bore	70	28	N	37	28	249	N	N	$454,430		
Huntington	F-001	W-K7, S-K17, W-IJ30, W-UV9, W-UV11, W-UV10, W-K9-PEM-1, S-K19	Dry-Ditch Open-Cut	1168	-	N	28	20	92	N	Y	$887,600	Dry-Ditch Open-Cut	A trenchless crossing in this location would require bore pits that are nearly twenty feet deep. Numerous cultural resources have been avoided by the current alignment. Avoiding/minimizing this minor impact through a conventional bore would create excessive spoil piles in an already reduced LOD. The trenchless crossing method would take nearly 160 days to complete, while the proposed method would take approximately 24 days to complete -- compounding the noise, aesthetic, and other impacts on nearby persons. Furthermore, the cost to bore is unreasonably high relative to the proposed construction method.
			Direct Pipe	1168	15	N	28	20	92	N	Y	$9,412,510		
Huntington	F-002	S-K21, S-K22	Dry-Ditch Open-Cut	123	-	N	78	32	185	N	N	$125,156	Dry-Ditch Open-Cut	The open cut method would result in a temporary impact to two small UNTs to Buffalo Creek. Avoiding/minimizing this minor impact through a conventional bore would require an excessively deep bore pit greater than 40 feet at the edge of a steep slope, thereby requiring the excavation of an interim ramp and two benches and dramatically increasing the space occupied by the bore pit and spoil pile. Using a conventional bore crossing method to avoid/minimize this minor temporary impact would be unreasonably expensive and would take twice as long to complete.
			Conventional Bore	123	48	N	78	32	185	N	N	$2,967,254		
Huntington	F-003	S-UV6, W-UV4	Dry-Ditch Open-Cut	70	-	N	49	27	52	N	N	$75,861	Dry-Ditch Open-Cut	A trenchless crossing of this small UNT to Morris Fork and wetlands system would require bore pits that are nearly thirty feet deep, which necessitates the use of a bench and interim ramp to access the bore pit. Avoiding/minimizing this minor impact through a conventional bore would create excessive spoil piles in an already reduced LOD. Because the pipeline ROW must remain free of woody vegetation to protect the pipe coating, a conversion impact is unavoidable. Furthermore, the cost to bore is unreasonably high relative to the proposed construction method.
			Conventional Bore	70	27	N	49	27	52	N	N	$445,295		
Huntington	F-004	W-UV8, S-UV2	Dry-Ditch Open-Cut	345	-	N	65	52	371	N	N	$290,616	Dry-Ditch Open-Cut	This crossing of a small UNT to Morris Fork presents multiple challenges that limit the available options and necessitate the development of a unique solution. A bore pit depth just short of 40 feet would required the excavation of an interim ramp and bench and dramatically increases the space occupied by the bore pit and spoil pile. Steep slopes (greater than 30%) adjacent to this waterbody also increase the complexity of a bored crossing, increase safety risk to personnel, and add risk of impact to the waterbody from upland work during a bore. In addition, this crossing is in close proximity to residences, and a trenchless crossing of this location would take longer than six weeks to complete -- compounding the noise, aesthetic, and other impacts on nearby persons. The open-cut method reduces construction duration thereby minimizing the disruption the affected residences and businesses. Accordingly, a trenchless crossing of this resource has been deemed logistically difficult due to the compounding constructability constraints.
			Guided Conventional Bore	345	36	N	65	52	371	N	N	$1,169,818		

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USACE District	Crossing #	Waterbody	Crossing Methods Evaluated	Evaluation Factors									Proposed Crossing Method	Crossing Method Decision Rationale
				Crossing Length	Pit Depth	Deep Stream	Maximum Steep Slope (%)	Maximum Average Slope (%)	Maximum Winch Hill Length (feet)	Karst Terrain Present	Sufficient Stockpile Storage Available	Total Cost ($)		
Huntington	F-004A	S-U22	Dry-Ditch Open-Cut	593	-	N	52	35	293	N	Y	$461,800	Dry-Ditch Open-Cut	This crossing presents multiple challenges that limit the available options and necessitated the development of a site-specific solution. The proximity of this stream to the adjacent bore of Interstate-64 makes it difficult to tie-in a bore of this resource. A bore pit depth nearing 40 feet at this location requires the excavation of an interim ramp and bench and dramatically increases the space occupied by the bore pit and spoil pile. Steep slopes (greater than 30%) adjacent to the waterbody increases the complexity of this crossing if bored, increases safety risk to personnel, and adds risk of impact to the waterbody from upland work during a bore. A trenchless crossing would take more than six weeks to be completed. Use of the open-cut method would reduce the construction duration and minimize noise and other disruptions to nearby persons due to construction activities. Accordingly, a trenchless crossing of this resource has been deemed logistically difficult due to the compounding constructability constraints.
			Guided Conventional Bore	593	37	N	52	35	293	N	Y	$1,556,221		
Huntington	F-005	W-EE4, S-EE4	Dry-Ditch Open-Cut	154	-	N	19	12	0	N	Y	$120,716	Dry-Ditch Open-Cut	A trenchless crossing of this small UNT to Red Spring Branch and wetland system would require bore pits greater than thirty feet deep, which necessitates the use of a bench and interim ramp to access the bore pit. Avoiding/minimizing this minor impact through a conventional bore would create excessive spoil piles in an already reduced LOD. Furthermore, the cost to bore is unreasonably high relative to the proposed construction method.
			Conventional Bore	154	32	N	19	12	0	N	Y	$1,021,669		
Huntington	F-006	S-M6, W-M2	Dry-Ditch Open-Cut	163	-	N	47	32	51	N	N	$130,313	Dry-Ditch Open-Cut	A trenchless crossing of this small UNT to Red Spring Branch and wetland system would require bore pits that are nearly forty feet deep, which necessitates the use of a bench and interim ramp to access the bore pit. Avoiding/minimizing this minor impact through a conventional bore would create excessive spoil piles in an already reduced LOD. Furthermore, the cost to bore is unreasonably high relative to the proposed construction method and would also take three times as long to complete.
			Conventional Bore	163	38	N	47	32	51	N	N	$1,156,828		
Huntington	F-007	S-J13	Dry-Ditch Open-Cut	37	-	N	25	15	0	N	Y	$43,400	Dry-Ditch Open-Cut	S-J13 is an UNT to Patterson Creek, a very small stream, and is crossed three times by the project. Crossing # F-007, 008, and 009 are discussed together since the requirements associated with a trenchless crossing are applicable to all three crossings. Each of these crossings would require a bore pit exceeding 20 feet, with F-009 being nearly thirty feet deep. Bore pits of this depth result in a significant amount of excavated material that must be stockpiled. The excess material is not only associated with the depth of the bore, but also the access ramps and associated benching that would be required to reach depths greater than 20 feet. Crossing F-009 is in a topographical setting that would require a technically and logistically difficult winching system. In addition to the deep bore pits and limited operating room, the costs to bore these crossings is unreasonably high relative to the proposed construction method.
			Conventional Bore	37	22	N	25	15	0	N	Y	$305,969		
Huntington	F-008	S-J13	Dry-Ditch Open-Cut	45	-	N	32	21	21	N	Y	$49,000	Dry-Ditch Open-Cut	S-J13 is an UNT to Patterson Creek, a very small stream, and is crossed three times by the project. Crossing # F-007, 008, and 009 are discussed together since the requirements associated with a trenchless crossing are applicable to all three crossings. Each of these crossings would require a bore pit exceeding 20 feet, with F-009 being nearly thirty feet deep. Bore pits of this depth result in a significant amount of excavated material that must be stockpiled. The excess material is not only associated with the depth of the bore, but also the access ramps and associated benching that would be required to reach depths greater than 20 feet. Crossing F-009 is in a topographical setting that would require a technically and logistically difficult winching system. In addition to the deep bore pits and limited operating room, the costs to bore these crossings is unreasonably high relative to the proposed construction method.
			Conventional Bore	45	21	N	32	21	21	N	Y	$319,538		
Huntington	F-009	S-J13	Dry-Ditch Open-Cut	75	-	N	42	34	419	N	Y	$70,000	Dry-Ditch Open-Cut	S-J13 is an UNT to Patterson Creek, a very small stream, and is crossed three times by the project. Crossing # F-007, 008, and 009 are discussed together since the requirements associated with a trenchless crossing are applicable to all three crossings. Each of these crossings would require a bore pit exceeding 20 feet, with F-009 being nearly thirty feet deep. Bore pits of this depth result in a significant amount of excavated material that must be stockpiled. The excess material is not only associated with the depth of the bore, but also the access ramps and associated benching that would be required to reach depths greater than 20 feet. Crossing F-009 is in a topographical setting that would require a technically and logistically difficult winching system. In addition to the deep bore pits and limited operating room, the costs to bore these crossings is unreasonably high relative to the proposed construction method.
			Conventional Bore	75	27	N	42	34	419	N	Y	$459,485		
Huntington	F-010	S-I17	Dry-Ditch Open-Cut	43	-	N	56	44	1538	N	N	$38,855	Dry-Ditch Open-Cut	The open cut method would result in a temporary impact to a small UNT to Lick Creek. The crossing is located at the base of an extremely long and steep slope and require bore pits exceeding forty feet. Avoiding/minimizing this minor impact through a conventional bore would require a deep bore pit which would create excessive spoil piles in a topographical setting that would require a technically and logistically difficult winching system, all while being located within an already reduced LOD. Using a conventional bore crossing method to avoid/minimize this minor temporary impact would be unreasonably expensive and would take twice as long to complete.
			Conventional Bore	43	31	N	56	44	1538	N	N	$688,384		

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USACE District	Crossing #	Waterbody	Crossing Methods Evaluated	Evaluation Factors: Crossing Length	Pit Depth	Deep Stream	Maximum Steep Slope (%)	Maximum Average Slope (%)	Maximum Winch Hill Length (feet)	Karst Terrain Present	Sufficient Stockpile Storage Available	Total Cost ($)	Proposed Crossing Method	Crossing Method Decision Rationale
Huntington	F-011	S-I19	Dry-Ditch Open-Cut	66	-	N	50	36	1200	N	N	$101,669	Dry-Ditch Open-Cut	The open cut method would result in a temporary impact to Lick Creek. The crossing is located at the base of an extremely long and steep slope and require bore pits exceeding forty feet. Avoiding/minimizing this minor impact through a conventional bore would create excessive spoil piles in a topographical setting that would require a technically and logistically difficult winching system, all while being located within an already reduced LOD. Using a conventional bore crossing method to avoid/minimize this minor temporary impact would be unreasonably expensive and would take twice as long to complete.
			Conventional Bore	66	44	N	50	36	1200	N	N	$2,587,307		
Huntington	F-011A	S-I20	Dry-Ditch Open-Cut	39	-	N	78	57	735	N	N	$76,000	Dry-Ditch Open-Cut	The open cut method would result in a temporary impact to a small UNT to Lick Creek. The crossing is located on an extremely long and steep slope and require bore pits that are nearly forty feet deep. Avoiding/minimizing this minor impact through a conventional bore would require a deep bore pit on which would create excessive spoil piles in a topographical setting that would require a technically and logistically difficult winching system, all while being located within an already reduced LOD. Using a conventional bore crossing method to avoid/minimize this minor temporary impact would be unreasonably expensive and would take twice as long to complete.
			Conventional Bore	39	35	N	78	57	735	N	N	$750,110		
Huntington	F-012	S-N5	Dry-Ditch Open-Cut	63	-	N	33	24	10	N	N	$52,226	Dry-Ditch Open-Cut	A trenchless crossing of this small UNT to Hungard Creek would require bore pits greater than 20 feet deep, which necessitates the use of a bench and interim ramp to access the bore pit. Avoiding/minimizing this minor impact through a conventional bore would create excessive spoil piles in an already reduced LOD. Furthermore, the cost to bore is unreasonably high relative to the proposed construction method.
			Conventional Bore	63	24	N	33	24	10	N	N	$398,025		
Huntington	F-013	S-K14	Dry-Ditch Open-Cut	35	-	N	40	34	252	N	N	$44,164	Dry-Ditch Open-Cut	A trenchless crossing of this small UNT to Hungard Creek would require bore pits greater than twenty feet deep, which necessitates the use of a bench and interim ramp to access the bore pit. Avoiding/minimizing this minor impact through a conventional bore would create excessive spoil piles in an already reduced LOD. Furthermore, the cost to bore is unreasonably high relative to the proposed construction method.
			Conventional Bore	35	22	N	40	34	252	N	N	$300,293		
Huntington	F-014	S-N3	Dry-Ditch Open-Cut	106	-	N	6	3	0	N	Y	$97,922	Conventional Bore	There are no significant constraints on available crossing methods or significant environmental impacts relevant to the available methods. The direct aquatic impact will be avoided/minimized by use of the conventional bore method. A minor temporary impact associated with the bore to maintain access will be required.
			Conventional Bore	106	15	N	6	3	0	N	Y	$369,336		
Huntington	F-015	S-N2	Dry-Ditch Open-Cut	48	-	N	36	10	0	N	Y	$107,232	Conventional Bore	There are no significant constraints on available crossing methods or significant environmental impacts relevant to the available methods. The direct aquatic impact will be avoided/minimized by use of the conventional bore method. A minor temporary impact associated with the bore to maintain access will be required.
			Conventional Bore	48	15	N	36	10	0	N	Y	$204,733		
Huntington	F-016	S-CD23	Dry-Ditch Open-Cut	128	-	N	8	3	0	N	Y	$98,350	Conventional Bore	This crossing is adjacent to planned bored, which will allow the existing bore pits to be utilized to avoid/minimize the aquatic impact at this location by boring. A minor temporary impact associated with the bore to maintain access will be required.
			Conventional Bore	128	15	N	8	3	0	N	Y	$431,772		
Huntington	F-017	S-N4, W-EF40	Dry-Ditch Open-Cut	99	-	N	9	4	0	N	Y	$83,735	Conventional Bore	There are no significant constraints on available crossing methods or significant environmental impacts relevant to the available methods. The direct aquatic impact will be avoided/minimized by use of the conventional bore method. A minor temporary impact associated with the bore to maintain access will be required.
			Conventional Bore	99	16	N	9	4	0	N	Y	$354,038		
Huntington	F-019	S-KL29	Dry-Ditch Open-Cut	208	-	N	46	0	0	N	Y	$299,600	Dry-Ditch Open-Cut	The pipeline has already been installed under an adjacent road (East Clayton Rd). There is no feasible way to tie the two sections of pipe together if a trenchless method is used to install this crossing. Lastly, substantial increase in cost and lost time (four weeks to complete bore) to avoid a temporary impact to this small, one-foot-wide stream is not appropriate and practicable.
			Conventional Bore	208	35	N	46	0	0	N	Y	$1,229,729		

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USACE District	Crossing #	Waterbody	Crossing Methods Evaluated	Evaluation Factors									Proposed Crossing Method	Crossing Method Decision Rationale
				Crossing Length	Pit Depth	Deep Stream	Maximum Steep Slope (%)	Maximum Average Slope (%)	Maximum Winch Hill Length (feet)	Karst Terrain Present	Sufficient Stockpile Storage Available	Total Cost ($)		
Huntington	F-020	W-MM20-PFO, S-CV17	Dry-Ditch Open-Cut	0	-	N	0	0	0	N	Y	-$700	Dry-Ditch Open-Cut	Crossing these resources requires the pipeline to negotiate a bend that cannot be completed with any available trenchless crossing technology.
			Conventional Bore	0	0	N	0	0	0	N	Y	$0		
Huntington	F-021	S-I8	Dry-Ditch Open-Cut	1250	-	Y	9	3	0	N	Y	$2,287,563	Direct Pipe	The Greenbrier River will be crossed using the Direct Pipe trenchless methodology. The stream depth would require an instream diversion system that would severely limit the amount of usable workspace in an already reduced LOD. The Greenbrier River is also classified by the WVDNR as Group 1 mussel stream. While mussel survey and relocation efforts were completed in 2020, completing a trenchless crossing will further minimize any potential impacts to mussel species.
			Direct Pipe	1250	13	Y	9	3	0	N	Y	$10,059,375		
Huntington	F-022	S-I9	Dry-Ditch Open-Cut	91	-	N	14	6	0	N	Y	$124,405	Conventional Bore	There are no significant constraints on available crossing methods or significant environmental impacts relevant to the available methods. The direct aquatic impact will be avoided/minimized by use of the conventional bore method. A minor temporary impact associated with the bore to maintain access will be required.
			Conventional Bore	91	18	N	14	6	0	N	Y	$340,469		
Huntington	F-023	S-L4	Dry-Ditch Open-Cut	30	-	N	42	33	293	N	N	$51,375	Dry-Ditch Open-Cut	A trenchless crossing of this small UNT to Greenbrier River would require bore pits greater than thirty feet deep, which necessitates the use of a bench and interim ramp to access the bore pit. Avoiding/minimizing this minor impact through a conventional bore would create excessive spoil piles in an already reduced LOD. Furthermore, the cost to bore is unreasonably high relative to the proposed construction method.
			Conventional Bore	30	33	N	42	33	293	N	N	$688,029		
Huntington	F-024	S-L2	Dry-Ditch Open-Cut	41	-	N	37	35	105	N	N	$42,713	Dry-Ditch Open-Cut	A trenchless crossing of this small UNT to Greenbrier River would require bore pits greater that are nearly 30 feet deep, which necessitates the use of a bench and interim ramp to access the bore pit. Avoiding/minimizing this minor impact through a conventional bore would create excessive spoil piles in an already reduced LOD. Furthermore, the cost to bore is unreasonably high relative to the proposed construction method.
			Conventional Bore	41	29	N	37	35	105	N	N	$381,263		
Huntington	F-025	W-K2-PEM, S-L1	Dry-Ditch Open-Cut	40	-	N	60	41	146	N	N	$49,003	Dry-Ditch Open-Cut	A trenchless crossing of this small wetland and small UNT to Kelly Creek would require bore pits greater than thirty feet deep, which necessitates the use of a bench and interim ramp to access the bore pit. Avoiding/minimizing this minor impact through a conventional bore would create excessive spoil piles in an already reduced LOD. Furthermore, the cost to bore is unreasonably high relative to the proposed construction method.
			Conventional Bore	40	32	N	60	41	146	N	N	$698,139		
Huntington	F-026	S-J5	Dry-Ditch Open-Cut	42	-	N	82	57	240	N	N	$100,783	Dry-Ditch Open-Cut	This crossing presents multiple challenges that limit the available options and necessitated the development of a unique solution. A bore pit depth greater than 20 feet requires the excavation of an interim ramp and bench and increases the space occupied by the bore pit and spoil pile. Steep slopes (greater than 30%) adjacent to these waterbodies increase the complexity of a bored crossing, increase safety risk to personnel, and add risk of impact to the waterbody from upland work during a bore. In addition, this crossing is on a property with a well or spring. The open cut method reduces the construction duration near the well/spring.
			Conventional Bore	42	24	N	82	57	240	N	N	$338,428		
Huntington	F-027	S-J4	Dry-Ditch Open-Cut	30	-	N	47	34	173	N	N	$37,647	Conventional Bore	There are no significant constraints on available crossing methods or significant environmental impacts relevant to the available methods. The direct aquatic impact will be avoided/minimized by use of the conventional bore method. A minor temporary impact associated with the bore to maintain access will be required.
			Conventional Bore	30	19	N	47	34	173	N	N	$171,919		
Huntington	F-028	W-OP1-PEM, S-OP1	Dry-Ditch Open-Cut	104	-	N	72	25	228	N	N	$83,831	Dry-Ditch Open-Cut	The pipeline is already installed through a portion of the wetland at this crossing. The layout of a conventional bore would require excavation of a bore pit unacceptably close to the installed pipe. Additionally, a trenchless method would require excavation of a bore pit within the wetland, meaning that that a longer-duration bore pit in the wetland is not less environmentally damaging than a much shorter duration impact associated with an open cut through the wetland and adjacent stream. Lastly, the cost to avoid a temporary impact to these resources is unreasonably high relative to the proposed construction method, especially in light of the fact that boring does not materially avoid or minimize the impact at this location.
			Conventional Bore	104	19	N	72	25	228	N	N	$381,930		

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USACE District	Crossing #	Waterbody	Crossing Methods Evaluated	Evaluation Factors: Crossing Length	Pit Depth	Deep Stream	Maximum Steep Slope (%)	Maximum Average Slope (%)	Maximum Winch Hill Length (feet)	Karst Terrain Present	Sufficient Stockpile Storage Available	Total Cost ($)	Proposed Crossing Method	Crossing Method Decision Rationale
Huntington	F-029-030	S-A63, W-A13, S-A61, S-A60	Dry-Ditch Open-Cut	742	-	N	20	9	0	N	Y	$554,400	Dry-Ditch Open-Cut	A trenchless crossing in this area would require bore pits that are nearly 20 feet deep. Avoiding/minimizing this minor impact through a conventional bore would create excessive spoil piles in an already reduced LOD. Furthermore, the cost to bore is unreasonably high relative to the proposed construction method. A trenchless crossing of this area would take approximately three times longer to complete than the proposed construction method -- compounding the noise, aesthetic, and other impacts on nearby persons. Reducing the time at the crossing and permanently stabilizing this area will reduce the potential for sedimentation and erosion along the hillside.
			Direct Pipe	742	15	N	20	9	0	N	Y	$6,004,510		
Huntington	F-031	S-D31	Dry-Ditch Open-Cut	81	-	N	55	42	99	N	N	$284,433	Dry-Ditch Open-Cut	This crossing presents multiple challenges that limit the available options and necessitated the development of a unique solution. A bore pit depth of nearly 40 feet will require the excavation of an interim ramp and bench and dramatically increase the space occupied by the bore pit and spoil pile. Steep slopes (greater than 30%) adjacent to stream increases the complexity of a bored crossing, increases safety risk to personnel, and adds risk of impact to the waterbody from upland work during a bore. In addition, this crossing is in close proximity to residences and/or businesses, which would cause increased noise and other impacts to persons nearby for the approximately seven weeks that would be required to complete a trenchless crossing. The open-cut method would reduce construction duration and minimize disruptions to persons due to construction activities.
			Conventional Bore	81	38	N	55	42	99	N	N	$924,113		
Huntington	F-032	S-D25	Dry-Ditch Open-Cut	32	-	N	23	11	74	N	Y	$36,432	Conventional Bore	There are no significant constraints on available crossing methods or significant environmental impacts relevant to the available methods. The direct aquatic impact will be avoided/minimized by use of the conventional bore method. A minor temporary impact associated with the bore to maintain access will be required.
			Conventional Bore	32	19	N	23	11	74	N	Y	$177,595		
Huntington	F-034	S-Z5, S-Z4	Dry-Ditch Open-Cut	31	-	N	32	25	10	Y	N	$30,454	Dry-Ditch Open-Cut	Site conditions do not allow sufficient space to stockpile spoils from bore pits. Karst terrain increases the risk of bore failure and environmental impact. Furthermore, avoiding this temporary impact to this small stream with a conventional bore crossing would be unreasonably expensive.
			Conventional Bore	31	26	N	32	25	10	Y	N	$325,479		
Huntington	F-035	W-MN15, W-MN14, S-MN2	Dry-Ditch Open-Cut	88	-	N	51	33	191	N	N	$86,108	Dry-Ditch Open-Cut	A trenchless crossing of these small wetlands and small UNT to Hans Creek would require bore pits that are 20 feet deep, which necessitates the use of a bench and interim ramp to access the bore pit. Avoiding/minimizing this minor impact through a conventional bore would create excessive spoil piles in an already reduced LOD. Furthermore, the cost to bore is unreasonably high relative to the proposed construction method. The proposed crossing method is also shorter in duration, which reduces the noise, aesthetic, and other impacts on nearby persons. Reducing the time at the crossing and permanently stabilizing this area will reduce the potential for sedimentation and erosion along the hillside.
			Conventional Bore	88	20	N	51	33	191	N	N	$432,436		
Huntington	F-036	S-CV19	Dry-Ditch Open-Cut	84	-	N	53	28	536	N	N	$148,571	Dry-Ditch Open-Cut	This crossing presents multiple challenges that limit the available options and necessitated the development of a unique solution. A bore pit depth of nearly 30 feet will require the excavation of an interim ramp and bench and dramatically increase the space occupied by the bore pit and spoil pile. Steep slopes (greater than 30%) adjacent to stream increases the complexity of a bored crossing, increases safety risk to personnel, and adds risk of impact to the waterbody from upland work during a bore. In addition, the topographical constraints create a technical and logistical limit on a winching system further increasing the worker safety risk. Furthermore, the cost to bore is unreasonably high relative to the proposed construction method. The proposed crossing method is also shorter in duration, which reduces the noise, aesthetic, and other impacts on nearby persons. Reducing the time at the crossing and permanently stabilizing this area will reduce the potential for sedimentation and erosion along the hillside. Accordingly, a trenchless crossing of this resource has been deemed logistically difficult due to the multiple compounding constraints.
			Conventional Bore	84	33	N	53	28	536	N	N	$841,280		
Huntington	F-037	S-MN39, S-MN40, W-CV24, S-MN38, S-MN37, W-MN18-PFO, W-MN18-PEM, W-MN1	Dry-Ditch Open-Cut	180	-	N	64	54	254	N	N	$140,000	Dry-Ditch Open-Cut	This crossing presents multiple challenges that limit the available options and necessitated the development of a unique solution. Installing a trenchless crossing at this location would require a deep bore pit (38 feet) at the bottom of a steep hill that would require winched equipment. There is insufficient space available at this location to stockpile spoils from the bore pit. Avoiding/minimize impacts to this cluster of small aquatic resources would require an extended construction period greater than six weeks and triple the total greenhouse gas emissions associated with completed the crossing. Lastly, the cost to avoid a temporary impact to these resources is unreasonably high relative to the proposed construction method
			Conventional Bore	180	38	N	64	54	254	N	N	$1,205,073		
Huntington	F-038	S-G44	Dry-Ditch Open-Cut	34	-	N	30	23	0	N	Y	$38,869	Dry-Ditch Open-Cut	A trenchless crossing of this small UNT to Hans Creek would require bore pits that are greater than 20 feet deep, which necessitates the use of a bench and interim ramp to access the bore pit. Avoiding/minimizing this minor impact through a conventional bore would create excessive spoil piles in an already reduced LOD. Furthermore, the cost to bore is unreasonably high relative to the proposed construction method. The proposed crossing method is shorter in duration, which reduces the noise, aesthetic, and other impacts on nearby persons. Reducing the time at the crossing and permanently stabilizing this area will reduce the potential for sedimentation and erosion along the hillside.
			Conventional Bore	34	24	N	30	23	0	N	Y	$315,724		

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USACE District	Crossing #	Waterbody	Crossing Methods Evaluated	Evaluation Factors: Crossing Length	Pit Depth	Deep Stream	Maximum Steep Slope (%)	Maximum Average Slope (%)	Maximum Winch Hill Length (feet)	Karst Terrain Present	Sufficient Stockpile Storage Available	Total Cost ($)	Proposed Crossing Method	Crossing Method Decision Rationale
Huntington	F-039	S-G43, W-MN1	Dry-Ditch Open-Cut	52	-	N	40	27	73	N	N	$56,420	Conventional Bore	There are no significant constraints on available crossing methods or significant environmental impacts relevant to the available methods. The direct aquatic impact will be avoided/minimized by use of the conventional bore method. A minor temporary impact associated with the bore to maintain access will be required.
			Conventional Bore	52	19	N	40	27	73	N	N	$234,355		
Huntington	F-040	W-G6, S-G42	Dry-Ditch Open-Cut	83	-	N	61	51	312	N	N	$69,021	Dry-Ditch Open-Cut	A trenchless crossing of this small wetland and UNT to Hans Creek would require bore pits that are greater than thirty feet deep, which necessitates the use of a bench and interim ramp to access the bore pit. Avoiding/minimizing this minor impact through a conventional bore would create excessive spoil piles in an already reduced LOD. Furthermore, the cost to bore is unreasonably high relative to the proposed construction method. The proposed crossing method is also shorter in duration, which reduces the noise, aesthetic, and other impacts on nearby persons. Reducing the time at the crossing and permanently stabilizing this area will reduce the potential for sedimentation and erosion along the hillside.
			Conventional Bore	83	34	N	61	51	312	N	N	$856,711		
Huntington	F-041	S-MN45, W-MN24	Dry-Ditch Open-Cut	42	-	N	45	33	342	N	N	$36,464	Dry-Ditch Open-Cut	A trenchless crossing of this small wetland and UNT to Hans Creek would require bore pits that are thirty feet deep, which necessitates the use of a bench and interim ramp to access the bore pit. In addition the crossing is located at the bottom of a long, steep slope, further complicating construction and worker safety. Avoiding/minimizing this minor impact through a conventional bore would create excessive spoil piles in an already reduced LOD. Furthermore, the cost to bore is unreasonably high relative to the proposed construction method. The proposed crossing method is also shorter in duration, which reduces the noise, aesthetic, and other impacts on nearby persons. Reducing the time at the crossing and permanently stabilizing this area will reduce the potential for sedimentation and erosion along the hillside.
			Conventional Bore	42	30	N	45	33	342	N	N	$667,277		
Huntington	F-042	W-CV25-PEM-2, W-CV25-PSS-1, S-CV27	Dry-Ditch Open-Cut	50	-	N	27	13	0	N	Y	$40,250	Dry-Ditch Open-Cut	A trenchless crossing of these small wetlands and UNT to Hans Creek would require bore pits that are approximately twenty feet deep, which necessitates the use of a bench and interim ramp to access the bore pit. Avoiding/minimizing this minor impact through a conventional bore would create excessive spoil piles in an already reduced LOD. Furthermore, the cost to bore is unreasonably high relative to the proposed construction method. The proposed crossing method is shorter in duration, which reduces the noise, aesthetic, and other impacts on nearby persons. Reducing the time at the crossing and permanently stabilizing this area will reduce the potential for sedimentation and erosion along the hillside.
			Conventional Bore	50	20	N	27	13	0	N	Y	$324,593		
Huntington	F-043	S-E43, S-E45	Dry-Ditch Open-Cut	42	-	N	34	30	210	Y	N	$58,269	Dry-Ditch Open-Cut	Site conditions do not allow sufficient space to stockpile spoils from bore pits. Karst terrain presents greater logistical and technical challenges. Furthermore, avoiding this temporary impact to this small stream with a conventional bore crossing would be unreasonably expensive.
			Conventional Bore	42	28	N	34	30	210	Y	N	$374,967		
Huntington	F-044	W-E12, S-E40, S-E41	Dry-Ditch Open-Cut	48	-	N	41	25	295	Y	N	$78,651	Dry-Ditch Open-Cut	Site conditions reduce the available space to stockpile spoils from bore pits. Karst terrain presents greater logistical and technical challenges.
			Conventional Bore	48	14	N	41	25	295	Y	N	$200,166		
Huntington	F-045	W-C14, W-C13, S-C38, S-C39	Dry-Ditch Open-Cut	181	-	N	31	19	10	N	Y	$151,803	Dry-Ditch Open-Cut	A trenchless crossing of these small wetlands and Painters Run would require bore pits that are approximately thirty feet deep, which necessitates the use of a bench and interim ramp to access the bore pit. Avoiding/minimizing this minor impact through a conventional bore would create excessive spoil piles in an already reduced LOD. In addition, the presence of steep slopes logistical and technical challenges. Furthermore, the cost to bore is unreasonably high relative to the proposed construction method. The time to complete the proposed crossing method is also shorter in duration (nearly half), which reduces the noise, aesthetic, and other impacts on nearby persons. Reducing the time at the crossing and permanently stabilizing this area will reduce the potential for sedimentation and erosion along the hillside.
			Conventional Bore	181	29	N	31	19	10	N	Y	$778,581		
Huntington	F-046	S-C41	Dry-Ditch Open-Cut	72	-	N	56	46	295	N	N	$61,161	Dry-Ditch Open-Cut	The open cut method would result in a temporary impact to this small UNT to Painters Run. The crossing is located on a steep slope and require bore pits nearly 30 feet. Avoiding/minimizing this minor impact through a conventional bore would require a deep bore pit which would create excessive spoil piles, all while being located within an already reduced LOD. Using a conventional bore crossing method to avoid/minimize this minor temporary impact would be unreasonably expensive and would take over forty days to complete.
			Conventional Bore	72	29	N	56	46	295	N	N	$469,241		
Norfolk	G-001	S-Q12	Dry-Ditch Open-Cut	42	-	N	64	44	75	Y	N	$43,449	Dry-Ditch Open-Cut	The open cut method would result in a temporary impact to this small UNT to Kimballton Branch. The crossing is located on a steep slope and require bore pits exceeding fifty feet. Avoiding/minimizing this minor impact through a conventional bore would require a deep bore pit which would create excessive spoil piles. Karst terrain presents greater logistical and technical challenges. Using a conventional bore crossing method to avoid/minimize this minor temporary impact would be unreasonably expensive and would take six times longer to complete.
			Conventional Bore	42	55	N	64	44	75	Y	N	$3,119,195		

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USACE District	Crossing #	Waterbody	Crossing Methods Evaluated	Evaluation Factors: Crossing Length	Pit Depth	Deep Stream	Maximum Steep Slope (%)	Maximum Average Slope (%)	Maximum Winch Hill Length (feet)	Karst Terrain Present	Sufficient Stockpile Storage Available	Total Cost ($)	Proposed Crossing Method	Crossing Method Decision Rationale
Norfolk	G-002	S-Q13	Dry-Ditch Open-Cut	69	-	N	45	29	331	Y	N	$118,248	Dry-Ditch Open-Cut	The open cut method would result in a temporary impact to Kimballton Branch. The crossing is located on a steep slope and require bore pits exceeding thirty feet. Avoiding/minimizing this minor impact through a conventional bore would require a deep bore pit which would create excessive spoil piles. Karst terrain increases the risk of bore failure and environmental impact. Using a conventional bore crossing method to avoid/minimize this minor temporary impact would be unreasonably expensive and would take three times longer to complete.
			Conventional Bore	69	33	N	45	29	331	Y	N	$798,710		
Norfolk	G-003	S-P6	Dry-Ditch Open-Cut	44	-	N	42	32	84	Y	N	$51,841	Dry-Ditch Open-Cut	The open cut method would result in a temporary impact to UNT to Stony Creek. The crossing is located adjacent to a steep slope and require bore pits nearly thirty feet deep. Avoiding/minimizing this minor impact through a conventional bore would require a deep bore pit which would create excessive spoil piles. Karst terrain increases the logistical and technical challenges. Using a conventional bore crossing method to avoid/minimize this minor temporary impact would be unreasonably expensive and would take nearly twice as long to complete.
			Conventional Bore	44	29	N	42	32	84	Y	N	$389,777		
Norfolk	G-004	S-S5-Braid-1, S-S5-Braid-2, S-S5	Dry-Ditch Open-Cut	300	-	N	21	5	66	N	N	$356,008	Dry-Ditch Open-Cut	There are no significant constraints on available crossing methods or significant environmental impacts relevant to the available methods. The direct aquatic impact will be avoided/minimized by use of the conventional bore method. A minor temporary impact associated with the bore to maintain access will be required.
			Guided Conventional Bore	300	0	N	21	5	66	N	N	$445,322		
Norfolk	G-005	S-G30, S-G29	Dry-Ditch Open-Cut	58	-	N	49	38	110	Y	N	$70,917	Dry-Ditch Open-Cut	The open cut method would result in a temporary impact to two UNT to Dry Branch. Both streams are very small - less than ten feet in width. The crossing is located adjacent to a steep slope and require bore pits nearly forty feet deep. Avoiding/minimizing this minor impact through a conventional bore would require a deep bore pit which would create excessive spoil piles. Karst terrain increases the logistical and technical challenges. Using a conventional bore crossing method to avoid/minimize this minor temporary impact would be unreasonably expensive and would take three times longer to complete.
			Conventional Bore	58	38	N	49	38	110	Y	N	$858,839		
Norfolk	G-006	S-G32	Dry-Ditch Open-Cut	100	-	N	46	28	607	Y	N	$100,749	Dry-Ditch Open-Cut	The open cut method would result in a temporary impact to Dry Branch. The crossing is located adjacent to a steep slope and require bore pits greater than twenty feet. Avoiding/minimizing this minor impact through a conventional bore would require a deep bore pit adjacent to an extremely long and steep slope which would create excessive spoil piles in a topographical setting that would require a technically and logistically difficult winching system, all while being located within an already reduced LOD. Karst terrain increases the logistical and technical challenges. Using a conventional bore crossing method to avoid/minimize this minor temporary impact would take twice as long to complete.
			Conventional Bore	100	24	N	46	28	607	Y	N	$503,031		
Norfolk	G-007	S-G33	Dry-Ditch Open-Cut	90	-	N	38	34	289	N	N	$93,649	Dry-Ditch Open-Cut	A trenchless crossing of this small UNT to Dry Branch (less than 10 feet) would require bore pits that are approximately thirty feet deep, which necessitates the use of a bench and interim ramp to access the bore pit. Avoiding/minimizing this minor impact through a conventional bore would create excessive spoil piles in an already reduced LOD. Furthermore, the cost to bore is unreasonably high relative to the proposed construction method. The proposed crossing method is also shorter in duration, which reduces the noise, aesthetic, and other impacts on nearby persons. Reducing the time at the crossing and permanently stabilizing this area will reduce the potential for sedimentation and erosion along the hillside.
			Conventional Bore	90	30	N	38	34	289	N	N	$803,500		
Norfolk	G-008	W-Z11	Dry-Ditch Open-Cut	60	-	N	39	26	220	N	N	$42,000	Dry-Ditch Open-Cut	A trenchless crossing of this small wetland would require bore pits that are greater than twenty feet deep, which necessitates the use of a bench and interim ramp to access the bore pit. Avoiding/minimizing this minor impact through a conventional bore would create excessive spoil piles in an already reduced LOD. Furthermore, the cost to bore is unreasonably high relative to the proposed construction method. The proposed crossing method is shorter in duration, which reduces the noise, aesthetic, and other impacts on nearby persons. Reducing the time at the crossing and permanently stabilizing this area will reduce the potential for sedimentation and erosion along the hillside.
			Conventional Bore	60	21	N	39	26	220	N	N	$362,107		
Norfolk	G-009	S-G35	Dry-Ditch Open-Cut	139	-	N	38	34	608	N	N	$225,223	Conventional Bore	Mountain Valley must use a conventional bore to cross an adjacent road (Big Branch Hollow Road). The bore can be extended to avoid this resource.
			Conventional Bore	139	30	N	38	34	608	N	N	$942,561		
Norfolk	G-010	S-SS4	Dry-Ditch Open-Cut	30	-	N	22	16	0	N	Y	$30,059	Conventional Bore	This stream is listed as trout water. The direct aquatic impact will be avoided/minimized by use of the conventional bore method. A minor temporary impact associated with the bore to maintain access will be required.
			Conventional Bore	30	27	N	22	16	0	N	Y	$331,776		

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USACE District	Crossing #	Waterbody	Crossing Methods Evaluated	Evaluation Factors									Proposed Crossing Method	Crossing Method Decision Rationale
				Crossing Length	Pit Depth	Deep Stream	Maximum Steep Slope (%)	Maximum Average Slope (%)	Maximum Winch Hill Length (feet)	Karst Terrain Present	Sufficient Stockpile Storage Available	Total Cost ($)		
Norfolk	G-011	S-Z9	Dry-Ditch Open-Cut	48	-	N	45	29	21	N	N	$49,564	Conventional Bore	This stream is listed as trout water. The direct aquatic impact will be avoided/minimized by use of the conventional bore method. A minor temporary impact associated with the bore to maintain access will be required.
			Conventional Bore	48	27	N	45	29	21	N	N	$382,860		
Norfolk	G-012	S-Z7, S-Z7-Braid-1	Dry-Ditch Open-Cut	47	-	N	24	14	0	N	Y	$44,128	Conventional Bore	There are no significant constraints on available crossing methods or significant environmental impacts relevant to the available methods. The direct aquatic impact will be avoided/minimized by use of the conventional bore method. A minor temporary impact associated with the bore to maintain access will be required.
			Conventional Bore	47	19	N	24	14	0	N	Y	$220,165		
Norfolk	G-013	S-Z10, S-Z11, S-Z12-EPH, W-Z3, S-Z13	Dry-Ditch Open-Cut	331	-	N	9	4	0	N	Y	$322,599	Guided Conventional Bore	There are no significant constraints on available crossing methods or significant environmental impacts relevant to the available methods. The direct aquatic impact will be avoided/minimized by use of the conventional bore method. A minor temporary impact associated with the bore to maintain access will be required.
			Guided Conventional Bore	331	23	N	9	4	0	N	Y	$701,437		
Norfolk	G-014	S-Z14	Dry-Ditch Open-Cut	53	-	N	37	32	292	N	N	$53,882	Conventional Bore	There are no significant constraints on available crossing methods or significant environmental impacts relevant to the available methods. The direct aquatic impact will be avoided/minimized by use of the conventional bore method. A minor temporary impact associated with the bore to maintain access will be required.
			Conventional Bore	53	15	N	37	32	292	N	N	$218,923		
Norfolk	G-015A	S-A34	Dry-Ditch Open-Cut	77	-	N	36	32	330	Y	N	$74,900	Dry-Ditch Open-Cut	The open cut method would result in a temporary impact to a small UNT to Doe Creek. The stream is very small - less than ten feet in width and would require bore pits nearly thirty feet deep. Avoiding/minimizing this minor impact through a conventional bore would require a deep bore pit which would create excessive spoil piles. Karst terrain increases the logistical and technical challenges. Using a conventional bore crossing method to avoid/minimize this minor temporary impact would be unreasonably expensive and would take twice as along to complete.
			Conventional Bore	77	29	N	36	32	330	Y	N	$483,431		
Norfolk	G-015B	S-A33	Dry-Ditch Open-Cut	58	-	N	36	30	388	Y	Y	$68,849	Dry-Ditch Open-Cut	The open cut method would result in a temporary impact to a small UNT to Doe Creek. The stream is very small - less than ten feet in width and would require bore pits greater than twenty feet deep on a steep slope. Avoiding/minimizing this minor impact through a conventional bore would require a deep bore pit which would create excessive spoil piles, with limited room for stockpiling. Karst terrain increases the logistical and technical challenges. Using a conventional bore crossing method to avoid/minimize this minor temporary impact would be unreasonably expensive and would take twice as along to complete.
			Conventional Bore	58	24	N	36	30	388	Y	Y	$383,836		
Norfolk	G-016	S-A32	Dry-Ditch Open-Cut	103	-	N	36	32	975	Y	N	$130,827	Dry-Ditch Open-Cut	The open cut method would result in a temporary impact to an UNT to Doe Creek. The crossing is located adjacent to a steep slope and require bore pits up to forty feet in depth. Avoiding/minimizing this minor impact through a conventional bore would require a deep bore pit adjacent to an extremely long and steep slope which would create excessive spoil piles in a topographical setting that would require a technically and logistically difficult winching system, all while being located within an already reduced LOD. Karst terrain increases the logistical and technical challenges. Using a conventional bore crossing method to avoid/minimize this minor temporary impact would be unreasonably expensive and would take eight times longer to complete. Reducing the time at the crossing and permanently stabilizing this area will reduce the potential for sedimentation and erosion along the hillside.
			Conventional Bore	103	40	N	36	32	975	Y	N	$2,474,130		
Norfolk	G-017	S-Y3, S-Y2	Dry-Ditch Open-Cut	246	-	N	52	25	328	Y	N	$263,200	Conventional Bore	Mountain Valley must use a conventional bore to cross an adjacent road (Doe Creek Road). The bore can be extended to avoid this resource.
			Conventional Bore	246	37	N	52	25	328	Y	N	$1,374,111		
Norfolk	G-019A	S-F24	Dry-Ditch Open-Cut	69	-	N	28	13	0	N	Y	$120,466	Dry-Ditch Open-Cut	This crossing is immediately adjacent to another crossing (G-019B) that will be bored. A significant change in elevation between the two crossing locations does not allow the pipeline to be tied-in together unless this crossing is completed with an open cut.

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USACE District	Crossing #	Waterbody	Crossing Methods Evaluated	Evaluation Factors									Proposed Crossing Method	Crossing Method Decision Rationale
				Crossing Length	Pit Depth	Deep Stream	Maximum Steep Slope (%)	Maximum Average Slope (%)	Maximum Winch Hill Length (feet)	Karst Terrain Present	Sufficient Stockpile Storage Available	Total Cost ($)		
Norfolk	G-019A	S-E24	Conventional Bore	69	32	N	28	13	0	N	Y	$780,441	Dry-Ditch Open-Cut	Furthermore, avoiding this temporary impact to a UNT to Sinking Creek with a conventional bore crossing would be unreasonably expensive.
Norfolk	G-019B	S-E25-Downstream	Dry-Ditch Open-Cut	92	-	N	48	20	450	N	Y	$99,400	Conventional Bore	There are no significant constraints on available crossing methods or significant environmental impacts relevant to the available methods. The direct aquatic impact will be avoided/minimized by use of the conventional bore method. A minor temporary impact associated with the bore to maintain access will be required.
			Conventional Bore	92	19	N	48	20	450	N	Y	$347,874		
Norfolk	G-020	S-RR5	Dry-Ditch Open-Cut	154	-	N	56	45	400	N	N	$146,371	Dry-Ditch Open-Cut	The open cut method would result in a temporary impact to an UNT to Sinking Creek. The crossing is located adjacent to a steep slope and require bore pits nearly forty feet deep. Avoiding/minimizing this minor impact through a conventional bore would require a deep bore pit adjacent to an extremely long and steep slope which would create excessive spoil piles in a topographical setting that would require a technically and logistically difficult winching system, all while being located within an already reduced LOD. Using a conventional bore crossing method to avoid/minimize this minor temporary impact would be unreasonably expensive and would take longer to complete.
			Conventional Bore	154	35	N	56	45	400	N	N	$1,076,478		
Norfolk	G-020A	S-IJ18	Dry-Ditch Open-Cut	22	-	N	41	13	11	N	N	$21,300	Dry-Ditch Open-Cut	A trenchless crossing of this small stream (UNT to Sinking Creek) would require bore pits that are nearly twenty feet deep. Avoiding/minimizing this minor impact through a conventional bore would create excessive spoil piles in an already reduced LOD. Furthermore, the cost to bore is unreasonably high relative to the proposed construction method. The proposed crossing method is shorter in duration, which reduces the noise, aesthetic, and other impacts on nearby persons. Reducing the time at the crossing and permanently stabilizing this area will reduce the potential for sedimentation and erosion along the hillside.
			Conventional Bore	22	19	N	41	13	11	N	N	$149,215		
Norfolk	G-022	S-IJ16-b	Dry-Ditch Open-Cut	50	-	N	70	42	537	Y	N	$52,912	Dry-Ditch Open-Cut	The open cut method would result in a temporary impact to an UNT to Sinking Creek. The crossing is located adjacent to a steep slope and require bore pits up to thirty feet in depth. Avoiding/minimizing this minor impact through a conventional bore would create excessive spoil piles in a topographical setting that would require a technically and logistically difficult winching system, all while being located within an already reduced LOD. Karst terrain increases the logistical and technical challenges. Using a conventional bore crossing method to avoid/minimize this minor temporary impact would be unreasonably expensive and would take nearly twice as long to complete. Reducing the time at the crossing and permanently stabilizing this area will reduce the potential for sedimentation and erosion along the hillside.
			Conventional Bore	50	33	N	70	42	537	Y	N	$744,789		
Norfolk	G-023	S-NN17	Dry-Ditch Open-Cut	140	-	N	62	40	372	Y	N	$296,363	Conventional Bore	Mountain Valley must use a conventional bore to cross an adjacent road (Rt. 604). The bore can be extended to avoid this resource.
			Conventional Bore	140	23	N	62	40	372	Y	N	$607,416		
Norfolk	G-024	S-RR2, S-YZ6, W-RR1b	Dry-Ditch Open-Cut	133	-	N	63	42	702	Y	N	$129,388	Conventional Bore	Mountain Valley must use a conventional bore to cross an adjacent road (Rt. 42). The bore can be extended to avoid this resource.
			Conventional Bore	133	28	N	63	42	702	Y	N	$633,223		
Norfolk	G-025	S-MM18	Dry-Ditch Open-Cut	35	-	N	45	41	349	Y	N	$43,253	Dry-Ditch Open-Cut	The open cut method would result in a temporary impact to a small UNT to Sinking Creek. The stream is very small - less than ten feet in width and would require bore pits approximately twenty feet deep. Avoiding/minimizing this minor impact through a conventional bore would require creating excessive spoil piles, with limited room for stockpiling. Karst terrain increases the logistical and technical challenges. Using a conventional bore crossing method to avoid/minimize this minor temporary impact would be unreasonably expensive and would take three times as along to complete.
			Conventional Bore	35	20	N	45	41	349	Y	N	$282,023		
Norfolk	G-026	S-NN12	Dry-Ditch Open-Cut	41	-	N	41	28	276	Y	N	$37,317	Dry-Ditch Open-Cut	The open cut method would result in a temporary impact to a small UNT to Sinking Creek. The stream is very small - less than five feet in width and would require bore pits that are twenty feet deep. Avoiding/minimizing this minor impact through a conventional bore would require a deep bore pit which would create excessive spoil piles, with limited room for stockpiling. Karst terrain increases the logistical and technical challenges. Using a conventional bore crossing method to avoid/minimize this minor temporary impact would be unreasonably expensive and would take longer to complete.
			Conventional Bore	41	20	N	41	28	276	Y	N	$299,051		
Norfolk	G-027	S-NN11	Dry-Ditch Open-Cut	147	-	N	38	26	43	Y	N	$121,499	Dry-Ditch Open-Cut	The open cut method would result in a temporary impact to a small UNT to Sinking Creek. The stream is very small - less than five feet in width and would require bore pits greater than twenty feet deep. Avoiding/minimizing this minor impact through a conventional bore would require a deep bore pit which would create excessive spoil piles, with limited room for stockpiling. Karst

Table 15. Crossing Method Determination Summary
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USACE District	Crossing #	Waterbody	Crossing Methods Evaluated	Evaluation Factors: Crossing Length	Pit Depth	Deep Stream	Maximum Steep Slope (%)	Maximum Average Slope (%)	Maximum Winch Hill Length (feet)	Karst Terrain Present	Sufficient Stockpile Storage Available	Total Cost ($)	Proposed Crossing Method	Crossing Method Decision Rationale
Norfolk	G-027	S-NN11	Conventional Bore	147	24	N	38	26	43	Y	N	$636,416	Dry-Ditch Open-Cut	conventional bore would require a deep bore pit which would create excessive spoil piles, with limited room for stockpiling. Karst terrain increases the logistical and technical challenges. Using a conventional bore crossing method to avoid/minimize this minor temporary impact would be unreasonably expensive and would take longer to complete.
Norfolk	G-028	S-KL43	Dry-Ditch Open-Cut	48	-	N	43	28	102	Y	N	$61,648	Dry-Ditch Open-Cut	The open cut method would result in a temporary impact to a small UNT to Sinking Creek. The stream is very small - less than ten feet in width and would require bore pits greater than twenty feet deep. Avoiding/minimizing this minor impact through a conventional bore would create excessive spoil piles, with limited room for stockpiling. Karst terrain increases the logistical and technical challenges.
			Conventional Bore	48	19	N	43	28	102	Y	N	$223,003		
Norfolk	G-029	W-CD12, S-OO14	Dry-Ditch Open-Cut	70	-	N	23	11	0	Y	Y	$63,367	Dry-Ditch Open-Cut	The open cut method would result in a temporary impact to a small wetland and small UNT to Sinking Creek. The stream is very small - less than ten feet in width and would require bore pits greater than twenty feet deep. Avoiding/minimizing this minor impact through a conventional bore would create excessive spoil piles, with limited room for stockpiling. Karst terrain increases the logistical and technical challenges. Using a conventional bore crossing method to avoid/minimize this minor temporary impact would be unreasonably expensive and would take longer to complete.
			Conventional Bore	70	22	N	23	11	0	Y	Y	$399,622		
Norfolk	G-030	S-OO12, S-OO13	Dry-Ditch Open-Cut	45	-	N	41	21	73	Y	N	$101,903	Dry-Ditch Open-Cut	The open cut method would result in a temporary impact to two small UNTs to Sinking Creek. This crossing is in proximity to a residence, and a trenchless crossing of this location would take nearly three times as long to complete -- compounding the noise, aesthetic, and other impacts on nearby persons. The open-cut method reduces construction duration to minimize disruption due to construction activities on the affected residents. Karst terrain increases the logistical and technical challenges.
			Conventional Bore	45	18	N	41	21	73	Y	N	$209,921		
Norfolk	G-031	S-PP1	Dry-Ditch Open-Cut	46	-	N	16	8	0	Y	Y	$43,348	Dry-Ditch Open-Cut	The open cut method would result in a temporary impact to a small (three-feet wide) intermittent UNT to Sinking Creek. This crossing is in close proximity to a residence, and a trenchless crossing of this location would take four times as long to complete -- compounding the noise, aesthetic, and other impacts on nearby persons. The open-cut method reduces construction duration to minimize disruption due to construction activities on the affected residents. Karst terrain increases the logistical and technical challenges.
			Conventional Bore	46	15	N	16	8	0	Y	Y	$199,057		
Norfolk	G-032	S-PP3	Dry-Ditch Open-Cut	25	-	N	17	12	0	Y	Y	$26,364	Dry-Ditch Open-Cut	The open cut method would result in a temporary impact to a small (three-feet wide) UNT to Sinking Creek. Karst terrain increases the logistical and technical challenges. Using a conventional bore crossing method to avoid/minimize this minor temporary impact would be unreasonably expensive.
			Conventional Bore	25	17	N	17	12	0	Y	Y	$148,594		
Norfolk	G-033	S-PP4	Dry-Ditch Open-Cut	38	-	N	22	11	0	Y	Y	$34,742	Dry-Ditch Open-Cut	The open cut method would result in a temporary impact to a small (two-feet wide) intermittent UNT to Sinking Creek. Karst terrain increases the logistical and technical challenges. Using a conventional bore crossing method to avoid/minimize this minor temporary impact would be unreasonably expensive.
			Conventional Bore	38	11	N	22	11	0	Y	Y	$158,084		
Norfolk	G-034	S-PP22	Dry-Ditch Open-Cut	48	-	N	57	48	203	N	N	$44,100	Dry-Ditch Open-Cut	Mountain Valley has only been authorized to boring the streams in this section of the project.
			Conventional Bore	48	19	N	57	48	203	N	N	$223,003		
Norfolk	G-035	S-PP21	Dry-Ditch Open-Cut	35	-	N	33	26	0	N	N	$38,975	Dry-Ditch Open-Cut	Mountain Valley has only been authorized to boring the streams in this section of the project.
			Conventional Bore	35	22	N	33	26	0	N	N	$300,293		
Norfolk	G-036	S-PP20	Dry-Ditch Open-Cut	48	-	N	26	9	0	N	Y	$58,844	Dry-Ditch Open-Cut	Mountain Valley has only been authorized to boring the streams in this section of the project.

Table 15. Crossing Method Determination Summary
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USACE District	Crossing #	Waterbody	Crossing Methods Evaluated	Evaluation Factors: Crossing Length	Pit Depth	Deep Stream	Maximum Steep Slope (%)	Maximum Average Slope (%)	Maximum Winch Hill Length (feet)	Karst Terrain Present	Sufficient Stockpile Storage Available	Total Cost ($)	Proposed Crossing Method	Crossing Method Decision Rationale
Norfolk	G-036	S-PP20	Conventional Bore	48	18	N	26	9	0	N	Y	$218,435	Dry-Ditch Open-Cut	Mountain Valley has only been authorized to boring the streams in this section of the project.
Norfolk	G-037	S-OO6	Dry-Ditch Open-Cut	61	-	N	20	8	0	N	Y	$166,001	Dry-Ditch Open-Cut	Mountain Valley has only been authorized to boring the streams in this section of the project.
			Conventional Bore	61	11	N	20	8	0	N	Y	$223,358		
Norfolk	G-038	S-RR14	Dry-Ditch Open-Cut	38	-	N	33	19	21	N	N	$52,813	Dry-Ditch Open-Cut	Mountain Valley has only been authorized to boring the streams in this section of the project.
			Conventional Bore	38	13	N	33	19	21	N	N	$167,219		
Norfolk	G-039	S-HH18	Dry-Ditch Open-Cut	55	-	N	42	24	216	N	N	$59,609	Dry-Ditch Open-Cut	Mountain Valley has only been authorized to boring the streams in this section of the project.
			Conventional Bore	55	29	N	42	24	216	N	N	$420,995		
Norfolk	G-040	S-MN21	Dry-Ditch Open-Cut	32	-	N	53	42	287	N	N	$40,296	Dry-Ditch Open-Cut	Access to this crossing location is extremely limited and requires removal and replacement of approximately 200 waterbars per day during period of active construction. Operating a boring operation at this location is logistically and technically challenging. Furthermore, avoiding this temporary impact to this small stream with a conventional bore crossing would be unreasonably expensive.
			Conventional Bore	32	28	N	53	42	287	N	N	$346,587		
Norfolk	G-041	S-MN22	Dry-Ditch Open-Cut	40	-	N	30	24	0	N	Y	$43,706	Dry-Ditch Open-Cut	The open cut method would result in a temporary impact to a small (four-feet wide) stream. Avoiding/minimizing this minor impact through a conventional bore would require a relatively deep bore pit of 20 feet at the edge of a steep slope, thereby requiring the excavation of an interim ramp and bench and dramatically increasing the space occupied by the bore pit and spoil pile. Using a conventional bore crossing method to avoid/minimize this minor temporary impact would be unreasonably expensive.
			Conventional Bore	40	20	N	30	24	0	N	Y	$296,213		
Norfolk	G-042	S-EF65	Dry-Ditch Open-Cut	88	-	N	43	27	560	Y	N	$166,301	Dry-Ditch Open-Cut	Avoiding/minimizing this minor impact through a conventional bore would require a relatively deep bore pit exceeding 20 feet, thereby requiring the excavation of an interim ramp and bench and dramatically increasing the space occupied by the bore pit and spoil pile. The stream is also located on a steep slope that would require logistically and technically challenging winching system in an already reduced work area. Karst terrain increases the logistical and technical challenges.
			Conventional Bore	88	22	N	43	27	560	Y	N	$450,706		
Norfolk	G-043	S-EF62	Dry-Ditch Open-Cut	38	-	N	28	17	293	Y	N	$58,103	Dry-Ditch Open-Cut	The stream is located on a steep slope that would require logistically and technically challenging winching system in an already reduced work area. Karst terrain increases the logistical and technical challenges.
			Conventional Bore	38	16	N	28	17	293	Y	N	$180,921		
Norfolk	G-044	S-IJ52, W-IJ46-PEM	Dry-Ditch Open-Cut	46	-	N	63	35	178	Y	N	$57,673	Dry-Ditch Open-Cut	Site conditions do not allow sufficient space to stockpile spoils from bore pits. Karst terrain increases the logistical and technical challenges. Furthermore, avoiding this temporary impact to this small stream with a conventional bore crossing would be unreasonably expensive and would take longer to complete.
			Conventional Bore	46	24	N	63	35	178	Y	N	$349,780		
			Dry-Ditch Open-Cut	301	-	N	74	46	1576	N	N	$232,364		The open cut method would result in a temporary impact to a small (six-feet wide) intermittent UNT to Roanoke River. Avoiding/minimizing this minor impact through a conventional bore would require a deep bore pit of nearly 40 feet at the edge of a steep slope, thereby requiring the excavation of an interim ramp and bench and dramatically increasing the space occupied by

Table 15. Crossing Method Determination Summary
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USACE District	Crossing #	Waterbody	Crossing Methods Evaluated	Evaluation Factors: Crossing Length	Pit Depth	Deep Stream	Maximum Steep Slope (%)	Maximum Average Slope (%)	Maximum Winch Hill Length (feet)	Karst Terrain Present	Sufficient Stockpile Storage Available	Total Cost ($)	Proposed Crossing Method	Crossing Method Decision Rationale
Norfolk	H-001	S-G39	Conventional Bore	301	36	N	74	46	1576	N	N	$1,511,931	Dry-Ditch Open-Cut	a steep slope, thereby requiring the excavation of an interim ramp and bench and dramatically increasing the space occupied by the bore pit and spoil pile. The slope adjacent to the crossing is steep and excessively long, requiring equipment operating within and around the bore pit to be winched to other equipment. That increases the complexity of this crossing if bored, increases safety risk to personnel, and adds risk of impact to the waterbody from upland work during a bore. There is insufficient space at this location for spoil piles from a bore pit. A conventional bore crossing would extend the duration of this crossing from 6 to 79 days, thereby increasing the greenhouse gas emissions associated with the crossing by nearly 1,400%. Using a conventional bore crossing method to avoid/minimize this minor temporary impact would be unreasonably expensive.
Norfolk	H-002	S-MM15	Dry-Ditch Open-Cut	37	-	N	39	29	74	N	N	$47,979	Dry-Ditch Open-Cut	The open cut method would result in a temporary impact to a small (six-feet wide) intermittent UNT to Flatwoods Branch. Avoiding/minimizing this minor impact through a conventional bore would require a deep bore pit of nearly 30 feet at the edge of a steep slope, thereby requiring the excavation of an interim ramp and bench and dramatically increasing the space occupied by the bore pit and spoil pile. Using a conventional bore crossing method to avoid/minimize this minor temporary impact would be unreasonably expensive.
			Conventional Bore	37	33	N	39	29	74	N	N	$707,895		
Norfolk	H-003	S-MM14	Dry-Ditch Open-Cut	100	-	N	42	33	243	N	N	$104,394	Dry-Ditch Open-Cut	The open cut method would result in a temporary impact to a UNT to Flatwoods Branch. Avoiding/minimizing this minor impact through a conventional bore would require a deep bore pit of nearly 40 feet at the edge of a steep slope, thereby requiring the excavation of an interim ramp and bench and dramatically increasing the space occupied by the bore pit and spoil pile. Using a conventional bore crossing method to avoid/minimize this minor temporary impact would be unreasonably expensive.
			Conventional Bore	100	37	N	42	33	243	N	N	$959,765		
Norfolk	H-004	S-MM13	Dry-Ditch Open-Cut	33	-	N	59	34	33	N	N	$41,924	Dry-Ditch Open-Cut	The open cut method would result in a temporary impact to a small (five-feet wide) UNT to Flatwoods Branch. Avoiding/minimizing this minor impact through a conventional bore would require a relatively deep bore pit exceeding 30 feet at the edge of a steep slope, thereby requiring the excavation of an interim ramp and bench and dramatically increasing the space occupied by the bore pit and spoil pile. This crossing is in close proximity to a residence, and a trenchless crossing of this location would take more than twice as long to complete -- compounding the noise, aesthetic, and other impacts on nearby persons. The open-cut method reduces construction duration to minimize disruption due to construction activities on the affected residents. Using a conventional bore crossing method to avoid/minimize this minor temporary impact would be unreasonably expensive.
			Conventional Bore	33	32	N	59	34	33	N	N	$678,274		
Norfolk	H-005	S-MM11	Dry-Ditch Open-Cut	34	-	N	46	24	33	N	N	$54,178	Dry-Ditch Open-Cut	The open cut method would result in a temporary impact to a small (nine-feet wide) UNT to Flatwoods Branch. Avoiding/minimizing this minor impact through a conventional bore would require a relatively deep bore pit exceeding 20 feet at the edge of a steep slope, thereby requiring the excavation of an interim ramp and bench and dramatically increasing the space occupied by the bore pit and spoil pile. This crossing is in close proximity to residences, and a trenchless crossing of this location would take more than twice as long to complete -- compounding the noise, aesthetic, and other impacts on nearby persons. The open-cut method reduces construction duration to minimize disruption due to construction activities on the affected residents. The open cut method would reduce the construction duration near a private drinking water well on the property. Using a conventional bore crossing method to avoid/minimize this minor temporary impact would be unreasonably expensive.
			Conventional Bore	34	25	N	46	24	33	N	N	$324,859		
Norfolk	H-006	W-F9-PFO, S-F15	Dry-Ditch Open-Cut	55	-	N	56	17	0	N	Y	$85,276	Dry-Ditch Open-Cut	The open cut method would result in a temporary impact to an intermittent UNT to Flatwoods Branch and an adjacent PFO wetland (0.02 ac). Avoiding/minimizing this minor impact through a conventional bore would require a relatively deep bore pit exceeding 30 feet at the edge of a steep slope, thereby requiring the excavation of an interim ramp and bench and dramatically increasing the space occupied by the bore pit and spoil pile. This crossing is in proximity to residences, and a trenchless crossing of this location would take twice as long to complete -- compounding the noise, aesthetic, and other impacts on nearby persons. The open-cut method reduces construction duration to minimize disruption due to construction activities on the affected residents. The open cut method would reduce the construction duration near a private drinking water well on the property. Using a conventional bore crossing method to avoid/minimize these minor temporary impacts would be unreasonably expensive.
			Conventional Bore	55	35	N	56	17	0	N	Y	$795,517		
Norfolk	H-007	S-F16a/F16b	Dry-Ditch Open-Cut	32	-	N	30	15	0	N	Y	$32,899	Dry-Ditch Open-Cut	The open cut method would result in a temporary impact to a small (three-feet wide) UNT to Flatwoods Branch. Avoiding/minimizing this minor impact through a conventional bore would require a relatively deep bore pit of nearly 30 feet at the edge of a steep slope, thereby requiring the excavation of an interim ramp and bench and dramatically increasing the space occupied by the bore pit and spoil pile. This crossing is in close proximity to residences, and a trenchless crossing of this location would take nearly twice as long to complete -- compounding the noise, aesthetic, and other impacts on nearby persons. The open-cut method reduces construction duration to minimize disruption due to construction activities on the affected residents. The open cut method would reduce the construction duration near a private drinking water well on the property. Using a conventional bore crossing method to avoid/minimize this minor temporary impact would be unreasonably expensive.
			Conventional Bore	32	27	N	30	15	0	N	Y	$337,452		
Norfolk	H-008	~~S-G33,~~ S-C36, W-C11	Dry-Ditch Open-Cut	313	-	N	21	15	0	N	Y	$240,100	Dry-Ditch Open-Cut	The open cut method would result in a temporary impact to a UNT to Flatwoods Branch. Avoiding/minimizing this minor impact through a conventional bore would require a relatively deep bore pit more than 20 feet, thereby requiring the excavation of an interim ramp and bench and dramatically increasing the space occupied by the bore pit and spoil pile. A conventional bore crossing would extend the duration of this crossing from 2 to 30 days, thereby increasing the greenhouse gas emissions associated with the crossing by over 1500%.
			Conventional Bore	313	23	N	21	15	0	N	Y	$1,098,387		
Norfolk	H-009	S-MM31	Dry-Ditch Open-Cut	40	-	N	5	3	0	N	Y	$43,566	Conventional Bore	There are no significant constraints on available crossing methods or significant environmental impacts relevant to the available methods. The direct aquatic impact will be avoided/minimized by use of the conventional bore method. A minor temporary impact associated with the bore to maintain access will be required.
			Conventional Bore	40	11	N	5	3	0	N	Y	$163,760		

Table 15. Crossing Method Determination Summary
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USACE District	Crossing #	Waterbody	Crossing Methods Evaluated	Evaluation Factors: Crossing Length	Pit Depth	Deep Stream	Maximum Steep Slope (%)	Maximum Average Slope (%)	Maximum Winch Hill Length (feet)	Karst Terrain Present	Sufficient Stockpile Storage Available	Total Cost ($)	Proposed Crossing Method	Crossing Method Decision Rationale
Norfolk	H-010	S-C29	Dry-Ditch Open-Cut	44	-	N	21	16	0	N	Y	$35,326	Dry-Ditch Open-Cut	The open cut method would result in a temporary impact to the small (one-foot wide) Flatwoods Branch. A conventional bore crossing would extend the duration of this crossing from 2 to 9 days, thereby increasing the greenhouse gas emissions associated with the crossing by over 450%. Using a conventional bore crossing method to avoid/minimize this minor temporary impact would be unreasonably expensive.
			Conventional Bore	44	17	N	21	16	0	N	Y	$202,516		
Norfolk	H-012	W-C5	Dry-Ditch Open-Cut	68	-	N	31	19	0	N	Y	$47,600	Dry-Ditch Open-Cut	The open cut method would result in a small temporary impact to a PEM wetland (0.05 ac). Avoiding/minimizing this minor impact through a conventional bore would require a deep bore pit of nearly 20 feet, thereby requiring the excavation of an interim ramp and bench and dramatically increasing the space occupied by the bore pit and spoil pile. A conventional bore crossing would extend the duration of this crossing from 2 to 8 days, thereby increasing the greenhouse gas emissions associated with the crossing by over 400%. Using a conventional bore crossing method to avoid/minimize this minor temporary impact would be unreasonably expensive.
			Conventional Bore	68	23	N	31	19	0	N	Y	$403,081		
Norfolk	H-013	S-C25	Dry-Ditch Open-Cut	65	-	N	39	29	52	N	N	$62,093	Dry-Ditch Open-Cut	The open cut method would result in a temporary impact to a small (five-feet wide) UNT to Bradshaw Creek. Avoiding/minimizing this minor impact through a conventional bore would require a deep bore pit of nearly 40 feet at the edge of a steep slope, thereby requiring the excavation of an interim ramp and bench and dramatically increasing the space occupied by the bore pit and spoil pile. A conventional bore crossing would extend the duration of this crossing from 2 to 18 days, thereby increasing the greenhouse gas emissions associated with the crossing by over 900%. Using a conventional bore crossing method to avoid/minimize this minor temporary impact would be unreasonably expensive.
			Conventional Bore	65	38	N	39	29	52	N	N	$878,705		
Norfolk	H-014	S-C24	Dry-Ditch Open-Cut	67	-	N	38	20	21	N	N	$64,412	Dry-Ditch Open-Cut	The open cut method would result in a temporary impact to a UNT to Bradshaw Creek. Avoiding/minimizing this minor impact through a conventional bore would require a relatively deep bore pit exceeding 30 feet at the edge of a steep slope, thereby requiring the excavation of an interim ramp and bench and dramatically increasing the space occupied by the bore pit and spoil pile. A conventional bore crossing would extend the duration of this crossing from 2 to 18 days, thereby increasing the greenhouse gas emissions associated with the crossing by over 900%. Using a conventional bore crossing method to avoid/minimize this minor temporary impact would be unreasonably expensive.
			Conventional Bore	67	34	N	38	20	21	N	N	$811,304		
Norfolk	H-015	S-C21	Dry-Ditch Open-Cut	90	-	N	18	6	21	N	N	$168,191	Conventional Bore	There are no significant constraints on available crossing methods or significant environmental impacts relevant to the available methods. The direct aquatic impact will be avoided/minimized by use of the conventional bore method. A minor temporary impact associated with the bore to maintain access will be required.
			Conventional Bore	90	26	N	18	6	21	N	N	$492,920		
Norfolk	H-017	S-OO16	Dry-Ditch Open-Cut	360	-	N	45	36	282	Y	N	$266,002	Conventional Bore	Mountain Valley must use a conventional bore to cross an adjacent road (I-81). The bore can be extended to avoid this resource.
			Conventional Bore	360	39	N	45	36	282	Y	N	$1,734,180		
Norfolk	H-018	S-NN19	Dry-Ditch Open-Cut	34	-	N	53	27	11	Y	N	$36,153	Dry-Ditch Open-Cut	The open cut method would result in a temporary impact to a small (four-feet wide) UNT to Roanoke River. Avoiding/minimizing this minor impact through a conventional bore would require a relatively deep bore pit exceeding 30 feet at the edge of a steep slope, thereby requiring the excavation of an interim ramp and bench and dramatically increasing the space occupied by the bore pit and spoil pile. This crossing is in close proximity to a residence, and a trenchless crossing of this location would take three weeks to complete -- compounding the noise, aesthetic, and other impacts on nearby persons. The open-cut method reduces construction duration to minimize disruption due to construction activities on the affected residents. Karst terrain increases the logistical and technical challenges. Using a conventional bore crossing method to avoid/minimize this minor temporary impact would be unreasonably expensive.
			Conventional Bore	34	33	N	53	27	11	Y	N	$699,381		
Norfolk	H-019	S-NN16, W-NN8	Dry-Ditch Open-Cut	316	-	N	23	14	0	Y	Y	$504,735	Dry-Ditch Open-Cut	Mountain Valley must use microtunneling to cross an adjacent road (Rt. 11). The bore can be extended to avoid this resource.
			Microtunnel	316	31	N	23	14	0	Y	Y	$3,726,351		
Norfolk	H-020	S-I1, S-AB16, W-AB7	Dry-Ditch Open-Cut	280	-	N	4	3	74	Y	Y	$244,999	Conventional Bore	Mountain Valley must use microtunneling to cross an adjacent road (Rt. 11). The bore can be extended to avoid this resource.
			Conventional Bore	280	16	N	4	3	74	Y	Y	$867,713		

Table 15. Crossing Method Determination Summary
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USACE District	Crossing #	Waterbody	Crossing Methods Evaluated	Evaluation Factors: Crossing Length	Pit Depth	Deep Stream	Maximum Steep Slope (%)	Maximum Average Slope (%)	Maximum Winch Hill Length (feet)	Karst Terrain Present	Sufficient Stockpile Storage Available	Total Cost ($)	Proposed Crossing Method	Crossing Method Decision Rationale
Norfolk	H-021	S-CD12b	Dry-Ditch Open-Cut	38	-	N	3	2	0	N	Y	$37,100	Conventional Bore	There are no significant constraints on available crossing methods or significant environmental impacts relevant to the available methods. The direct aquatic impact will be avoided/minimized by use of the conventional bore method. A minor temporary impact associated with the bore to maintain access will be required.
			Conventional Bore	38	11	N	3	2	0	N	Y	$158,084		
Norfolk	H-022	W-KL58	Dry-Ditch Open-Cut	114	-	N	1	0	0	N	Y	$79,800	Conventional Bore	There are no significant constraints on available crossing methods or significant environmental impacts relevant to the available methods. The direct aquatic impact will be avoided/minimized by use of the conventional bore method. A minor temporary impact associated with the bore to maintain access will be required.
			Conventional Bore	114	12	N	1	0	0	N	Y	$378,338		
Norfolk	H-023	S-EF19	Dry-Ditch Open-Cut	30	-	N	76	60	647	N	N	$24,179	Dry-Ditch Open-Cut	The open cut method would result in a temporary impact to a small (one-foot wide) UNT to Indian Run. Avoiding/minimizing this minor impact through a trenchless crossing would require an excessively deep bore pit exceeding 50 feet, thereby requiring the excavation of an interim ramp and up to three benches and dramatically increasing the space occupied by the bore pit and spoil pile. The slope adjacent to the crossing is steep and excessively long, requiring equipment operating within and around the bore pit to be winched to other equipment. That increases the complexity of this crossing if bored, increases safety risk to personnel, and adds risk of impact to the waterbody from upland work during a bore. There is insufficient space at this location for spoil piles from a bore pit. Using a trenchless method to avoid/minimize this minor temporary impact would be unreasonably expensive.
			Microtunnel	30	51	N	76	60	647	N	N	$3,081,818		
Norfolk	H-024	W-EF5-PFO, S-EF20a	Dry-Ditch Open-Cut	83	-	N	63	52	768	N	N	$80,005	Dry-Ditch Open-Cut	The open cut method would result in a temporary impact to a small (five-feet wide) UNT to Roanoke River and an adjacent PFO wetland (0.11 ac). Avoiding/minimizing these minor impacts through a conventional bore would require an excessively deep bore pit greater than 40 feet, thereby requiring the excavation of an interim ramp and two benches and dramatically increasing the space occupied by the bore pit and spoil pile. The slope adjacent to the crossing is steep and excessively long, requiring equipment operating within and around the bore pit to be winched to other equipment. That increases the complexity of this crossing if bored, increases safety risk to personnel, and adds risk of impact to the waterbody from upland work during a bore. There is insufficient space at this location for spoil piles from a bore pit. In forested wetlands, a 30-foot corridor generally must be maintained free of trees. Accordingly, conversion impacts to the PFO wetland are unavoidable, even if a bore is used. This crossing also is in close proximity to a residence, and a trenchless crossing of this location would take 27 days -- compounding the noise, aesthetic, and other impacts on nearby persons. The open-cut method reduces construction duration to minimize disruption due to construction activities on the affected residents. Using a conventional bore crossing method to avoid/minimize these minor temporary impacts would be unreasonably expensive.
			Conventional Bore	83	44	N	63	52	768	N	N	$2,635,553		
Norfolk	H-025	S-MM22	Dry-Ditch Open-Cut	200	-	N	33	25	2582	N	N	$192,500	Dry-Ditch Open-Cut	The stream is located on a slope that will increase the logistical and technical difficulty of crossing this small stream. The bore pits are nearly 20 feet deep which makes stockpiling the spoils on such steep slope and logistical challenge.
			Conventional Bore	200	17	N	33	25	2582	N	N	$645,242		
Norfolk	H-026	S-IJ50	Dry-Ditch Open-Cut	88	-	N	74	66	2681	N	N	$96,784	Dry-Ditch Open-Cut	The open cut method would result in a temporary impact to a small UNT to Roanoke River. Avoiding/minimizing this minor impact through a trenchless crossing would require an excessively deep bore pit of nearly 60 feet, thereby requiring the excavation of an interim ramp and up to three benches and dramatically increasing the space occupied by the bore pit and spoil pile. The slope adjacent to the crossing is steep and excessively long, requiring equipment operating within and around the bore pit to be winched to other equipment. That increases the complexity of this crossing if bored, increases safety risk to personnel, and adds risk of impact to the waterbody from upland work during a bore. There is insufficient space at this location for spoil piles from a bore pit. Using a trenchless method to avoid/minimize this minor temporary impact would be unreasonably expensive.
			Microtunnel	88	59	N	74	66	2681	N	N	$4,098,182		
Norfolk	H-027	S-Y13, S-Y14	Dry-Ditch Open-Cut	104	-	N	66	45	670	N	N	$124,613	Dry-Ditch Open-Cut	The open cut method would result in a temporary impact to two small UNTs to Bottom Creek. The slope adjacent to the crossing is steep and excessively long, requiring equipment operating within and around the bore pit to be winched to other equipment. That increases the complexity of this crossing if bored, increases safety risk to personnel, and adds risk of impact to the waterbody from upland work during a bore. There is insufficient space at this location for spoil piles from a bore pit. Using a conventional bore crossing method to avoid/minimize these minor temporary impacts would be unreasonably expensive.
			Conventional Bore	104	38	N	66	45	670	N	N	$989,387		
Norfolk	H-028	S-EF34b, S-EF55	Dry-Ditch Open-Cut	100	-	N	63	51	508	N	N	$105,000	Dry-Ditch Open-Cut	The open cut method would result in a temporary impact to two small UNTs to Bottom Creek. Avoiding/minimizing these minor impacts through a conventional bore would require an excessively deep bore pit greater than 40 feet, thereby requiring the excavation of an interim ramp and two benches and dramatically increasing the space occupied by the bore pit and spoil pile. The slope adjacent to the crossing is steep and excessively long, requiring equipment operating within and around the bore pit to be winched to other equipment. That increases the complexity of this crossing if bored, increases safety risk to personnel, and adds risk of impact to the waterbody from upland work during a bore. There is insufficient space at this location for spoil piles from a bore pit. Using a conventional bore crossing method to avoid/minimize these minor temporary impacts would be unreasonably expensive.
			Conventional Bore	100	45	N	63	51	508	N	N	$2,738,344		
Norfolk	H-029	S-EF33	Dry-Ditch Open-Cut	43	-	N	42	19	560	N	N	$48,809	Dry-Ditch Open-Cut	The open cut method would result in a temporary impact to a small (five-feet wide) intermittent UNT to Bottom Creek. Avoiding/minimizing this minor impact through a conventional bore would require a relatively deep bore pit of nearly 30 feet, thereby requiring the excavation of an interim ramp and bench and dramatically increasing the space occupied by the bore pit and

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USACE District	Crossing #	Waterbody	Crossing Methods Evaluated	Evaluation Factors									Proposed Crossing Method	Crossing Method Decision Rationale
				Crossing Length	Pit Depth	Deep Stream	Maximum Steep Slope (%)	Maximum Average Slope (%)	Maximum Winch Hill Length (feet)	Karst Terrain Present	Sufficient Stockpile Storage Available	Total Cost ($)		
Norfolk	H-029	S-LP33	Conventional Bore	43	31	N	42	19	560	N	N	$688,384	Dry-Ditch Open-Cut	thereby requiring the excavation of an interim ramp and bench and dramatically increasing the space occupied by the bore pit and spoil pile. Using a conventional bore crossing method to avoid/minimize this minor temporary impact would be unreasonably expensive.
Norfolk	H-030	S-IJ82	Dry-Ditch Open-Cut	73	-	N	25	14	0	N	Y	$70,275	Conventional Bore	The stream is a trout water and the direct aquatic impact will be avoided/minimized by use of the conventional bore method.
			Conventional Bore	73	27	N	25	14	0	N	Y	$453,809		
Norfolk	H-031	W-IJ94-PEM, W-IJ95-PSS, S-IJ83, S-IJ88, S-IJ84, W-IJ102	Dry-Ditch Open-Cut	362	-	N	25	12	0	N	Y	$292,224	Conventional Bore	Orangefin madtom habitat may be present in this stream and it is a trout water. The direct aquatic impact will be avoided/minimized by use of the conventional bore method. A minor temporary impact associated with the bore to maintain access will be required.
			Conventional Bore	362	28	N	25	12	0	N	Y	$1,283,121		
Norfolk	H-032	S-IJ89, S-IJ90	Dry-Ditch Open-Cut	108	-	N	34	22	212	N	N	$94,134	Conventional Bore	Orangefin madtom habitat may be present in this stream and it is a trout water. The direct aquatic impact will be avoided/minimized by use of the conventional bore method. A minor temporary impact associated with the bore to maintain access will be required.
			Conventional Bore	108	22	N	34	22	212	N	N	$507,465		
Norfolk	H-033	W-KL17, S-KL25	Dry-Ditch Open-Cut	59	-	N	14	9	521	N	N	$53,001	Dry-Ditch Open-Cut	The open cut method would result in a temporary impact to a small (three-feet wide) intermittent UNT to Mill Creek and a PSS wetland (0.04 ac). The slope adjacent to the crossing is steep and excessively long, requiring equipment operating within and around the bore pit to be winched to other equipment. That increases the complexity of this crossing if bored, increases safety risk to personnel, and adds risk of impact to the waterbody from upland work during a bore. There is insufficient space at this location for spoil piles from a bore pit. This crossing also is in close proximity to a residence, and a trenchless crossing of this location increases the duration of the crossing work -- compounding the noise, aesthetic, and other impacts on nearby persons. The open-cut method reduces construction duration to minimize disruption due to construction activities on the affected residents.
			Conventional Bore	59	16	N	14	9	521	N	N	$240,519		
Norfolk	H-035	W-KL15	Dry-Ditch Open-Cut	59	-	N	15	12	0	N	Y	$41,300	Dry-Ditch Open-Cut	The open cut method would result in a small temporary impact to a PEM wetland (0.03 ac). This crossing is in close proximity to residences, and a trenchless crossing of this location nearly triples the duration of the crossing work -- compounding the noise, aesthetic, and other impacts on nearby persons. The open-cut method reduces construction duration to minimize disruption due to construction activities on the affected residents. Using a conventional bore crossing method to avoid/minimize the impact to this PEM would be unreasonably expensive.
			Conventional Bore	59	16	N	15	12	0	N	Y	$240,519		
Norfolk	H-036	W-EF42, W-HS02, W-AB6-PEM-2, W-AB6-PFO-1, W-AB6-PEM-1, W-AB6-PSS, W-AB5, W-AB3-PEM-2	Dry-Ditch Open-Cut	1600	-	N	4	2	0	N	Y	$1,120,000	Dry-Ditch Open-Cut	The open cut method would result in a small temporary impacts several closely grouped wetland features. To avoid excavating bore pits in wetland areas, Direct Pipe would be necessary to span the excessively long crossing distance. The trenchless crossing would take more than one month to complete (as opposed to three days for an open cut crossing). The greenhouse gas footprint of the crossing would therefore increase by over 1,400%. Furthermore, using a Direct Pipe crossing method to avoid/minimize the temporary impacts to these features would be unreasonably expensive. A minor temporary impact associated with the bore to maintain access will be required.
			Direct Pipe	1600	10	N	4	2	0	N	Y	$12,845,673		
Norfolk	H-040	W-EF46, S-ST9b	Dry-Ditch Open-Cut	179	-	N	31	17	10	N	N	$152,132	Conventional Bore	Orangefin madtom habitat may be present in this stream and it is a trout water. The direct aquatic impact will be avoided/minimized by use of the conventional bore method. A minor temporary impact associated with the bore to maintain access will be required.
			Conventional Bore	179	21	N	31	17	10	N	N	$699,827		
Norfolk	H-041	W-KL48-PSS-1	Dry-Ditch Open-Cut	70	-	N	10	5	0	N	Y	$49,000	Dry-Ditch Open-Cut	The open cut method would result in a small temporary impact to PSS wetland. Using a conventional bore crossing method to avoid/minimize this minor temporary impact would be unreasonably expensive.
			Conventional Bore	70	17	N	10	5	0	N	Y	$276,304		
Norfolk	H-042	W-KL49-PEM, W-KL51-PEM, S-KL55	Dry-Ditch Open-Cut	202	-	N	17	13	0	N	Y	$181,156	Conventional Bore	Orangefin madtom habitat may be present in this stream and it is a trout water. The direct aquatic impact will be avoided/minimized by use of the conventional bore method. A minor temporary impact associated with the bore to maintain

Table 15. Crossing Method Determination Summary
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USACE District	Crossing #	Waterbody	Crossing Methods Evaluated	Evaluation Factors: Crossing Length	Pit Depth	Deep Stream	Maximum Steep Slope (%)	Maximum Average Slope (%)	Maximum Winch Hill Length (feet)	Karst Terrain Present	Sufficient Stockpile Storage Available	Total Cost ($)	Proposed Crossing Method	Crossing Method Decision Rationale
Norfolk	H-042	KL51-PEM, S-KL53, W-KL51-PSS	Conventional Bore	202	22	N	17	13	0	N	Y	$774,236	Conventional Bore	avoided/minimized by use of the conventional bore method. A minor temporary impact associated with the bore to maintain access will be required.
Norfolk	H-043	W-MN7-PEM, S-IJ12	Dry-Ditch Open-Cut	87	-	N	31	22	340	N	N	$74,999	Conventional Bore	Orangefin madtom habitat may be present in this stream and it is a trout water. The direct aquatic impact will be avoided/minimized by use of the conventional bore method. A minor temporary impact associated with the bore to maintain access will be required.
			Conventional Bore	87	25	N	31	22	340	N	N	$475,272		
Norfolk	H-044	S-EF44, W-EF44	Dry-Ditch Open-Cut	45	-	N	45	33	84	N	N	$49,054	Conventional Bore	There are no significant constraints on available crossing methods or significant environmental impacts relevant to the available methods. The direct aquatic impact will be avoided/minimized by use of the conventional bore method.
			Conventional Bore	45	21	N	45	33	84	N	N	$319,538		
Norfolk	H-045	W-IJ36, S-IJ43	Dry-Ditch Open-Cut	282	-	N	43	26	230	N	N	$251,003	Conventional Bore	Orangefin madtom habitat may be present in this stream and it is a trout water. The direct aquatic impact will be avoided/minimized by use of the conventional bore method.
			Conventional Bore	282	30	N	43	26	230	N	N	$1,348,393		
Norfolk	H-046	S-Y7, W-Y2, S-Y8	Dry-Ditch Open-Cut	140	-	N	44	24	43	N	N	$117,275	Conventional Bore	Orangefin madtom habitat may be present in this stream and it is a trout water. The direct aquatic impact will be avoided/minimized by use of the conventional bore method.
			Conventional Bore	140	25	N	44	24	43	N	N	$625,685		
Norfolk	H-047A	S-B22	Dry-Ditch Open-Cut	64	-	N	9	5	0	N	Y	$59,056	Conventional Bore	Orangefin madtom habitat may be present in this stream and it is a trout water. The direct aquatic impact will be avoided/minimized by use of the conventional bore method.
			Conventional Bore	64	14	N	9	5	0	N	Y	$245,574		
Norfolk	H-047B	W-B25-PEM-1	Dry-Ditch Open-Cut	154	-	N	9	4	0	N	Y	$107,800	Dry-Ditch Open-Cut	The open cut method would result in a small (0.19 ac) temporary impact to PEM wetland. This crossing is in close proximity to several residences, and a trenchless crossing of this location would take 30 days to complete -- compounding the noise, aesthetic, and other impacts on nearby persons. The open-cut method reduces construction duration to minimize disruption due to construction activities on the affected residents.
			Conventional Bore	154	13	N	9	4	0	N	Y	$496,425		
Norfolk	H-048A	W-B25-PSS-2, S-B25	Dry-Ditch Open-Cut	253	-	N	3	1	0	N	Y	$202,035	Conventional Bore	There are no significant constraints on available crossing methods or significant environmental impacts relevant to the available methods. The direct aquatic impact will be avoided/minimized by use of the conventional bore method.
			Conventional Bore	253	11	N	3	1	0	N	Y	$768,251		
Norfolk	H-048B	W-B24-PEM, W-B24-PSS, S-B21	Dry-Ditch Open-Cut	228	-	N	9	6	0	N	Y	$176,494	Dry-Ditch Open-Cut	The pipeline is already installed through a portion of the wetland at this crossing. The layout of a conventional bore would require excavation of a bore pit unacceptably close to the installed pipe. Additionally, a trenchless method would require excavation of a bore pit within the wetland, meaning that that a longer-duration bore pit in the wetland (3 to 4 weeks) is not less environmentally damaging than a much shorter duration impact associated with an open cut through the wetlands and adjacent four-foot-wide UNT to Mill Creek.
			Conventional Bore	228	20	N	9	6	0	N	Y	$829,754		
Norfolk	H-051	W-ST2-PEM, S-	Dry-Ditch Open-Cut	96	-	N	57	48	130	N	N	$95,320	Dry-Ditch Open-Cut	The open cut method would result in a temporary impact to two small UNTs to Green Creek and a PEM wetland. Avoiding/minimizing these minor impacts through a conventional bore would require a deep bore pit of nearly 40 feet at the edge of a steep slope, thereby requiring the excavation of an interim ramp and bench and dramatically increasing the space occupied by the bore pit and spoil pile. This crossing is in close proximity to a residence, and a trenchless crossing of this location increases

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USACE District	Crossing #	Waterbody	Crossing Methods Evaluated	Evaluation Factors: Crossing Length	Pit Depth	Deep Stream	Maximum Steep Slope (%)	Maximum Average Slope (%)	Maximum Winch Hill Length (feet)	Karst Terrain Present	Sufficient Stockpile Storage Available	Total Cost ($)	Proposed Crossing Method	Crossing Method Decision Rationale
Norfolk	H-051	G24, S-G25	Conventional Bore	96	36	N	57	48	130	N	N	$930,144	Dry-Ditch Open-Cut	by the bore pit and spoil pile. This crossing is in close proximity to a residence, and a trenchless crossing of this location increases the duration of the crossing from 2 to 19 days -- compounding the noise, aesthetic, and other impacts on nearby persons. The open-cut method reduces construction duration to minimize disruption due to construction activities on the affected residents. Using a conventional bore crossing method to avoid/minimize these minor temporary impacts would be unreasonably expensive.
Norfolk	H-052	S-D14	Dry-Ditch Open-Cut	79	-	N	34	24	729	N	N	$65,800	Dry-Ditch Open-Cut	The open cut method would result in a temporary impact to a small (three-feet wide) UNT. The slope adjacent to the crossing is steep and excessively long, requiring equipment operating within and around the bore pit to be winched to other equipment. That increases the complexity of this crossing if bored, increases safety risk to personnel, and adds risk of impact to the waterbody from upland work during a bore. There is insufficient space at this location for spoil piles from a bore pit.
			Conventional Bore	79	19	N	34	24	729	N	N	$310,980		
Norfolk	H-053	W-D7-PEM, S-D13, S-D12	Dry-Ditch Open-Cut	89	-	N	27	20	83	N	N	$84,077	Dry-Ditch Open-Cut	The open cut method would result in a temporary impact to two small intermittent UNTs to North Fork Blackwater River and a PEM wetland. Avoiding/minimizing these minor impacts through a conventional bore would require a relatively deep bore pit exceeding 20 feet at the edge of a steep slope, thereby requiring the excavation of an interim ramp and bench and dramatically increasing the space occupied by the bore pit and spoil pile. Using a conventional bore crossing method to avoid/minimize these minor temporary impacts would be unreasonably expensive.
			Conventional Bore	89	24	N	27	20	83	N	N	$471,813		
Norfolk	H-054	S-D11	Dry-Ditch Open-Cut	81	-	N	33	10	51	N	N	$119,688	Conventional Bore	There are no significant constraints on available crossing methods or significant environmental impacts relevant to the available methods. The direct aquatic impact will be avoided/minimized by use of the conventional bore method. A minor temporary impact associated with the bore to maintain access will be required.
			Conventional Bore	81	22	N	33	10	51	N	N	$430,840		
Norfolk	H-055	S-D8	Dry-Ditch Open-Cut	60	-	N	43	37	585	N	N	$107,791	Dry-Ditch Open-Cut	The open cut method would result in a temporary impact to a small (four-feet wide) UNT to North Fork Blackwater River. Avoiding/minimizing these minor impacts through a conventional bore would require a deep bore pit exceeding 30 feet, thereby requiring the excavation of an interim ramp and two benches and dramatically increasing the space occupied by the bore pit and spoil pile. The slope adjacent to the crossing is steep and excessively long, requiring equipment operating within and around the bore pit to be winched to other equipment. That increases the complexity of this crossing if bored, increases safety risk to personnel, and adds risk of impact to the waterbody from upland work during a bore. There is insufficient space at this location for spoil piles from a bore pit. Using a conventional bore crossing method to avoid/minimize this minor temporary impact would be unreasonably expensive.
			Conventional Bore	60	35	N	43	37	585	N	N	$809,707		
Norfolk	H-056	S-GH15	Dry-Ditch Open-Cut	35	-	N	62	54	148	N	N	$38,526	Dry-Ditch Open-Cut	The open cut method would result in a temporary impact to a small (four-feet wide) intermittent UNT to North Fork Blackwater River. Avoiding/minimizing this minor impact through a conventional bore would require a relatively deep bore pit exceeding 20 feet at the edge of a steep slope, thereby requiring the excavation of an interim ramp and bench and dramatically increasing the space occupied by the bore pit and spoil pile. Using a conventional bore crossing method to avoid/minimize this minor temporary impact would be unreasonably expensive.
			Conventional Bore	35	24	N	62	54	148	N	N	$318,562		
Norfolk	H-057	S-GH14	Dry-Ditch Open-Cut	54	-	N	48	34	109	N	N	$52,050	Dry-Ditch Open-Cut	The open cut method would result in a temporary impact to a small (four-feet wide) UNT to North Fork Blackwater River. Avoiding/minimizing this minor impact through a conventional bore would require a relatively deep bore pit exceeding 30 feet at the edge of a steep slope, thereby requiring the excavation of an interim ramp and bench and dramatically increasing the space occupied by the bore pit and spoil pile. Using a conventional bore crossing method to avoid/minimize this minor temporary impact would be unreasonably expensive.
			Conventional Bore	54	36	N	48	34	109	N	N	$810,949		
Norfolk	H-058	S-GH11	Dry-Ditch Open-Cut	31	-	N	54	42	231	N	N	$32,688	Dry-Ditch Open-Cut	The open cut method would result in a temporary impact to a small (three-feet wide) intermittent UNT to Blackwater River. Avoiding/minimizing this minor impact through a conventional bore would require a relatively deep bore pit exceeding 30 feet at the edge of a steep slope, thereby requiring the excavation of an interim ramp and bench and dramatically increasing the space occupied by the bore pit and spoil pile. This crossing is in close proximity to a residence, and a trenchless crossing of this location would take longer to complete -- compounding the noise, aesthetic, and other impacts on nearby persons. The open-cut method reduces construction duration to minimize disruption due to construction activities on the affected residents. The open cut method would reduce the construction duration near private drinking water wells on the property. Using a conventional bore crossing method to avoid/minimize this minor temporary impact would be unreasonably expensive.
			Conventional Bore	31	32	N	54	42	231	N	N	$672,598		
Norfolk	H-059	S-GH9	Dry-Ditch Open-Cut	48	-	N	47	24	62	N	N	$48,203	Dry-Ditch Open-Cut	The open cut method would result in a temporary impact to a small (four-feet wide) UNT to North Fork Blackwater River. Avoiding/minimizing this minor impact through a conventional bore would require a relatively deep bore pit exceeding 30 feet at the edge of a steep slope, thereby requiring the excavation of an interim ramp and bench and dramatically increasing the space occupied by the bore pit and spoil pile. This crossing is in close proximity to a residence, and a trenchless crossing of this location would take nearly twice as long to complete -- compounding the noise, aesthetic, and other impacts on nearby persons. The open-cut method reduces construction duration to minimize disruption due to construction activities on the affected residents. Using a conventional bore crossing method to avoid/minimize this minor temporary impact would be unreasonably expensive.
			Conventional Bore	48	34	N	47	24	62	N	N	$757,382		
Norfolk	H-060	S-RR08	Dry-Ditch Open-Cut	43	-	N	20	12	0	N	Y	$54,799	Conventional Bore	There are no significant constraints on available crossing methods or significant environmental impacts relevant to the available methods. The direct aquatic impact will be avoided/minimized by use of the conventional bore method. A minor temporary impact

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USACE District	Crossing #	Waterbody	Crossing Methods Evaluated	Evaluation Factors: Crossing Length	Pit Depth	Deep Stream	Maximum Steep Slope (%)	Maximum Average Slope (%)	Maximum Winch Hill Length (feet)	Karst Terrain Present	Sufficient Stockpile Storage Available	Total Cost ($)	Proposed Crossing Method	Crossing Method Decision Rationale
Norfolk	H-060	S-RR08	Conventional Bore	43	15	N	20	12	0	N	Y	$190,543	Conventional Bore	methods. The direct aquatic impact will be avoided/minimized by use of the conventional bore method. A minor temporary impact associated with the bore to maintain access will be required.
Norfolk	H-061	S-RR09	Dry-Ditch Open-Cut	30	-	N	56	34	64	N	N	$48,428	Dry-Ditch Open-Cut	The open cut method would result in a temporary impact to a small (nine-feet wide) UNT to North Fork Blackwater River. Avoiding/minimizing this minor impact through a conventional bore would require a relatively deep bore pit exceeding 30 feet at the edge of a steep slope, thereby requiring the excavation of an interim ramp and bench and dramatically increasing the space occupied by the bore pit and spoil pile. This crossing is in close proximity to a residence, and a trenchless crossing of this location would take nearly twice as long to complete -- compounding the noise, aesthetic, and other impacts on nearby persons. The open-cut method reduces construction duration to minimize disruption due to construction activities on the affected residents. Using a conventional bore crossing method to avoid/minimize this minor temporary impact would be unreasonably expensive.
			Conventional Bore	30	31	N	56	34	64	N	N	$651,490		
Norfolk	H-062	S-RR11	Dry-Ditch Open-Cut	38	-	N	39	26	136	N	N	$51,125	Dry-Ditch Open-Cut	The open cut method would result in a temporary impact to a small (seven-feet wide) UNT to North Fork Blackwater River Blackwater River. Avoiding/minimizing this minor impact through a conventional bore would require an excessively deep bore pit greater than 20 feet at the edge of a steep slope, thereby requiring the excavation of an interim ramp and two benches and dramatically increasing the space occupied by the bore pit and spoil pile. Using a conventional bore crossing method to avoid/minimize this minor temporary impact would be unreasonably expensive.
			Conventional Bore	38	27	N	39	26	136	N	N	$354,480		
Norfolk	H-063	S-IJ1, W-IJ1, S-IJ2	Dry-Ditch Open-Cut	133	-	N	44	37	928	N	N	$135,744	Dry-Ditch Open-Cut	The open cut method would result in a temporary impact to two small UNTs to North Fork Blackwater River and a PEM wetland (0.002 ac). Avoiding/minimizing these minor impacts through a conventional bore would require an excessively deep bore pit greater than 40 feet, thereby requiring the excavation of an interim ramp and two benches and dramatically increasing the space occupied by the bore pit and spoil pile. The slope adjacent to the crossing is steep and excessively long, requiring equipment operating within and around the bore pit to be winched to other equipment. That increases the complexity of this crossing if bored, increases safety risk to personnel, and adds risk of impact to the waterbody from upland work during a bore. There is insufficient space at this location for spoil piles from a bore pit. This crossing is in close proximity to a residence, and a trenchless crossing of this location would take nearly three times as long to complete -- compounding the noise, aesthetic, and other impacts on nearby persons. The open-cut method reduces construction duration to minimize disruption due to construction activities on the affected residents. The open cut method would reduce the construction duration near a private drinking water well on the property. Using a conventional bore crossing method to avoid/minimize these minor temporary impacts would be unreasonably expensive.
			Conventional Bore	133	41	N	44	37	928	N	N	$2,613,815		
Norfolk	I-001	S-E28	Dry-Ditch Open-Cut	56	-	N	46	18	0	N	Y	$95,200	Dry-Ditch Open-Cut	This crossing is immediately adjacent to a mainline valve. Trenchless crossing methods are logistically difficult because they would require the pipe to be installed too deeply to facilitate connection to the valve site. An open cut crossing is necessary to facilitate connection to the mainline valve.
			Conventional Bore	56	16	N	46	18	0	N	Y	$232,005		
Norfolk	I-001A	S-GH3	Dry-Ditch Open-Cut	22	-	N	41	19	31	N	N	$33,100	Conventional Bore	There are no significant constraints on available crossing methods or significant environmental impacts relevant to the available methods. The direct aquatic impact will be avoided/minimized by use of the conventional bore method. A minor temporary impact associated with the bore to maintain access will be required.
			Conventional Bore	22	14	N	41	19	31	N	N	$126,378		
Norfolk	I-002	S-E29	Dry-Ditch Open-Cut	52	-	N	4	2	0	N	Y	$65,383	Dry-Ditch Open-Cut	This UNT to Teels Creek is in an area with highly erodible solids. The stream banks at the crossing location are rapidly eroding due to natural conditions unrelated to pipeline construction. Instream work will be necessary to permanently restore and stabilize the banks, which will provide greater protection for the pipeline and have the benefit of reducing long-term sediment loads in the stream. That work can be done efficiently and effectively after completion of an open-cut crossing. Therefore, temporary stream impacts are unavoidable at this location.
			Conventional Bore	52	14	N	4	2	0	N	Y	$211,518		
Norfolk	I-003	S-E28	Dry-Ditch Open-Cut	45	-	N	15	3	0	N	Y	$87,500	Dry-Ditch Open-Cut	Teels Creek in an area with highly erodible solids. The stream banks at the crossing location are rapidly eroding due to natural conditions unrelated to pipeline construction. Instream work will be necessary to permanently restore and stabilize the banks, which will provide greater protection for the pipeline and have the benefit of reducing long-term sediment loads in the stream. That work can be done efficiently and effectively after completion of an open-cut crossing. Therefore, temporary stream impacts are unavoidable at this location.
			Conventional Bore	45	15	N	15	3	0	N	Y	$196,219		
Norfolk	I-004	W-E7	Dry-Ditch Open-Cut	298	-	N	18	6	0	N	Y	$208,600	Dry-Ditch Open-Cut	Avoiding/minimizing these minor impacts through a conventional bore would require a relatively deep bore pit of nearly 30 feet, thereby requiring the excavation of an interim ramp and two benches and dramatically increasing the space occupied by the bore pit and spoil pile. This crossing is in close proximity to residences, and a trenchless crossing of this location would take 14 days to complete -- compounding the noise, aesthetic, and other impacts on nearby persons. The open-cut method reduces construction duration to minimize disruption due to construction activities on the affected residents. The open cut method would reduce the construction duration near private drinking water wells on the property. Using a conventional bore crossing method to avoid/minimize the impact to this PEM would be unreasonably expensive.
			Conventional Bore	298	21	N	18	6	0	N	Y	$1,037,547		

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USACE District	Crossing #	Waterbody	Crossing Methods Evaluated	Evaluation Factors									Proposed Crossing Method	Crossing Method Decision Rationale
				Crossing Length	Pit Depth	Deep Stream	Maximum Steep Slope (%)	Maximum Average Slope (%)	Maximum Winch Hill Length (feet)	Karst Terrain Present	Sufficient Stockpile Storage Available	Total Cost ($)		
Norfolk	I-005A	W-E8	Dry-Ditch Open-Cut	150	-	N	37	29	0	N	Y	$105,000	Dry-Ditch Open-Cut	The open cut method would result in a small temporary impact (0.07 ac) to a PEM wetland. Avoiding/minimizing these minor impacts through a conventional bore would require a relatively deep bore pit of nearly 30 feet on the edge of a steep slope, thereby requiring the excavation of an interim ramp and two benches and dramatically increasing the space occupied by the bore pit and spoil pile. This crossing is in close proximity to residences, and a trenchless crossing of this location would take 19 days to complete -- compounding the noise, aesthetic, and other impacts on nearby persons. The open-cut method reduces construction duration to minimize disruption due to construction activities on the affected residents. Using a conventional bore crossing method to avoid/minimize the impact to this PEM would be unreasonably expensive.
			Conventional Bore	150	27	N	37	29	0	N	Y	$672,334		
Norfolk	I-005B	S-E28	Dry-Ditch Open-Cut	67	-	N	24	18	0	N	Y	$102,900	Dry-Ditch Open-Cut	This Section of Teels Creek is in an area with highly erodible solids. The stream banks at the crossing location are rapidly eroding due to natural conditions unrelated to pipeline construction. Instream work will be necessary to permanently restore and stabilize the banks, which will provide greater protection for the pipeline and have the benefit of reducing long-term sediment loads in the stream. That work can be done efficiently and effectively after completion of an open-cut crossing. Therefore, temporary stream impacts are unavoidable at this location.
			Conventional Bore	67	23	N	24	18	0	N	Y	$400,243		
Norfolk	I-006	S-EF4	Dry-Ditch Open-Cut	59	-	N	48	29	62	N	N	$81,979	Dry-Ditch Open-Cut	This intermittent UNT to Teels Creek is in an area with highly erodible solids. The stream banks at the crossing location are rapidly eroding due to natural conditions unrelated to pipeline construction. Instream work will be necessary to permanently restore and stabilize the banks, which will provide greater protection for the pipeline and have the benefit of reducing long-term sediment loads in the stream. That work can be done efficiently and effectively after completion of an open-cut crossing. Therefore, temporary stream impacts are unavoidable at this location. Furthermore, it would be unreasonably expensive to use a trenchless crossing to avoid only a fraction of the aquatic impact to this small (three-foot wide) stream.
			Conventional Bore	59	34	N	48	29	62	N	N	$788,600		
Norfolk	I-007	S-EF12	Dry-Ditch Open-Cut	68	-	N	8	2	124	N	N	$123,232	Dry-Ditch Open-Cut	This UNT to Teels Creek is in an area with highly erodible solids. The stream banks at the crossing location are rapidly eroding due to natural conditions unrelated to pipeline construction. Instream work will be necessary to permanently restore and stabilize the banks, which will provide greater protection for the pipeline and have the benefit of reducing long-term sediment loads in the stream. That work can be done efficiently and effectively after completion of an open-cut crossing. Therefore, temporary stream impacts are unavoidable at this location.
			Conventional Bore	68	16	N	8	2	124	N	N	$266,060		
Norfolk	I-008	S-MM42	Dry-Ditch Open-Cut	43	-	N	25	18	0	N	Y	$37,690	Dry-Ditch Open-Cut	The open cut method would result in a temporary impact to a small (two-feet wide) UNT to Teels Creek. Avoiding/minimizing this minor impact through a conventional bore would require a relatively deep bore pit exceeding 20 feet, thereby requiring the excavation of an interim ramp and bench and dramatically increasing the space occupied by the bore pit and spoil pile. This crossing is in close proximity to residences, and a trenchless crossing of this location would take nearly twice as long to complete -- compounding the noise, aesthetic, and other impacts on nearby persons. The open-cut method reduces construction duration to minimize disruption due to construction activities on the affected residents. The open cut method would reduce the construction duration near private drinking water wells on the property. Using a conventional bore crossing method to avoid/minimize this minor temporary impact would be unreasonably expensive.
			Conventional Bore	43	23	N	25	18	0	N	Y	$332,131		
Norfolk	I-009	S-RR15	Dry-Ditch Open-Cut	60	-	N	25	12	30	N	N	$102,185	Conventional Bore	Although the bore pits associated with this crossing are 20 feet deep, the relatively flat approaches are reasonable for winching equipment and the excessive spoils associated with deeper bore pits can be managed appropriately.
			Conventional Bore	60	20	N	25	12	30	N	N	$352,973		
Norfolk	I-010	S-D23	Dry-Ditch Open-Cut	71	-	N	39	19	87	N	N	$136,216	Dry-Ditch Open-Cut	The stream banks at the crossing location are rapidly eroding due to natural conditions unrelated to pipeline construction. Instream work will be necessary to permanently restore and stabilize the banks, which will provide greater protection for the pipeline and have the benefit of reducing long-term sediment loads in the stream. That work can be done efficiently and effectively after completion of an open-cut crossing. Therefore, temporary stream impacts are unavoidable at this location. This location has construction constraints, including winch-hill construction and limited space for soil stockpiles. The open cut method also reduces the construction duration near a private drinking water well on the property.
			Conventional Bore	71	28	N	39	19	87	N	N	$457,268		
Norfolk	I-011	S-D22	Dry-Ditch Open-Cut	42	-	N	31	21	0	N	Y	$61,662	Dry-Ditch Open-Cut	The open cut method would result in a temporary impact to a small (eight-feet wide) intermittent UNT to Teels Creek. Avoiding/minimizing this minor impact through a conventional bore would require a relatively deep bore pit nearly 20 feet at the edge of a steep slope, thereby requiring the excavation of an interim ramp and bench and dramatically increasing the space occupied by the bore pit and spoil pile. Using a conventional bore crossing method to avoid/minimize this minor temporary impact would be unreasonably expensive.
			Conventional Bore	42	21	N	31	21	0	N	Y	$311,024		
Norfolk	I-012	S-D20	Dry-Ditch Open-Cut	29	-	N	35	27	113	N	N	$43,964	Dry-Ditch Open-Cut	The open cut method would result in a temporary impact to a small (eight-feet wide) intermittent UNT to Teels Creek. Avoiding/minimizing this minor impact through a conventional bore would require a relatively deep bore pit nearly 30 feet at the edge of a steep slope, thereby requiring the excavation of an interim ramp and bench and dramatically increasing the space occupied by the bore pit and spoil pile. This crossing is in close proximity to a residence, and a trenchless crossing of this location would take more than twice as long to complete -- compounding the noise, aesthetic, and other impacts on nearby persons. The open-cut method reduces construction duration to minimize disruption due to construction activities on the affected residents. Using a conventional bore crossing method to avoid/minimize this minor temporary impact would be unreasonably expensive.
			Conventional Bore	29	28	N	35	27	113	N	N	$338,073		

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Norfolk	I-013	S-C14	Dry-Ditch Open-Cut	90	-	N	40	28	53	N	N	$271,204	Dry-Ditch Open-Cut	Teels Creek is in an area with highly erodible solids. The stream banks at the crossing location are rapidly eroding due to natural conditions unrelated to pipeline construction. Instream work will be necessary to permanently restore and stabilize the banks, which will provide greater protection for the pipeline and have the benefit of reducing long-term sediment loads in the stream. That work can be done efficiently and effectively after completion of an open-cut crossing. Therefore, temporary stream impacts are unavoidable at this location. Construction constraints at this location include a bore pit depth of nearly 40 feet and steep slopes on both sides of the creek, one of which would require winched equipment. The open cut method also reduces the construction duration near a private drinking water well on the property.
			Conventional Bore	90	38	N	40	28	53	N	N	$949,655		
Norfolk	I-014	S-C17	Dry-Ditch Open-Cut	62	-	N	21	16	0	N	Y	$187,051	Conventional Bore	Roanoke logperch habitat may be present in this stream. The direct aquatic impact will be avoided/minimized by use of the conventional bore method.
			Conventional Bore	62	20	N	21	16	0	N	Y	$358,649		
Norfolk	I-015	S-CD6	Dry-Ditch Open-Cut	109	-	N	4	1	0	N	Y	$276,201	Dry-Ditch Open-Cut	Teels Creek is in an area with highly erodible solids. The stream banks at the crossing location are rapidly eroding due to natural conditions unrelated to pipeline construction. Instream work will be necessary to permanently restore and stabilize the banks, which will provide greater protection for the pipeline and have the benefit of reducing long-term sediment loads in the stream. That work can be done efficiently and effectively after completion of an open-cut crossing. Therefore, temporary stream impacts are unavoidable at this location.
			Conventional Bore	109	20	N	4	1	0	N	Y	$492,034		
Norfolk	I-016	W-CD6	Dry-Ditch Open-Cut	94	-	N	4	1	0	N	Y	$65,800	Conventional Bore	There are no significant constraints on available crossing methods or significant environmental impacts relevant to the available methods. The direct aquatic impact will be avoided/minimized by use of the conventional bore method. A minor temporary impact associated with the bore to maintain access will be required.
			Conventional Bore	94	11	N	4	1	0	N	Y	$317,011		
Norfolk	I-017	W-CD5	Dry-Ditch Open-Cut	88	-	N	67	54	122	N	N	$61,600	Dry-Ditch Open-Cut	The open cut method would result in a small temporary impact (0.11 ac) to a PFO wetland. Avoiding/minimizing these minor impacts through a conventional bore would require an excessively deep bore pit exceeding 50 feet on the edge of a very steep slope, thereby requiring the excavation of an interim ramp and two benches and dramatically increasing the space occupied by the bore pit and spoil pile. This crossing is in proximity to a residence, and a trenchless crossing of this location would increase the duration of the crossing from 4 to 35 days -- compounding the noise, aesthetic, and other impacts on nearby persons. The open-cut method reduces construction duration to minimize disruption due to construction activities on the affected residents. Because the pipeline ROW must remain free of woody vegetation to protect the pipe coating, a conversion impact is unavoidable with any crossing method. Using a conventional bore crossing method to avoid/minimize a portion of the impact to this PFO would be unreasonably expensive.
			Conventional Bore	88	52	N	67	54	122	N	N	$3,086,106		
Norfolk	I-018	S-II2	Dry-Ditch Open-Cut	98	-	N	13	3	0	N	Y	$278,804	Dry-Ditch Open-Cut	Little Creek is in an area with highly erodible solids. The stream banks at the crossing location are rapidly eroding due to natural conditions unrelated to pipeline construction. Instream work will be necessary to permanently restore and stabilize the banks, which will provide greater protection for the pipeline and have the benefit of reducing long-term sediment loads in the stream. That work can be done efficiently and effectively after completion of an open-cut crossing. Therefore, temporary stream impacts are unavoidable at this location. The open cut method also reduces the construction duration near a private drinking water wells on the property.
			Conventional Bore	98	20	N	13	3	0	N	Y	$460,816		
Norfolk	I-019	S-CD1, W-CD1	Dry-Ditch Open-Cut	110	-	N	22	12	0	N	Y	$89,800	Dry-Ditch Open-Cut	This crossing is in close proximity to a residence, and a trenchless crossing of this location would take nearly four times longer to long to complete -- compounding the noise, aesthetic, and other impacts on nearby persons. The open-cut method reduces construction duration to minimize disruption due to construction activities on the affected residents.
			Conventional Bore	110	18	N	22	12	0	N	Y	$394,390		
Norfolk	I-020	S-KL35, W-EF48	Dry-Ditch Open-Cut	72	-	N	32	14	106	N	N	$62,773	Conventional Bore	There are no significant constraints on available crossing methods or significant environmental impacts relevant to the available methods. The direct aquatic impact will be avoided/minimized by use of the conventional bore method. A minor temporary impact associated with the bore to maintain access will be required.
			Conventional Bore	72	16	N	32	14	106	N	N	$277,412		
Norfolk	I-021	S-KL36	Dry-Ditch Open-Cut	39	-	N	34	18	32	N	Y	$55,130	Conventional Bore	There are no significant constraints on available crossing methods or significant environmental impacts relevant to the available methods. The direct aquatic impact will be avoided/minimized by use of the conventional bore method. A minor temporary impact associated with the bore to maintain access will be required.
			Conventional Bore	39	17	N	34	18	32	N	Y	$188,326		

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USACE District	Crossing #	Waterbody	Crossing Methods Evaluated	Evaluation Factors: Crossing Length	Pit Depth	Deep Stream	Maximum Steep Slope (%)	Maximum Average Slope (%)	Maximum Winch Hill Length (feet)	Karst Terrain Present	Sufficient Stockpile Storage Available	Total Cost ($)	Proposed Crossing Method	Crossing Method Decision Rationale
Norfolk	I-022	S-KL38	Dry-Ditch Open-Cut	200	-	N	54	24	0	N	Y	$165,254	Dry-Ditch Open-Cut	The pipeline has already been installed under an adjacent road (Hwy. 220). There is no feasible way to tie the two sections of pipe together if a trenchless method is used to install this crossing. Furthermore, avoiding this temporary impact to this small UNT to the Blackwater River with a conventional bore crossing would be unreasonably expensive.
			Conventional Bore	200	35	N	54	24	0	N	Y	$1,207,025		
Norfolk	I-023	S-KL39	Dry-Ditch Open-Cut	98	-	N	40	31	85	N	N	$92,713	Dry-Ditch Open-Cut	The open cut method would result in a temporary impact to a small (seven-feet wide) UNT to Blackwater River. Avoiding/minimizing this minor impact through a conventional bore would require a relatively deep bore pit exceeding 30 feet at the edge of a steep slope, thereby requiring the excavation of an interim ramp and bench and dramatically increasing the space occupied by the bore pit and spoil pile. This crossing is in close proximity to a residence, and a trenchless crossing of this location would take nearly twice as long to complete -- compounding the noise, aesthetic, and other impacts on nearby persons. The open cut method would reduce the construction duration near private drinking water wells on the property. The open-cut method reduces construction duration to minimize disruption due to construction activities on the affected residents. Using a conventional bore crossing method to avoid/minimize this minor temporary impact would be unreasonably expensive.
			Conventional Bore	98	32	N	40	31	85	N	N	$862,742		
Norfolk	I-024	S-YZ5	Dry-Ditch Open-Cut	40	-	N	31	19	0	N	Y	$43,080	Dry-Ditch Open-Cut	The open cut method would result in a temporary impact to a small (four-feet wide) UNT to Blackwater River. Avoiding/minimizing this minor impact through a conventional bore would require a relatively deep bore pit nearly 30 feet at the edge of a steep slope, thereby requiring the excavation of an interim ramp and bench and dramatically increasing the space occupied by the bore pit and spoil pile. This crossing is in close proximity to several residences, and a trenchless crossing of this location would take more than twice as long to complete -- compounding the noise, aesthetic, and other impacts on nearby persons. The open-cut method reduces construction duration to minimize disruption due to construction activities on the affected residents. Using a conventional bore crossing method to avoid/minimize this minor temporary impact would be unreasonably expensive.
			Conventional Bore	40	28	N	31	19	0	N	Y	$369,291		
Norfolk	I-025	S-YZ4	Dry-Ditch Open-Cut	32	-	N	37	28	52	N	N	$33,182	Dry-Ditch Open-Cut	The open cut method would result in a temporary impact to a small (three-feet wide) UNT to Blackwater River. Avoiding/minimizing this minor impact through a conventional bore would require a relatively deep bore pit nearly 30 feet at the edge of a steep slope, thereby requiring the excavation of an interim ramp and bench and dramatically increasing the space occupied by the bore pit and spoil pile. This crossing is in close proximity to several residences, and a trenchless crossing of this location would take longer to complete -- compounding the noise, aesthetic, and other impacts on nearby persons. The open-cut method reduces construction duration to minimize disruption due to construction activities on the affected residents. The open cut method would reduce the construction duration near private drinking water wells on the property. Using a conventional bore crossing method to avoid/minimize this minor temporary impact would be unreasonably expensive.
			Conventional Bore	32	22	N	37	28	52	N	N	$291,779		
Norfolk	I-026	S-EF48, W-EF51	Dry-Ditch Open-Cut	42	-	N	32	29	0	N	Y	$36,404	Dry-Ditch Open-Cut	The open cut method would result in a temporary impact to a small (two-feet wide) intermittent UNT to Blackwater River and an adjacent PEM wetland (0.01 ac). Avoiding/minimizing this minor impact through a conventional bore would require a relatively deep bore pit nearly 30 feet at the edge of a steep slope, thereby requiring the excavation of an interim ramp and bench and dramatically increasing the space occupied by the bore pit and spoil pile. This crossing is in close proximity to several residences, and a trenchless crossing of this location would take twice as long to complete -- compounding the noise, aesthetic, and other impacts on nearby persons. The open-cut method reduces construction duration to minimize disruption due to construction activities on the affected residents. The open cut method would reduce the construction duration near a private drinking water well on the property. Using a conventional bore crossing method to avoid/minimize this minor temporary impact would be unreasonably expensive.
			Conventional Bore	42	28	N	32	29	0	N	Y	$374,967		
Norfolk	I-027	S-KL41	Dry-Ditch Open-Cut	48	-	N	41	32	83	N	N	$75,690	Dry-Ditch Open-Cut	The open cut method would result in a temporary impact to a UNT to Blackwater River. Avoiding/minimizing this minor impact through a conventional bore would require a relatively deep bore pit exceeding 30 feet at the edge of a steep slope, thereby requiring the excavation of an interim ramp and bench and dramatically increasing the space occupied by the bore pit and spoil pile. It also would increase the duration of the crossing from 8 to 33 days. The open cut method would reduce the construction duration near a private drinking water well on the property. Using a conventional bore crossing method to avoid/minimize this minor temporary impact would be unreasonably expensive.
			Conventional Bore	48	33	N	41	32	83	N	N	$739,113		
Norfolk	I-028	S-C8	Dry-Ditch Open-Cut	44	-	N	32	23	31	N	N	$48,854	Dry-Ditch Open-Cut	The open cut method would result in a temporary impact to a small (five-feet wide) intermittent UNT to Blackwater River. Avoiding/minimizing this minor impact through a conventional bore would require a relatively deep bore pit of nearly 30 feet at the edge of a steep slope, thereby requiring the excavation of an interim ramp and bench and dramatically increasing the space occupied by the bore pit and spoil pile. It also would increase the duration of the crossing from 5 to 11 days. The open cut method would reduce the construction duration near several private drinking water wells on the property. Using a conventional bore crossing method to avoid/minimize this minor temporary impact would be unreasonably expensive.
			Conventional Bore	44	28	N	32	23	31	N	N	$380,643		
Norfolk	I-029	S-KL51	Dry-Ditch Open-Cut	45	-	N	36	27	105	N	N	$50,762	Dry-Ditch Open-Cut	The open cut method would result in a temporary impact to a small (six-feet wide) stream. Avoiding/minimizing this minor impact through a conventional bore would require a relatively deep bore pit exceeding 20 feet at the edge of a steep slope, thereby requiring the excavation of an interim ramp and bench and dramatically increasing the space occupied by the bore pit and spoil pile. This crossing is in close proximity to a residence, and a trenchless crossing of this location would take more than twice as long to complete -- compounding the noise, aesthetic, and other impacts on nearby persons. The open-cut method reduces construction duration to minimize disruption due to construction activities on the affected residents. The open cut method would reduce the construction duration near a private drinking water well on the property. Using a conventional bore crossing method to avoid/minimize this minor temporary impact would be unreasonably expensive.
			Conventional Bore	45	24	N	36	27	105	N	N	$346,942		
Norfolk	I-030	S-KL52	Dry-Ditch Open-Cut	59	-	N	23	18	0	N	Y	$45,967	Dry-Ditch Open-Cut	The open cut method would result in a temporary impact to a small (one-foot wide) stream. Avoiding/minimizing this minor impact through a conventional bore would require a relatively deep bore pit exceeding 20 feet, thereby requiring the excavation of an interim ramp and a bench and dramatically increasing the space occupied by the bore pit and spoil pile. This crossing is in close proximity to a residence, and a trenchless crossing of this location would take twice as long to complete -- compounding the noise, aesthetic, and other impacts on nearby persons. The open-cut method reduces construction duration to minimize disruption due to construction activities on the affected residents. The open-cut method would reduce the construction duration near private drinking water wells on the property. Using a conventional bore crossing method to avoid/minimize this minor temporary impact would be unreasonably expensive.
			Conventional Bore	59	23	N	23	18	0	N	Y	$377,539		

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USACE District	Crossing #	Waterbody	Crossing Methods Evaluated	Evaluation Factors									Proposed Crossing Method	Crossing Method Decision Rationale
				Crossing Length	Pit Depth	Deep Stream	Maximum Steep Slope (%)	Maximum Average Slope (%)	Maximum Winch Hill Length (feet)	Karst Terrain Present	Sufficient Stockpile Storage Available	Total Cost ($)		
Norfolk	I-031	S-KL54	Dry-Ditch Open-Cut	32	-	N	29	21	0	N	Y	$57,639	Dry-Ditch Open-Cut	The open-cut method would result in a temporary impact to a small (one-foot wide) stream. Avoiding/minimizing this minor impact through a conventional bore would require a relatively deep bore pit that is nearly 20 feet deep, potentially requiring the excavation of an interim ramp and a bench and dramatically increasing the space occupied by the bore pit and spoil pile. This crossing is in proximity to a residence, and a trenchless crossing of this location would take twice as long to complete -- compounding the noise, aesthetic, and other impacts on nearby persons. The open-cut method reduces construction duration to minimize disruption due to construction activities on the affected residents. The open-cut method would reduce the construction duration near private drinking water wells on the property.
			Conventional Bore	32	20	N	29	21	0	N	Y	$273,509		
Norfolk	I-032	S-F8	Dry-Ditch Open-Cut	206	-	N	32	26	0	N	Y	$257,327	Dry-Ditch Open-Cut	The pipeline has already been installed under an adjacent road (Rt. 122). There is no feasible way to tie the two sections of pipe together if a trenchless method is used to install this crossing. If a trenchless crossing were attempted, it would require a bore pit depth exceeding 40 feet, which would require the excavation of an interim ramp and bench and dramatically increase the space occupied by the bore pit and spoil pile. Lastly, avoiding this temporary impact to this small UNT to the Maggodee Creek with a conventional bore crossing would be unreasonably expensive.
			Conventional Bore	206	41	N	32	26	0	N	Y	$2,820,988		
Norfolk	I-033	S-HH4	Dry-Ditch Open-Cut	63	-	N	29	18	20	N	N	$77,464	Dry-Ditch Open-Cut	The open cut method would result in a temporary impact to an intermittent UNT to Maggodee Creek. Avoiding/minimizing this minor impact through a conventional bore would require a relatively deep bore pit exceeding 30 feet at the edge of a steep slope, thereby requiring the excavation of an interim ramp and bench and dramatically increasing the space occupied by the bore pit and spoil pile. This crossing is in close proximity to residences, and a trenchless crossing of this location would take 17 days to complete -- compounding the noise, aesthetic, and other impacts on nearby persons. The open-cut method reduces construction duration to minimize disruption due to construction activities on the affected residents. Using a conventional bore crossing method to avoid/minimize this minor temporary impact would be unreasonably expensive.
			Conventional Bore	63	32	N	29	18	20	N	N	$763,413		
Norfolk	I-034	S-C20	Dry-Ditch Open-Cut	52	-	N	20	13	0	N	Y	$50,437	Conventional Bore	There are no significant constraints on available crossing methods or significant environmental impacts relevant to the available methods. The direct aquatic impact will be avoided/minimized by use of the conventional bore method. A minor temporary impact associated with the bore to maintain access will be required.
			Conventional Bore	52	17	N	20	13	0	N	Y	$225,220		
Norfolk	I-035	S-C19	Dry-Ditch Open-Cut	100	-	N	49	41	234	N	N	$227,598	Dry-Ditch Open-Cut	The open-cut method would result in a temporary impact to Maggodee Creek. Avoiding/minimizing this minor impact through a conventional bore would require an excessively deep bore pit of greater than 40 feet at the edge of a steep slope, thereby requiring the excavation of an interim ramp and two benches and dramatically increasing the space occupied by the bore pit and spoil pile. This crossing is in close proximity to residences, and a trenchless crossing of this location would take 34 days to complete -- compounding the noise, aesthetic, and other impacts on nearby persons. The open-cut method reduces construction duration to minimize disruption due to construction activities on the affected residents. Using a microtunnel crossing method to avoid/minimize this minor temporary impact would be unreasonably expensive.
			Microtunnel	100	46	N	49	41	234	N	N	$3,509,091		
Norfolk	I-036	S-F11	Dry-Ditch Open-Cut	139	-	N	56	40	100	N	N	$415,926	Dry-Ditch Open-Cut	The Blackwater River's banks at the crossing location are rapidly eroding due to natural conditions unrelated to pipeline construction. Instream work will be necessary to permanently restore and stabilize the banks, which will provide greater protection for the pipeline and have the benefit of reducing long-term sediment loads in the stream. That work can be done efficiently and effectively after completion of an open-cut crossing. Therefore, temporary stream impacts are unavoidable at this location. A trenchless crossing at this location also faces significant constructability constraints. The bore pits for this crossing would be just short of 40-feet deep. Site conditions do not allow sufficient space to stockpile spoils from bore pits of that size.
			Conventional Bore	139	39	N	56	40	100	N	N	$1,106,985		
Norfolk	I-037	S-F9b	Dry-Ditch Open-Cut	56	-	N	37	30	62	N	N	$92,048	Dry-Ditch Open-Cut	The open cut method would result in a temporary impact to a UNT to Blackwater River. Avoiding/minimizing this minor impact through a conventional bore would require a relatively deep bore pit exceeding 30 feet at the edge of a steep slope, thereby requiring the excavation of an interim ramp and bench and dramatically increasing the space occupied by the bore pit and spoil pile. This crossing is in close proximity to residences, and a trenchless crossing of this location would take 16 days to complete -- compounding the noise, aesthetic, and other impacts on nearby persons. The open-cut method reduces construction duration to minimize disruption due to construction activities on the affected residents. The open cut method would reduce the construction duration near several private drinking water wells on the property. Using a conventional bore crossing method to avoid/minimize this minor temporary impact would be unreasonably expensive.
			Conventional Bore	56	31	N	37	30	62	N	N	$725,278		
Norfolk	I-038	S-F10	Dry-Ditch Open-Cut	47	-	N	16	9	0	N	Y	$72,699	Conventional Bore	There are no significant constraints on available crossing methods or significant environmental impacts relevant to the available methods. The direct aquatic impact will be avoided/minimized by use of the conventional bore method. A minor temporary impact associated with the bore to maintain access will be required.
			Conventional Bore	47	16	N	16	9	0	N	Y	$206,463		
Norfolk	I-039	S-F9a	Dry-Ditch Open-Cut	66	-	N	20	12	0	N	Y	$98,700	Conventional Bore	There are no significant constraints on available crossing methods or significant environmental impacts relevant to the available methods. The direct aquatic impact will be avoided/minimized by use of the conventional bore method. A minor temporary impact associated with the bore to maintain access will be required.
			Conventional Bore	66	20	N	20	12	0	N	Y	$370,001		

Table 15. Crossing Method Determination Summary
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USACE District	Crossing #	Waterbody	Crossing Methods Evaluated	Evaluation Factors: Crossing Length	Pit Depth	Deep Stream	Maximum Steep Slope (%)	Maximum Average Slope (%)	Maximum Winch Hill Length (feet)	Karst Terrain Present	Sufficient Stockpile Storage Available	Total Cost ($)	Proposed Crossing Method	Crossing Method Decision Rationale
Norfolk	I-040	S-GG4	Dry-Ditch Open-Cut	53	-	N	18	13	0	N	Y	$56,010	Conventional Bore	There are no significant constraints on available crossing methods or significant environmental impacts relevant to the available methods. The direct aquatic impact will be avoided/minimized by use of the conventional bore method. A minor temporary impact associated with the bore to maintain access will be required.
			Conventional Bore	53	17	N	18	13	0	N	Y	$228,058		
Norfolk	I-041	S-A36	Dry-Ditch Open-Cut	51	-	N	21	10	0	N	Y	$49,896	Dry-Ditch Open-Cut	The open cut method would result in a temporary impact to a small (four-feet wide) UNT to Foul Ground Creek. Avoiding/minimizing this minor impact through a conventional bore would require a relatively deep bore pit exceeding 20 feet, thereby requiring the excavation of an interim ramp and bench and dramatically increasing the space occupied by the bore pit and spoil pile. This crossing is in close proximity to several residences, and a trenchless crossing of this location would take nearly twice as long to complete -- compounding the noise, aesthetic, and other impacts on nearby persons. The open-cut method reduces construction duration to minimize disruption due to construction activities on the affected residents. Using a conventional bore crossing method to avoid/minimize this minor temporary impact would be unreasonably expensive.
			Conventional Bore	51	22	N	21	10	0	N	Y	$345,700		
Norfolk	I-042	S-A38	Dry-Ditch Open-Cut	78	-	N	20	16	0	N	Y	$92,243	Conventional Bore	There are no significant constraints on available crossing methods or significant environmental impacts relevant to the available methods. The direct aquatic impact will be avoided/minimized by use of the conventional bore method. A minor temporary impact associated with the bore to maintain access will be required.
			Conventional Bore	78	20	N	20	16	0	N	Y	$404,056		
Norfolk	I-043A	S-A41	Dry-Ditch Open-Cut	114	-	N	14	10	0	N	Y	$121,800	Dry-Ditch Open-Cut	Foul Ground Creek is in an area with highly erodible solids. The stream banks at the crossing location are rapidly eroding due to natural conditions unrelated to pipeline construction. Instream work will be necessary to permanently restore and stabilize the banks, which will provide greater protection for the pipeline and have the benefit of reducing long-term sediment loads in the stream. That work can be done efficiently and effectively after completion of an open-cut crossing. Therefore, temporary stream impacts are unavoidable at this location. Lastly, it would be unreasonably expensive to use a trenchless crossing to avoid only a fraction of the aquatic impact to this resource.
			Conventional Bore	114	17	N	14	10	0	N	Y	$401,175		
Norfolk	I-043B	W-DD1	Dry-Ditch Open-Cut	110	-	N	14	7	0	N	Y	$77,000	Dry-Ditch Open-Cut	The open cut method would result in a small (0.05 ac) temporary impact to PEM wetland. The open cut method would reduce construction time for this crossing by 11 days. Using a conventional bore crossing method to avoid/minimize this minor temporary impact would be unreasonably expensive.
			Conventional Bore	110	18	N	14	7	0	N	Y	$394,390		
Norfolk	I-044A	S-GH36, S-KL17	Dry-Ditch Open-Cut	103	-	N	21	9	0	N	Y	$89,600	Conventional Bore	There are no significant constraints on available crossing methods or significant environmental impacts relevant to the available methods. The direct aquatic impact will be avoided/minimized by use of the conventional bore method. A minor temporary impact associated with the bore to maintain access will be required.
			Conventional Bore	103	19	N	21	9	0	N	Y	$379,092		
Norfolk	I-044B	S-GH39	Dry-Ditch Open-Cut	61	-	N	27	23	0	N	Y	$56,700	Dry-Ditch Open-Cut	The open cut method would result in a temporary impact to a small (four-feet wide) intermittent UNT to Foul Ground Creek. Avoiding/minimizing this minor impact through a conventional bore would require a relatively deep bore pit of nearly 30 feet, thereby requiring the excavation of an interim ramp and bench and dramatically increasing the space occupied by the bore pit and spoil pile. It also would increase the duration of the crossing from 8 to 25 days. The open cut method would reduce the construction duration near several private drinking water wells on the property. Using a conventional bore crossing method to avoid/minimize this minor temporary impact would be unreasonably expensive.
			Conventional Bore	61	26	N	27	23	0	N	Y	$410,619		
Norfolk	I-045	S-GH40	Dry-Ditch Open-Cut	57	-	N	17	13	0	N	Y	$50,751	Dry-Ditch Open-Cut	The open-cut method would result in a temporary impact to a small (three-feet wide) UNT to Foul Ground Creek. Avoiding/minimizing this minor impact through a conventional bore would require a relatively deep bore pit of exceeding 20 feet, thereby requiring the excavation of an interim ramp and bench and dramatically increasing the space occupied by the bore pit and spoil pile. It also would double the duration of the crossing. The open-cut method would reduce the construction duration near several private drinking water wells on the property. Using a conventional bore crossing method to avoid/minimize this minor temporary impact would be unreasonably expensive.
			Conventional Bore	57	22	N	17	13	0	N	Y	$362,728		
Norfolk	I-046	S-GH44, S-GH38, S-IJ47, W-GH16	Dry-Ditch Open-Cut	217	-	N	11	7	0	N	Y	$181,597	Conventional Bore	There are no significant constraints on available crossing methods or significant environmental impacts relevant to the available methods. The direct aquatic impact will be avoided/minimized by use of the conventional bore method. A minor temporary impact associated with the bore to maintain access will be required.
			Conventional Bore	217	20	N	11	7	0	N	Y	$798,536		

Table 15. Crossing Method Determination Summary
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USACE District	Crossing #	Waterbody	Crossing Methods Evaluated	Evaluation Factors									Proposed Crossing Method	Crossing Method Decision Rationale
				Crossing Length	Pit Depth	Deep Stream	Maximum Steep Slope (%)	Maximum Average Slope (%)	Maximum Winch Hill Length (feet)	Karst Terrain Present	Sufficient Stockpile Storage Available	Total Cost ($)		
Norfolk	I-047	S-G22	Dry-Ditch Open-Cut	48	-	N	50	38	87	N	N	$76,133	Dry-Ditch Open-Cut	The open cut method would result in a temporary impact to a UNT to Poplar Camp Creek. Avoiding/minimizing this minor impact through a conventional bore would require a relatively deep bore pit of nearly 40 feet on the edge of a steep slope, thereby requiring the excavation of an interim ramp and bench and dramatically increasing the space occupied by the bore pit and spoil pile. It also would increase the duration of the crossing from 4 to 44 days. The open cut method would reduce the construction duration near two private drinking water wells on the property. Using a conventional bore crossing method to avoid/minimize this minor temporary impact would be unreasonably expensive.
			Conventional Bore	48	37	N	50	38	87	N	N	$812,190		
Norfolk	I-048	S-G20	Dry-Ditch Open-Cut	62	-	N	39	18	93	N	N	$81,267	Conventional Bore	There are no significant constraints on available crossing methods or significant environmental impacts relevant to the available methods. The direct aquatic impact will be avoided/minimized by use of the conventional bore method. A minor temporary impact associated with the bore to maintain access will be required.
			Conventional Bore	62	15	N	39	18	93	N	N	$244,465		
Norfolk	I-049	S-G18	Dry-Ditch Open-Cut	37	-	N	35	18	10	N	N	$33,422	Dry-Ditch Open-Cut	The open cut method would result in a temporary impact to a small (two-feet wide) intermittent UNT to the Blackwater River. The open cut method would reduce by half the construction duration near a private drinking water well on the property. Using a conventional bore crossing method to avoid/minimize this minor temporary impact would be unreasonably expensive.
			Conventional Bore	37	19	N	35	18	10	N	N	$191,785		
Norfolk	I-050	S-E18	Dry-Ditch Open-Cut	38	-	N	27	18	0	N	Y	$54,216	Dry-Ditch Open-Cut	The open cut method would result in a temporary impact to a small (eight-feet wide) UNT to Blackwater River. Avoiding/minimizing these minor impacts through a conventional bore would require a relatively deep bore pit of exceeding 20 feet, thereby requiring the excavation of an interim ramp and bench and dramatically increasing the space occupied by the bore pit and spoil pile. Using a conventional bore crossing method to avoid/minimize this minor temporary impact would be unreasonably expensive.
			Conventional Bore	38	21	N	27	18	0	N	Y	$299,672		
Norfolk	I-051	S-E17	Dry-Ditch Open-Cut	77	-	N	35	16	32	N	Y	$88,594	Dry-Ditch Open-Cut	The open-cut method would result in a temporary impact to a UNT to the Blackwater River. This crossing is in proximity to a residence, and a trenchless crossing of this location would take twice as long to complete -- compounding the noise, aesthetic, and other impacts on nearby persons. The open-cut method reduces construction duration to minimize disruption due to construction activities on the affected residents. The open-cut method would reduce the construction duration near a private drinking water well on the property.
			Conventional Bore	77	16	N	35	16	32	N	Y	$291,602		
Norfolk	I-052	S-E14	Dry-Ditch Open-Cut	60	-	N	25	18	0	N	Y	$117,336	Dry-Ditch Open-Cut	The open-cut method would result in a temporary impact to a UNT to the Blackwater River. Avoiding/minimizing this minor impact through a conventional bore would require a relatively deep bore pit exceeding 20 feet, thereby requiring the excavation of an interim ramp and bench and dramatically increasing the space occupied by the bore pit and spoil pile. This crossing is in proximity to a residence, and a trenchless crossing of this location would take twice as long to complete -- compounding the noise, aesthetic, and other impacts on nearby persons. The open-cut method reduces construction duration to minimize disruption due to construction activities on the affected residents. The open cut method would reduce the construction duration near a private drinking water well on the property.
			Conventional Bore	60	25	N	25	18	0	N	Y	$398,646		
Norfolk	I-053	S-H38, W-H17	Dry-Ditch Open-Cut	169	-	N	18	6	0	N	Y	$164,668	Conventional Bore	Orangefin madtom habitat may be present in this stream. The direct aquatic impact will be avoided/minimized by use of the conventional bore method.
			Conventional Bore	169	22	N	18	6	0	N	Y	$680,582		
Norfolk	I-054	S-H37	Dry-Ditch Open-Cut	35	-	N	47	23	31	N	N	$45,685	Dry-Ditch Open-Cut	The open cut method would result in a temporary impact to the small (six-feet wide) UNT to Jacks Creek. Avoiding/minimizing this minor impact through a conventional bore would require a relatively deep bore pit exceeding 30 feet on the edge of a steep slope, thereby requiring the excavation of an interim ramp and bench and dramatically increasing the space occupied by the bore pit and spoil pile. This crossing is in close proximity to a residence, and a trenchless crossing of this location would take 15 days to complete -- compounding the noise, aesthetic, and other impacts on nearby persons. The open-cut method reduces construction duration to minimize disruption due to construction activities on the affected residents. Using a conventional bore crossing method to avoid/minimize this minor temporary impact would be unreasonably expensive.
			Conventional Bore	35	33	N	47	23	31	N	N	$702,219		
Norfolk	I-055	S-H36, W-H16	Dry-Ditch Open-Cut	84	-	N	31	25	10	N	N	$168,404	Conventional Bore	Orangefin madtom habitat may be present in this stream. The direct aquatic impact will be avoided/minimized by use of the conventional bore method.
			Conventional Bore	84	30	N	31	25	10	N	N	$786,472		

Table 15. Crossing Method Determination Summary
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USACE District	Crossing #	Waterbody	Crossing Methods Evaluated	Evaluation Factors									Proposed Crossing Method	Crossing Method Decision Rationale
				Crossing Length	Pit Depth	Deep Stream	Maximum Steep Slope (%)	Maximum Average Slope (%)	Maximum Winch Hill Length (feet)	Karst Terrain Present	Sufficient Stockpile Storage Available	Total Cost ($)		
Norfolk	I-056	S-H34	Dry-Ditch Open-Cut	32	-	N	40	24	32	N	N	$33,003	Conventional Bore	Orangefin madtom habitat may be present in this stream. The direct aquatic impact will be avoided/minimized by use of the conventional bore method.
			Conventional Bore	32	24	N	40	24	32	N	N	$310,048		
Norfolk	I-057	S-H32	Dry-Ditch Open-Cut	46	-	N	38	29	74	N	N	$68,296	Conventional Bore	Orangefin madtom habitat may be present in this stream. The direct aquatic impact will be avoided/minimized by use of the conventional bore method.
			Conventional Bore	46	26	N	38	29	74	N	N	$368,049		
Norfolk	I-058	W-H11	Dry-Ditch Open-Cut	83	-	N	32	18	0	N	Y	$58,100	Dry-Ditch Open-Cut	The open cut method would result in a small temporary impact to a PEM wetland. Avoiding/minimizing this minor impact through a conventional bore would require a relatively deep bore pit of 30 feet, thereby requiring the excavation of an interim ramp and bench and dramatically increasing the space occupied by the bore pit and spoil pile. This crossing is in close proximity to several residences, and a trenchless crossing of this location would take 17 days to complete -- compounding the noise, aesthetic, and other impacts on nearby persons. The open-cut method reduces construction duration to minimize disruption due to construction activities on the affected residents. The open cut method would reduce the construction duration near a private drinking water well on the property. Using a conventional bore crossing method to avoid/minimize this minor temporary impact would be unreasonably expensive.
			Conventional Bore	83	30	N	32	18	0	N	Y	$783,634		
Norfolk	I-059	S-A18	Dry-Ditch Open-Cut	92	-	N	26	17	0	N	Y	$80,003	Dry-Ditch Open-Cut	The open cut method would result in a temporary impact to the small (four-feet wide) intermittent UNT to Jacks Creek. Avoiding/minimizing this minor impact through a conventional bore would require a relatively deep bore pit of nearly 20 feet, thereby requiring the excavation of an interim ramp and bench and dramatically increasing the space occupied by the bore pit and spoil pile. This crossing is in proximity to a residence, and a trenchless crossing of this location would take 13 days to complete -- compounding the noise, aesthetic, and other impacts on nearby persons. The open-cut method reduces construction duration to minimize disruption due to construction activities on the affected residents. Using a conventional bore crossing method to avoid/minimize this minor temporary impact would be unreasonably expensive.
			Conventional Bore	92	24	N	26	17	0	N	Y	$480,327		
Norfolk	I-060A	S-A19/H26	Dry-Ditch Open-Cut	93	-	N	39	28	52	N	Y	$149,100	Dry-Ditch Open-Cut	The open cut method would result in a temporary impact to an intermittent UNT to Jacks Creek. Avoiding/minimizing this minor impact through a conventional bore would require an excessively deep bore pit of greater than 40 feet, thereby requiring the excavation of an interim ramp and two benches and dramatically increasing the space occupied by the bore pit and spoil pile. Using a conventional bore crossing method to avoid/minimize this minor temporary impact would be unreasonably expensive.
			Conventional Bore	93	41	N	39	28	52	N	Y	$2,500,296		
Norfolk	I-060B	S-A20	Dry-Ditch Open-Cut	82	-	N	39	23	0	N	Y	$81,900	Conventional Bore	Orangefin madtom habitat may be present in this stream. The direct aquatic impact will be avoided/minimized by use of the conventional bore method.
			Conventional Bore	82	39	N	39	23	0	N	Y	$945,220		
Norfolk	I-061A	S-A22	Dry-Ditch Open-Cut	52	-	N	27	18	0	N	Y	$67,900	Conventional Bore	There are no significant constraints on available crossing methods or significant environmental impacts relevant to the available methods. The direct aquatic impact will be avoided/minimized by use of the conventional bore method. A minor temporary impact associated with the bore to maintain access will be required.
			Conventional Bore	52	16	N	27	18	0	N	Y	$220,653		
Norfolk	I-061B	S-H27	Dry-Ditch Open-Cut	60	-	N	28	14	0	N	Y	$77,000	Dry-Ditch Open-Cut	The open cut method would result in a temporary impact to a small UNT to Jacks Creek. Avoiding/minimizing these minor impacts through a conventional bore would require a relatively deep bore pit of nearly 30 feet, thereby requiring the excavation of an interim ramp and bench and dramatically increasing the space occupied by the bore pit and spoil pile. Using a conventional bore crossing method to avoid/minimize this minor temporary impact would be unreasonably expensive.
			Conventional Bore	60	29	N	28	14	0	N	Y	$435,185		
Norfolk	I-062	S-MM44	Dry-Ditch Open-Cut	54	-	N	36	24	0	N	Y	$54,544	Conventional Bore	Orangefin madtom habitat may be present in this stream. The direct aquatic impact will be avoided/minimized by use of the conventional bore method. A minor temporary impact associated with the bore to maintain access will be required.
			Conventional Bore	54	36	N	36	24	0	N	Y	$810,949		

Table 15. Crossing Method Determination Summary
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USACE District	Crossing #	Waterbody	Crossing Methods Evaluated	Evaluation Factors: Crossing Length	Pit Depth	Deep Stream	Maximum Steep Slope (%)	Maximum Average Slope (%)	Maximum Winch Hill Length (feet)	Karst Terrain Present	Sufficient Stockpile Storage Available	Total Cost ($)	Proposed Crossing Method	Crossing Method Decision Rationale
Norfolk	I-063	S-MM48	Dry-Ditch Open-Cut	83	-	N	29	18	0	N	Y	$91,845	Conventional Bore	Orangefin madtom habitat may be present in this stream. The direct aquatic impact will be avoided/minimized by use of the conventional bore method. A minor temporary impact associated with the bore to maintain access will be required.
			Conventional Bore	83	29	N	29	18	0	N	Y	$500,459		
Norfolk	I-064	S-H25, W-H9	Dry-Ditch Open-Cut	31	-	N	40	21	31	N	N	$53,320	Conventional Bore	Orangefin madtom habitat may be present in this stream. The direct aquatic impact will be avoided/minimized by use of the conventional bore method. A minor temporary impact associated with the bore to maintain access will be required.
			Conventional Bore	31	26	N	40	21	31	N	N	$325,479		
Norfolk	I-065	S-H24	Dry-Ditch Open-Cut	79	-	N	31	21	0	N	Y	$216,378	Conventional Bore	Orangefin madtom habitat may be present in this stream. The direct aquatic impact will be avoided/minimized by use of the conventional bore method. A minor temporary impact associated with the bore to maintain access will be required.
			Conventional Bore	79	28	N	31	21	0	N	Y	$479,972		
Norfolk	I-066	S-H23	Dry-Ditch Open-Cut	45	-	N	30	23	0	N	Y	$49,679	Dry-Ditch Open-Cut	The open cut method would result in a temporary impact to the small (five-feet wide) intermittent UNT to Turkey Creek. Avoiding/minimizing this minor impact through a conventional bore would require a relatively deep bore pit of nearly 30 feet, thereby requiring the excavation of an interim ramp and bench and dramatically increasing the space occupied by the bore pit and spoil pile. This crossing is in close proximity to a residence, and a trenchless crossing of this location would take more than twice as long to complete -- compounding the noise, aesthetic, and other impacts on nearby persons. The open-cut method reduces construction duration to minimize disruption due to construction activities on the affected residents. Using a conventional bore crossing method to avoid/minimize this minor temporary impact would be unreasonably expensive.
			Conventional Bore	45	27	N	30	23	0	N	Y	$374,346		
Norfolk	I-067	S-A13	Dry-Ditch Open-Cut	54	-	N	21	16	0	N	Y	$81,560	Conventional Bore	Orangefin madtom habitat may be present in this stream. The direct aquatic impact will be avoided/minimized by use of the conventional bore method.
			Conventional Bore	54	20	N	21	16	0	N	Y	$335,945		
Norfolk	I-069A	S-A7	Dry-Ditch Open-Cut	61	-	N	23	10	0	N	Y	$74,200	Conventional Bore	Orangefin madtom habitat may be present in this stream. The direct aquatic impact will be avoided/minimized by use of the conventional bore method. A minor temporary impact associated with the bore to maintain access will be required.
			Conventional Bore	61	19	N	23	10	0	N	Y	$259,897		
Norfolk	I-069B	S-H17	Dry-Ditch Open-Cut	90	-	N	27	20	0	N	Y	$86,898	Dry-Ditch Open-Cut	The open cut method would result in a temporary impact to the small (seven-feet wide) intermittent Dinner Creek. Avoiding/minimizing this minor impact through a conventional bore would require a relatively deep bore pit nearing 30 feet, thereby requiring the excavation of an interim ramp and bench and dramatically increasing the space occupied by the bore pit and spoil pile. This crossing is in proximity to a residence, and a trenchless crossing of this location would take 22 days to complete -- compounding the noise, aesthetic, and other impacts on nearby persons. The open-cut method reduces construction duration to minimize disruption due to construction activities on the affected residents. The open cut method would reduce the construction duration near several private drinking water wells on the property. Using a conventional bore crossing method to avoid/minimize this minor temporary impact would be unreasonably expensive.
			Conventional Bore	90	28	N	27	20	0	N	Y	$511,190		
Norfolk	I-070	S-SS8	Dry-Ditch Open-Cut	51	-	N	31	24	0	N	Y	$77,803	Conventional Bore	Orangefin madtom habitat may be present in this stream. The direct aquatic impact will be avoided/minimized by use of the conventional bore method.
			Conventional Bore	51	26	N	31	24	0	N	Y	$382,239		
Norfolk	I-071	S-CD8	Dry-Ditch Open-Cut	38	-	N	27	24	0	N	Y	$43,598	Dry-Ditch Open-Cut	The open cut method would result in a temporary impact to a small (five-feet wide) intermittent UNT to Owens Creek. Avoiding/minimizing these minor impacts through a conventional bore would require a relatively deep bore pit of nearly 30 feet, thereby requiring the excavation of an interim ramp and bench and dramatically increasing the space occupied by the bore pit and spoil pile. Using a conventional bore crossing method to avoid/minimize this minor temporary impact would be unreasonably expensive.
			Conventional Bore	38	27	N	27	24	0	N	Y	$354,480		

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USACE District	Crossing #	Waterbody	Crossing Methods Evaluated	Evaluation Factors									Proposed Crossing Method	Crossing Method Decision Rationale
				Crossing Length	Pit Depth	Deep Stream	Maximum Steep Slope (%)	Maximum Average Slope (%)	Maximum Winch Hill Length (feet)	Karst Terrain Present	Sufficient Stockpile Storage Available	Total Cost ($)		
Norfolk	I-072	S-AB8	Dry-Ditch Open-Cut	44	-	N	35	24	11	N	N	$49,580	Dry-Ditch Open-Cut	The open cut method would result in a temporary impact to a small (five-feet wide) intermittent UNT to Owens Creek. Avoiding/minimizing these minor impacts through a conventional bore would require a relatively deep bore pit exceeding 30 feet on the edge of a short but steep slope, thereby requiring the excavation of an interim ramp and bench and dramatically increasing the space occupied by the bore pit and spoil pile. Using a conventional bore crossing method to avoid/minimize this minor temporary impact would be unreasonably expensive.
			Conventional Bore	44	34	N	35	24	11	N	N	$746,030		
Norfolk	I-073	S-DD3	Dry-Ditch Open-Cut	81	-	N	10	8	91	N	Y	$121,514	Conventional Bore	Orangefin madtom habitat may be present in this stream. The direct aquatic impact will be avoided/minimized by use of the conventional bore method. A minor temporary impact associated with the bore to maintain access will be required.
			Conventional Bore	81	16	N	10	8	91	N	Y	$302,954		
Norfolk	I-074	S-G16	Dry-Ditch Open-Cut	53	-	N	34	23	0	N	Y	$142,157	Conventional Bore	Orangefin madtom habitat may be present in this stream. The direct aquatic impact will be avoided/minimized by use of the conventional bore method. A minor temporary impact associated with the bore to maintain access will be required.
			Conventional Bore	53	31	N	34	23	0	N	Y	$716,764		
Norfolk	I-075	S-G15	Dry-Ditch Open-Cut	54	-	N	31	20	10	N	Y	$72,205	Dry-Ditch Open-Cut	The open cut method would result in a temporary impact to a small intermittent UNT to Parrott Branch. Avoiding/minimizing this minor impact through a conventional bore would require a relatively deep bore pit exceeding 30 feet on the edge of a short but steep slope, thereby requiring the excavation of an interim ramp and bench and dramatically increasing the space occupied by the bore pit and spoil pile. It also would more than double the duration of the crossing. The open cut method would reduce the construction duration near several private drinking water wells on the property. Using a conventional bore crossing method to avoid/minimize this minor temporary impact would be unreasonably expensive.
			Conventional Bore	54	33	N	31	20	10	N	Y	$756,141		
Norfolk	I-076	S-G13	Dry-Ditch Open-Cut	42	-	N	57	36	107	N	N	$57,417	Conventional Bore	Orangefin madtom habitat may be present in this stream. The direct aquatic impact will be avoided/minimized by use of the conventional bore method. A minor temporary impact associated with the bore to maintain access will be required.
			Conventional Bore	42	26	N	57	36	107	N	N	$356,697		
Norfolk	I-077	S-D7, W-MM17	Dry-Ditch Open-Cut	39	-	N	36	20	21	N	N	$57,474	Dry-Ditch Open-Cut	The open cut method would result in a temporary impact to the small (nine-feet wide) intermittent UNT to Jonnikin Creek. Avoiding/minimizing this minor impact through a conventional bore would require a relatively deep bore pit exceeding 20 feet on the edge of a short but steep slope, thereby requiring the excavation of an interim ramp and bench and dramatically increasing the space occupied by the bore pit and spoil pile. This crossing is in close proximity to a residence, and a trenchless crossing of this location would take more than twice as long to complete -- compounding the noise, aesthetic, and other impacts on nearby persons. The open-cut method reduces construction duration to minimize disruption due to construction activities on the affected residents. The open cut method would reduce the construction duration near several private drinking water wells on the property. Using a conventional bore crossing method to avoid/minimize this minor temporary impact would be unreasonably expensive.
			Conventional Bore	39	25	N	36	20	21	N	N	$339,049		
Norfolk	I-078	S-D3	Dry-Ditch Open-Cut	43	-	N	28	16	0	N	Y	$65,776	Conventional Bore	Orangefin madtom habitat may be present in this stream. The direct aquatic impact will be avoided/minimized by use of the conventional bore method. A minor temporary impact associated with the bore to maintain access will be required.
			Conventional Bore	43	16	N	28	16	0	N	Y	$195,111		
Norfolk	I-079	S-D4	Dry-Ditch Open-Cut	62	-	N	35	20	10	N	N	$73,648	Dry-Ditch Open-Cut	The open cut method would result in a temporary impact to a small (six-feet wide) intermittent UNT to Jonnikin Creek. Avoiding/minimizing these minor impacts through a conventional bore would require a relatively deep bore pit of nearly 40 feet, thereby requiring the excavation of an interim ramp and bench and dramatically increasing the space occupied by the bore pit and spoil pile. Using a conventional bore crossing method to avoid/minimize this minor temporary impact would be unreasonably expensive.
			Conventional Bore	62	38	N	35	20	10	N	N	$870,191		
Norfolk	I-080	S-D2, W-D3	Dry-Ditch Open-Cut	54	-	N	41	21	96	N	N	$102,144	Conventional Bore	Orangefin madtom habitat may be present in this stream. The direct aquatic impact will be avoided/minimized by use of the conventional bore method. A minor temporary impact associated with the bore to maintain access will be required.
			Conventional Bore	54	19	N	41	21	96	N	N	$240,031		

Table 15. Crossing Method Determination Summary
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USACE District	Crossing #	Waterbody	Crossing Methods Evaluated	Evaluation Factors									Proposed Crossing Method	Crossing Method Decision Rationale
				Crossing Length	Pit Depth	Deep Stream	Maximum Steep Slope (%)	Maximum Average Slope (%)	Maximum Winch Hill Length (feet)	Karst Terrain Present	Sufficient Stockpile Storage Available	Total Cost ($)		
Norfolk	I-081	S-D1-EPH	Dry-Ditch Open-Cut	82	-	N	28	19	0	N	Y	$95,632	Dry-Ditch Open-Cut	Avoiding/minimizing this minor impact through a conventional bore would require a relatively deep bore pit of nearly 30 feet, thereby requiring the excavation of an interim ramp and bench and dramatically increasing the space occupied by the bore pit and spoil pile. The stream banks at the crossing location are rapidly eroding due to natural conditions unrelated to pipeline construction. Instream work will be necessary to permanently restore and stabilize the banks, which will provide greater protection for the pipeline and have the benefit of reducing long-term sediment loads in the stream. That work can be done efficiently and effectively after completion of an open-cut crossing. Therefore, temporary stream impacts are unavoidable at this location. It would be unreasonably expensive to use a trenchless crossing to avoid only a fraction of the aquatic impact to this UNT to Jonnikin Creek.
			Conventional Bore	82	29	N	28	19	0	N	Y	$497,621		
Norfolk	I-082	S-G11	Dry-Ditch Open-Cut	55	-	N	35	16	0	N	Y	$59,983	Dry-Ditch Open-Cut	The open cut method would result in a temporary impact to the small (six-feet wide) intermittent UNT to Jonnikin Creek. Avoiding/minimizing this minor impact through a conventional bore would require a relatively deep bore pit exceeding 30 feet, thereby requiring the excavation of an interim ramp and bench and dramatically increasing the space occupied by the bore pit and spoil pile. This crossing is in close proximity to a residence, and a trenchless crossing of this location would take more than twice as long to complete -- compounding the noise, aesthetic, and other impacts on nearby persons. The open-cut method reduces construction duration to minimize disruption due to construction activities on the affected residents. The open cut method would reduce the construction duration near several private drinking water wells on the property. Using a conventional bore crossing method to avoid/minimize this minor temporary impact would be unreasonably expensive.
			Conventional Bore	55	33	N	35	16	0	N	Y	$758,979		
Norfolk	I-083	S-G9, W-B5	Dry-Ditch Open-Cut	44	-	N	24	14	10	N	N	$45,226	Dry-Ditch Open-Cut	The open cut method would result in a temporary impact to the small (four-feet wide) intermittent UNT to Jonnikin Creek. Avoiding/minimizing this minor impact through a conventional bore would require a relatively deep bore pit exceeding 20 feet on the edge of a short slope, thereby requiring the excavation of an interim ramp and bench and dramatically increasing the space occupied by the bore pit and spoil pile. It also would increase the duration of the crossing by one week. Using a conventional bore crossing method to avoid/minimize this minor temporary impact would be unreasonably expensive.
			Conventional Bore	44	20	N	24	14	10	N	N	$307,565		
Norfolk	I-084A	S-G8	Dry-Ditch Open-Cut	41	-	N	24	16	0	N	Y	$42,700	Dry-Ditch Open-Cut	The open cut method would result in a temporary impact to the small (four-feet wide) intermittent UNT to Jonnikin Creek. Avoiding/minimizing this minor impact through a conventional bore would require a relatively deep bore pit exceeding 20 feet, thereby requiring the excavation of an interim ramp and bench and dramatically increasing the space occupied by the bore pit and spoil pile. It also would increase the duration of the crossing from 5 to 17 days. Using a conventional bore crossing method to avoid/minimize this minor temporary impact would be unreasonably expensive.
			Conventional Bore	41	21	N	24	16	0	N	Y	$308,186		
Norfolk	I-084B	S-Q15	Dry-Ditch Open-Cut	48	-	N	26	22	0	N	Y	$54,600	Dry-Ditch Open-Cut	The open cut method would result in a temporary impact to the small (six-feet wide) UNT to Jonnikin Creek. Avoiding/minimizing this minor impact through a conventional bore would require a relatively deep bore pit exceeding 20 feet, thereby requiring the excavation of an interim ramp and bench and dramatically increasing the space occupied by the bore pit and spoil pile. It also would increase the duration of the crossing from 5 to 17 days. Using a conventional bore crossing method to avoid/minimize this minor temporary impact would be unreasonably expensive.
			Conventional Bore	48	25	N	26	22	0	N	Y	$364,590		
Norfolk	I-085	S-A6	Dry-Ditch Open-Cut	44	-	N	28	21	0	N	Y	$51,308	Conventional Bore	Orangefin madtom habitat may be present in this stream. The direct aquatic impact will be avoided/minimized by use of the conventional bore method. A minor temporary impact associated with the bore to maintain access will be required.
			Conventional Bore	44	22	N	28	21	0	N	Y	$325,834		
Norfolk	I-086	S-C7	Dry-Ditch Open-Cut	65	-	N	42	19	96	N	N	$115,499	Conventional Bore	Orangefin madtom habitat may be present in this stream. The direct aquatic impact will be avoided/minimized by use of the conventional bore method. A minor temporary impact associated with the bore to maintain access will be required.
			Conventional Bore	65	19	N	42	19	96	N	N	$271,248		
Norfolk	I-087	S-C4, S-C3	Dry-Ditch Open-Cut	126	-	N	34	27	115	N	N	$153,189	Conventional Bore	Orangefin madtom habitat may be present in this stream. The direct aquatic impact will be avoided/minimized by use of the conventional bore method. A minor temporary impact associated with the bore to maintain access will be required.
			Conventional Bore	126	27	N	34	27	115	N	N	$604,222		
Norfolk	I-088	S-H13, W-H5	Dry-Ditch Open-Cut	173	-	N	33	25	21	N	N	$191,262	Dry-Ditch Open-Cut	The stream banks at the crossing location are rapidly eroding due to natural conditions unrelated to pipeline construction. Instream work will be necessary to permanently restore and stabilize the banks, which will provide greater protection for the pipeline and have the benefit of reducing long-term sediment loads in the stream. That work can be done efficiently and effectively after completion of an open-cut crossing. Therefore, temporary stream impacts are unavoidable at this location. Lastly, it would be unreasonably expensive to use a trenchless crossing to avoid only a fraction of the aquatic impact to this UNT to Little Cherrystone Creek and adjacent wetland.
			Conventional Bore	173	35	N	33	25	21	N	N	$1,130,399		

Table 15. Crossing Method Determination Summary
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USACE District	Crossing #	Waterbody	Crossing Methods Evaluated	Evaluation Factors									Proposed Crossing Method	Crossing Method Decision Rationale
				Crossing Length	Pit Depth	Deep Stream	Maximum Steep Slope (%)	Maximum Average Slope (%)	Maximum Winch Hill Length (feet)	Karst Terrain Present	Sufficient Stockpile Storage Available	Total Cost ($)		
Norfolk	I-089	S-G6	Dry-Ditch Open-Cut	60	-	N	30	23	0	N	Y	$63,951	Dry-Ditch Open-Cut	The open cut method would result in a temporary impact to the small (six-feet wide) UNT to Harpen Creek. Avoiding/minimizing this minor impact through a conventional bore would require a relatively deep bore pit exceeding 30 feet, thereby requiring the excavation of an interim ramp and bench and dramatically increasing the space occupied by the bore pit and spoil pile. It also would more than double the duration of the crossing. Using a conventional bore crossing method to avoid/minimize this minor temporary impact would be unreasonably expensive.
			Conventional Bore	60	34	N	30	23	0	N	Y	$791,438		
Norfolk	I-090	S-G5	Dry-Ditch Open-Cut	50	-	N	26	17	0	N	Y	$56,003	Dry-Ditch Open-Cut	The open cut method would result in a temporary impact to the small (six-feet wide) UNT to Harpen Creek. Avoiding/minimizing this minor impact through a conventional bore would require a relatively deep bore pit exceeding 30 feet, thereby requiring the excavation of an interim ramp and bench and dramatically increasing the space occupied by the bore pit and spoil pile. It also would increase the duration of the crossing from 4 to 10 days. Using a conventional bore crossing method to avoid/minimize this minor temporary impact would be unreasonably expensive.
			Conventional Bore	50	26	N	26	17	0	N	Y	$379,401		
Norfolk	I-091	S-G4	Dry-Ditch Open-Cut	74	-	N	30	18	0	N	Y	$167,471	Conventional Bore	Orangefin madtom habitat may be present in this stream. The direct aquatic impact will be avoided/minimized by use of the conventional bore method. A minor temporary impact associated with the bore to maintain access will be required.
			Conventional Bore	74	32	N	30	18	0	N	Y	$794,631		
Norfolk	I-092	S-G3	Dry-Ditch Open-Cut	39	-	N	31	17	0	N	Y	$61,935	Conventional Bore	Orangefin madtom habitat may be present in this stream. The direct aquatic impact will be avoided/minimized by use of the conventional bore method. A minor temporary impact associated with the bore to maintain access will be required.
			Conventional Bore	39	20	N	31	17	0	N	Y	$293,375		
Norfolk	I-093	S-CC16	Dry-Ditch Open-Cut	52	-	N	18	11	0	N	Y	$75,678	Conventional Bore	Orangefin madtom habitat may be present in this stream. The direct aquatic impact will be avoided/minimized by use of the conventional bore method. A minor temporary impact associated with the bore to maintain access will be required.
			Conventional Bore	52	16	N	18	11	0	N	Y	$220,653		
Norfolk	I-094	S-CC13, S-CC14	Dry-Ditch Open-Cut	110	-	N	25	18	0	N	Y	$105,108	Conventional Bore	There are no significant constraints on available crossing methods or significant environmental impacts relevant to the available methods. The direct aquatic impact will be avoided/minimized by use of the conventional bore method. A minor temporary impact associated with the bore to maintain access will be required.
			Conventional Bore	110	23	N	25	18	0	N	Y	$522,276		
Norfolk	I-095	S-MM8, W-MM5	Dry-Ditch Open-Cut	39	-	N	20	14	0	N	Y	$48,302	Conventional Bore	There are no significant constraints on available crossing methods or significant environmental impacts relevant to the available methods. The direct aquatic impact will be avoided/minimized by use of the conventional bore method. A minor temporary impact associated with the bore to maintain access will be required.
			Conventional Bore	39	19	N	20	14	0	N	Y	$197,461		
Norfolk	I-096	S-CC15	Dry-Ditch Open-Cut	33	-	N	18	14	0	N	Y	$45,144	Conventional Bore	There are no significant constraints on available crossing methods or significant environmental impacts relevant to the available methods. The direct aquatic impact will be avoided/minimized by use of the conventional bore method. A minor temporary impact associated with the bore to maintain access will be required.
			Conventional Bore	33	18	N	18	14	0	N	Y	$175,866		
Norfolk	I-097	S-CC8, S-CC5	Dry-Ditch Open-Cut	78	-	N	32	11	10	N	N	$128,994	Conventional Bore	There are no significant constraints on available crossing methods or significant environmental impacts relevant to the available methods. The direct aquatic impact will be avoided/minimized by use of the conventional bore method. A minor temporary impact associated with the bore to maintain access will be required.
			Conventional Bore	78	14	N	32	11	10	N	N	$285,306		

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USACE District	Crossing #	Waterbody	Crossing Methods Evaluated	Evaluation Factors: Crossing Length	Pit Depth	Deep Stream	Maximum Steep Slope (%)	Maximum Average Slope (%)	Maximum Winch Hill Length (feet)	Karst Terrain Present	Sufficient Stockpile Storage Available	Total Cost ($)	Proposed Crossing Method	Crossing Method Decision Rationale
Norfolk	I-098	S-CC9	Dry-Ditch Open-Cut	42	-	N	45	26	21	N	N	$48,685	Dry-Ditch Open-Cut	The open cut method would result in a temporary impact to the small (six-feet wide) UNT to Cherrystone Creek. Avoiding/minimizing this minor impact through a conventional bore would require a relatively deep bore pit exceeding 30 feet, thereby requiring the excavation of an interim ramp and bench and dramatically increasing the space occupied by the bore pit and spoil pile. It also would increase the duration of the crossing from 4 to 10 days. Using a conventional bore crossing method to avoid/minimize this minor temporary impact would be unreasonably expensive.
			Conventional Bore	42	35	N	45	26	21	N	N	$758,623		
Norfolk	I-099	S-CC10	Dry-Ditch Open-Cut	38	-	N	38	20	21	N	N	$58,726	Dry-Ditch Open-Cut	The open cut method would result in a temporary impact to the small (nine-feet wide) intermittent UNT to Cherrystone Creek. Avoiding/minimizing this minor impact through a conventional bore would require a relatively deep bore pit exceeding 30 feet, thereby requiring the excavation of an interim ramp and bench and dramatically increasing the space occupied by the bore pit and spoil pile. It also would increase the duration of the crossing from 4 to 10 days. The open cut method would reduce the construction duration near a private drinking water well on the property. Using a conventional bore crossing method to avoid/minimize this minor temporary impact would be unreasonably expensive.
			Conventional Bore	38	32	N	38	20	21	N	N	$692,463		
Norfolk	I-100	S-CC11	Dry-Ditch Open-Cut	42	-	N	44	19	0	N	Y	$60,039	Dry-Ditch Open-Cut	The open cut method would result in a temporary impact to the small (nine-feet wide) UNT to Cherrystone Creek. Avoiding/minimizing this minor impact through a conventional bore would require a relatively deep bore pit of nearly 30 feet on the edge of a short but steep slope, thereby requiring the excavation of an interim ramp and bench and dramatically increasing the space occupied by the bore pit and spoil pile. It also would increase the duration of the crossing from 4 to 10 days. The open cut method would reduce the construction duration near a private drinking water well on the property. Using a conventional bore crossing method to avoid/minimize this minor temporary impact would be unreasonably expensive.
			Conventional Bore	42	27	N	44	19	0	N	Y	$365,832		
Norfolk	I-101A	W-MM9	Dry-Ditch Open-Cut	35	-	N	44	26	52	N	N	$83,561	Conventional Bore	There are no significant constraints on available crossing methods or significant environmental impacts relevant to the available methods. The direct aquatic impact will be avoided/minimized by use of the conventional bore method.
			Conventional Bore	35	18	N	44	26	52	N	N	$181,542		
Norfolk	I-101B	W-MM8-PFO, W-MM8-PEM, S-CC1	Dry-Ditch Open-Cut	161	-	N	20	8	32	N	Y	$172,200	Dry-Ditch Open-Cut	The open cut method would result in a temporary impact to the small intermittent UNT to Cherrystone Creek and two adjacent wetland features (PEM and PFO). Avoiding/minimizing these minor impacts through a conventional bore would require a relatively deep bore pit of nearly 40 feet , thereby requiring the excavation of an interim ramp and bench and dramatically increasing the space occupied by the bore pit and spoil pile. It also would increase the duration of the crossing from 4 to 60 days. The open cut method would reduce the construction duration near a private drinking water well on the property. Because the pipeline ROW must remain free of woody vegetation to protect the pipe coating, a conversion impact is unavoidable with any crossing method. Using a conventional bore crossing method to avoid/minimize these minor temporary impacts would be unreasonably expensive.
			Conventional Bore	161	38	N	20	8	32	N	Y	$1,151,152		
Norfolk	I-102	S-CC3	Dry-Ditch Open-Cut	38	-	N	40	21	0	N	Y	$56,288	Dry-Ditch Open-Cut	The open cut method would result in a temporary impact to the small (eight-feet wide) UNT to Cherrystone Creek. Avoiding/minimizing this minor impact through a conventional bore would require a relatively deep bore pit of nearly 30 feet on the edge, thereby requiring the excavation of an interim ramp and bench and dramatically increasing the space occupied by the bore pit and spoil pile. It also would increase the duration of the crossing from 4 to 10 days. The open cut method would reduce the construction duration near a private drinking water well on the property. Using a conventional bore crossing method to avoid/minimize this minor temporary impact would be unreasonably expensive.
			Conventional Bore	38	30	N	40	21	0	N	Y	$655,925		
Norfolk	I-103	S-P5	Dry-Ditch Open-Cut	47	-	N	12	10	0	N	Y	$56,790	Conventional Bore	There are no significant constraints on available crossing methods or significant environmental impacts relevant to the available methods. The direct aquatic impact will be avoided/minimized by use of the conventional bore method.
			Conventional Bore	47	11	N	12	10	0	N	Y	$183,626		
Norfolk	I-104	S-IJ35-EPH	Dry-Ditch Open-Cut	32	-	N	23	16	0	N	Y	$36,895	Dry-Ditch Open-Cut	The open cut method would result in a temporary impact to the small (five-feet wide) UNT to Pole Bridge Branch. Avoiding/minimizing this minor impact through a conventional bore would increase the duration of the crossing from 4 to 11 days. The open cut method would reduce the construction duration near a private drinking water well on the property. Using a conventional bore crossing method to avoid/minimize this minor temporary impact would be unreasonably expensive.
			Conventional Bore	32	23	N	23	16	0	N	Y	$300,913		
Norfolk	I-105	S-Q4	Dry-Ditch Open-Cut	48	-	N	22	7	0	N	Y	$56,601	Conventional Bore	There are no significant constraints on available crossing methods or significant environmental impacts relevant to the available methods. The direct aquatic impact will be avoided/minimized by use of the conventional bore method.
			Conventional Bore	48	19	N	22	7	0	N	Y	$223,003		

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USACE District	Crossing #	Waterbody	Crossing Methods Evaluated	Evaluation Factors									Proposed Crossing Method	Crossing Method Decision Rationale
				Crossing Length	Pit Depth	Deep Stream	Maximum Steep Slope (%)	Maximum Average Slope (%)	Maximum Winch Hill Length (feet)	Karst Terrain Present	Sufficient Stockpile Storage Available	Total Cost ($)		
Norfolk	I-106A	S-Q2	Dry-Ditch Open-Cut	51	-	N	17	15	0	N	Y	$123,204	Conventional Bore	There are no significant constraints on available crossing methods or significant environmental impacts relevant to the available methods. The direct aquatic impact will be avoided/minimized by use of the conventional bore method.
			Conventional Bore	51	16	N	17	15	0	N	Y	$217,815		
Norfolk	I-106B	W-Q2, S-Q3	Dry-Ditch Open-Cut	319	-	N	17	6	0	N	Y	$253,621	Dry-Ditch Open-Cut	This crossing presents multiple challenges that limit the available options and necessitated the development of a site-specific solution. A bore pit depth exceeding 20 feet at this location requires the excavation of an interim ramp and bench and dramatically increases the space occupied by the bore pit and spoil pile. Steep slopes (greater than 30%) adjacent to the waterbody increases the complexity of this crossing if bored, increases safety risk to personnel, and adds risk of impact to the waterbody from upland work during a bore. The open cut method also reduces the construction duration near private drinking water wells on the property. Attempting a conventional bore would extend the duration of this crossing from 5 days for an open cut to 60 days for a guided conventional bore -- which also would increase the total greenhouse gas emissions associated with this crossing by 15 times. Furthermore, the other significant environmental impacts associated with a trenchless crossing method at this location outweigh the minimized temporary impact to Pole Bridge Branch.
			Guided Conventional Bore	319	26	N	17	6	0	N	Y	$711,028		
Norfolk	I-107	W-Q1	Dry-Ditch Open-Cut	55	-	N	10	8	0	N	Y	$38,500	Dry-Ditch Open-Cut	The open cut method would result in a small temporary impact to a PEM wetland. Avoiding/minimizing this minor impact through a conventional bore would increase the duration of the crossing from 4 to 43 days. The open cut method would reduce the construction duration near a private drinking water well on the property. Using a conventional bore crossing method to avoid/minimize this minor temporary impact would be unreasonably expensive.
			Conventional Bore	55	16	N	10	8	0	N	Y	$229,167		
Norfolk	I-108	S-B6	Dry-Ditch Open-Cut	55	-	N	42	19	0	N	Y	$80,024	Dry-Ditch Open-Cut	The open cut method would result in a temporary impact to the small (five-feet wide) intermittent UNT to Pole Bridge Branch. Avoiding/minimizing this minor impact through a conventional bore would require a relatively deep bore pit of nearly 40 feet, thereby requiring the excavation of an interim ramp and bench and dramatically increasing the space occupied by the bore pit and spoil pile. It also would increase the duration of the crossing from 4 to 11 days. The open cut method would reduce the construction duration near a private drinking water well on the property. Using a conventional bore crossing method to avoid/minimize this minor temporary impact would be unreasonably expensive.
			Conventional Bore	55	36	N	42	19	0	N	Y	$813,787		
Norfolk	I-109	S-B8	Dry-Ditch Open-Cut	43	-	N	31	16	0	N	Y	$46,214	Dry-Ditch Open-Cut	The open cut method would result in a temporary impact to the small (five-feet wide) intermittent UNT to Pole Bridge Branch. Avoiding/minimizing this minor impact through a conventional bore would require a relatively deep bore pit of nearly 30 feet, thereby requiring the excavation of an interim ramp and bench and dramatically increasing the space occupied by the bore pit and spoil pile. It also would increase the duration of the crossing from 4 to 44 days. The open cut method would reduce the construction duration near a private drinking water well on the property. Using a conventional bore crossing method to avoid/minimize this minor temporary impact would be unreasonably expensive.
			Conventional Bore	43	29	N	31	16	0	N	Y	$386,939		
Norfolk	I-110	S-B9	Dry-Ditch Open-Cut	41	-	N	19	13	0	N	Y	$53,226	Dry-Ditch Open-Cut	The open cut method would result in a temporary impact to the small (seven-feet wide) UNT to Pole Bridge Branch. Avoiding/minimizing this minor impact through a conventional bore would require a relatively deep bore pit exceeding 20 feet, thereby requiring the excavation of an interim ramp and bench and dramatically increasing the space occupied by the bore pit and spoil pile. Using a conventional bore crossing method to avoid/minimize this minor temporary impact would be unreasonably expensive.
			Conventional Bore	41	22	N	19	13	0	N	Y	$317,320		
Norfolk	I-111	S-DD4	Dry-Ditch Open-Cut	230	-	N	9	5	0	N	Y	$213,500	Dry-Ditch Open-Cut	The pipeline has already been installed under an adjacent railroad. There is no feasible way to tie the two sections of pipe together if a trenchless method is used to install this crossing. Furthermore, the railroad bore encountered difficult conditions, which indicates that completing another crossing at this location has a higher degree of potential failure.
			Conventional Bore	230	17	N	9	5	0	N	Y	$730,381		
Norfolk	i-111A	S-DD4	Dry-Ditch Open-Cut	33	-	N	23	13	0	N	Y	$75,600	Conventional Bore	There are no significant constraints on available crossing methods or significant environmental impacts relevant to the available methods. The direct aquatic impact will be avoided/minimized by use of the conventional bore method.
			Conventional Bore	33	15	N	23	13	0	N	Y	$162,164		
Norfolk	I-112	S-KL27	Dry-Ditch Open-Cut	33	-	N	12	7	0	N	Y	$27,032	Dry-Ditch Open-Cut	The open cut method would result in a temporary impact to the small (one-foot wide) UNT to Mill Creek. It also would double the duration of the crossing. Using a conventional bore crossing method to avoid/minimize this minor temporary impact would be unreasonably expensive.
			Conventional Bore	33	15	N	12	7	0	N	Y	$162,164		

Table 15. Crossing Method Determination Summary
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USACE District	Crossing #	Waterbody	Crossing Methods Evaluated	Evaluation Factors: Crossing Length	Pit Depth	Deep Stream	Maximum Steep Slope (%)	Maximum Average Slope (%)	Maximum Winch Hill Length (feet)	Karst Terrain Present	Sufficient Stockpile Storage Available	Total Cost ($)	Proposed Crossing Method	Crossing Method Decision Rationale
Norfolk	I-113	S-C1	Dry-Ditch Open-Cut	61	-	N	38	11	0	N	Y	$64,849	Dry-Ditch Open-Cut	The open cut method would result in a temporary impact to the small intermittent Mill Creek. Avoiding/minimizing this minor impact through a conventional bore would require a relatively deep bore pit exceeding 30 feet with an excavator operating from a bench within the pit, at the edge of short but steep slope, and nearly triple the duration of the crossing. It also would require the excavation of an interim ramp and bench, thereby dramatically increasing the space occupied by the bore pit and spoil pile. Using a conventional bore crossing method to avoid/minimize this minor temporary impact would be unreasonably expensive.
			Conventional Bore	61	31	N	38	11	0	N	Y	$739,468		
Norfolk	I-114	S-G2, W-G2	Dry-Ditch Open-Cut	122	-	N	35	16	11	N	Y	$111,010	Conventional Bore	There are no significant constraints on available crossing methods or significant environmental impacts relevant to the available methods. The direct aquatic impact will be avoided/minimized by use of the conventional bore method. A minor temporary impact associated with the bore to maintain access will be required.
			Conventional Bore	122	21	N	35	16	11	N	Y	$538,062		
Norfolk	I-115	S-B2	Dry-Ditch Open-Cut	40	-	N	21	12	0	N	Y	$46,015	Conventional Bore	There are no significant constraints on available crossing methods or significant environmental impacts relevant to the available methods. The direct aquatic impact will be avoided/minimized by use of the conventional bore method. A minor temporary impact associated with the bore to maintain access will be required.
			Conventional Bore	40	18	N	21	12	0	N	Y	$195,732		
Norfolk	I-116	S-H55	Dry-Ditch Open-Cut	40	-	N	13	8	0	N	Y	$38,950	Conventional Bore	There are no significant constraints on available crossing methods or significant environmental impacts relevant to the available methods. The direct aquatic impact will be avoided/minimized by use of the conventional bore method. A minor temporary impact associated with the bore to maintain access will be required.
			Conventional Bore	40	16	N	13	8	0	N	Y	$186,597		
Norfolk	I-117	S-H54	Dry-Ditch Open-Cut	56	-	N	15	9	0	N	Y	$88,685	Conventional Bore	There are no significant constraints on available crossing methods or significant environmental impacts relevant to the available methods. The direct aquatic impact will be avoided/minimized by use of the conventional bore method. A minor temporary impact associated with the bore to maintain access will be required.
			Conventional Bore	56	16	N	15	9	0	N	Y	$232,005		
Norfolk	I-118	S-H5, W-H1, W-H2, S-H3, W-H3	Dry-Ditch Open-Cut	835	-	N	22	7	0	N	Y	$616,507	Dry-Ditch Open-Cut	Due a close cluster of wetlands that would be crossed in one undertaking, this crossing is unusually long at over 800 feet. The direct pipe method would be necessary to cross these features. That crossing would method would extend the duration of this crossing from seven days for an open cut to 99 days for the trenchless method (increasing greenhouse gas emissions associated with the crossing by nearly 1,900%). The open cut method would reduce the construction duration near multiple private drinking water wells on the property. Using a Direct Pipe crossing method to avoid/minimize these minor temporary impacts two a small (6-foot wide) intermittent stream, small (8-foot wide) perennial stream, and two small PEM wetlands would be unreasonably expensive.
			Direct Pipe	835	0	N	22	7	0	N	Y	$6,680,000		
Norfolk	I-119	S-OO1, W-MM3	Dry-Ditch Open-Cut	59	-	N	35	20	10	N	N	$58,931	Dry-Ditch Open-Cut	The open cut method would result in a temporary impact to a small intermittent UNT to Little Cherrystone Creek and an adjacent PSS wetland. Avoiding/minimizing this minor impact through a conventional bore would require a relatively deep bore pit of nearly 30 feet, with equipment operating within a bore pit at the edge of short but steep slope, as well as more than quadrupling the duration of the crossing and the relevant greenhouse gas emissions. The open cut method would reduce the construction duration near multiple private drinking water wells on the property. Lastly, using a conventional bore crossing method to avoid/minimize this minor temporary impact would be unreasonably expensive.
			Conventional Bore	59	27	N	35	20	10	N	N	$414,078		
Norfolk	I-120	S-OO2	Dry-Ditch Open-Cut	37	-	N	40	22	0	N	Y	$44,417	Dry-Ditch Open-Cut	The open cut method would result in a temporary impact to a small intermittent UNT to Little Cherrystone Creek. Avoiding/minimizing this minor impact through a conventional bore would require a relatively deep bore pit exceeding 30 feet with an excavator operating from a bench within the pit, at the edge of short but steep slope, and more than double the duration of the crossing. Furthermore, using a conventional bore crossing method to avoid/minimize this minor temporary impact would be unreasonably expensive.
			Conventional Bore	37	31	N	40	22	0	N	Y	$671,356		
Norfolk	I-121	S-EF26, W-IJ22-PFO, W-IJ22-PEM	Dry-Ditch Open-Cut	405	-	N	18	9	0	N	Y	$357,812	Conventional Bore	There are no significant constraints on available crossing methods or significant environmental impacts relevant to the available methods. The direct aquatic impact will be avoided/minimized by use of the conventional bore method. A minor temporary impact associated with the bore to maintain access will be required.
			Conventional Bore	405	19	N	18	9	0	N	Y	$1,236,163		

Table 15. Crossing Method Determination Summary
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USACE District	Crossing #	Waterbody	Crossing Methods Evaluated	Evaluation Factors									Proposed Crossing Method	Crossing Method Decision Rationale
				Crossing Length	Pit Depth	Deep Stream	Maximum Steep Slope (%)	Maximum Average Slope (%)	Maximum Winch Hill Length (feet)	Karst Terrain Present	Sufficient Stockpile Storage Available	Total Cost ($)		
Norfolk	I-122	S-H44	Dry-Ditch Open-Cut	68	-	N	10	8	0	N	Y	$87,003	Conventional Bore	There are no significant constraints on available crossing methods or significant environmental impacts relevant to the available methods. The direct aquatic impact will be avoided/minimized by use of the conventional bore method. A minor temporary impact associated with the bore to maintain access will be required.
			Conventional Bore	68	17	N	10	8	0	N	Y	$270,628		
Norfolk	I-123	S-H42	Dry-Ditch Open-Cut	43	-	N	20	8	0	N	Y	$68,600	Conventional Bore	There are no significant constraints on available crossing methods or significant environmental impacts relevant to the available methods. The direct aquatic impact will be avoided/minimized by use of the conventional bore method. A minor temporary impact associated with the bore to maintain access will be required.
			Conventional Bore	43	23	N	20	8	0	N	Y	$332,131		
Norfolk	I-124	W-EF6	Dry-Ditch Open-Cut	155	-	N	5	3	30	N	N	$108,500	Dry-Ditch Open-Cut	To protect the integrity of the pipeline coating, woody vegetation cannot be allowed to grow close to the pipe. In forested wetlands, a 30-foot corridor generally must be maintained free of trees. Accordingly, conversion impacts to this wetland are unavoidable. The conventional bore method also entails significant environmental consequences at this location. This crossing is in close proximity to a residence, and a trenchless crossing of this location would take nearly four weeks to complete -- compounding the noise, aesthetic, and other impacts on nearby residents. The longer-duration bore also nearly quadruples the greenhouse gas emissions associated with the crossing.
			Conventional Bore	155	13	N	5	3	30	N	N	$499,263		