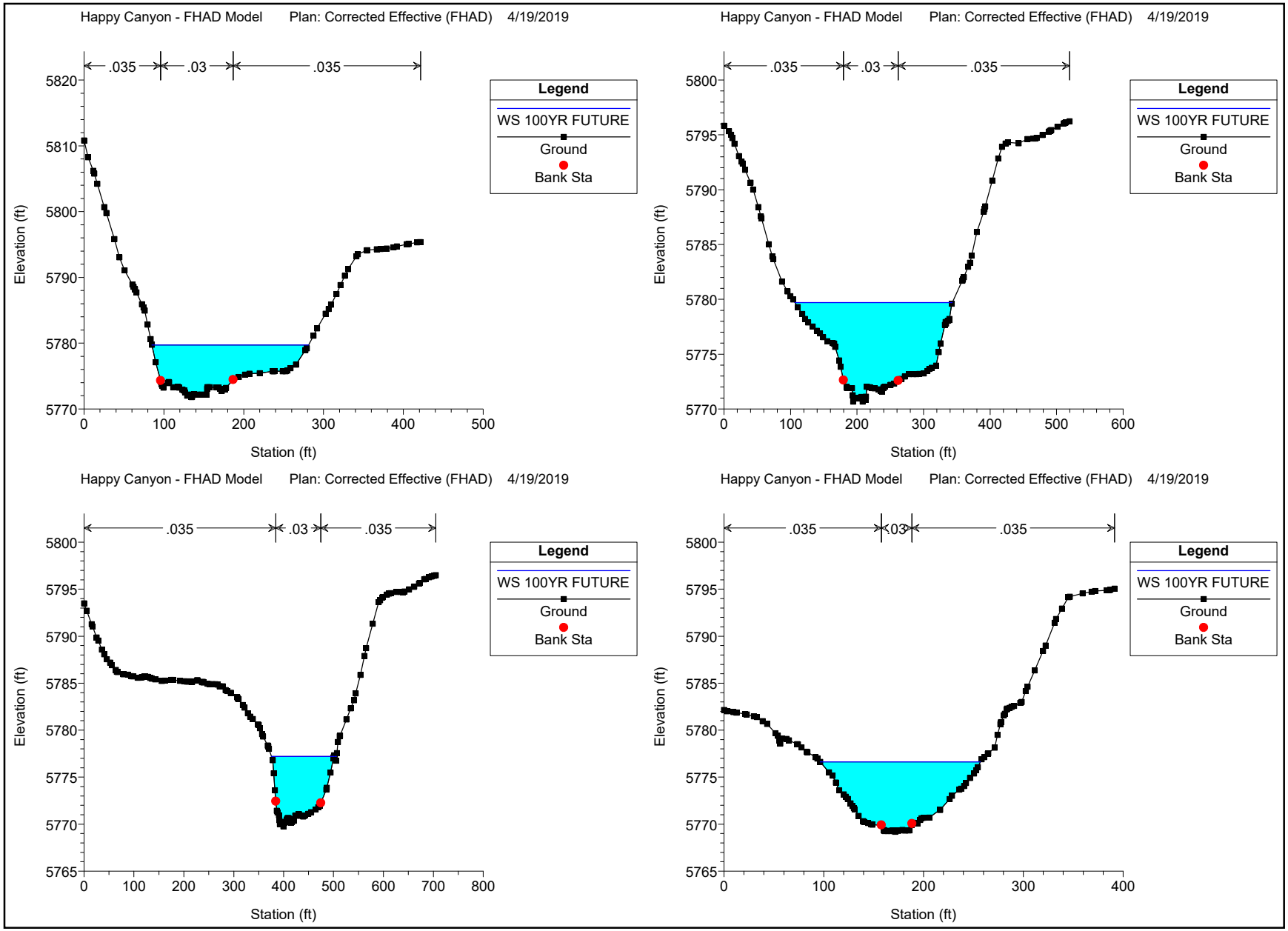
Happy Canyon - FHAD Model Plan: Corrected Effective (FHAD) 4/19/2019
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Legend
WS 100YR FUTURE
Ground
Bank Sta
Elevation (ft)
Station (ft)
5820
5810
5800
5790
5780
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100
200
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400
500
Happy Canyon - FHAD Model Plan: Corrected Effective (FHAD) 4/19/2019
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Legend
WS 100YR FUTURE
Ground
Bank Sta
Elevation (ft)
Station (ft)
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Happy Canyon - FHAD Model Plan: Corrected Effective (FHAD) 4/19/2019
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Legend
WS 100YR FUTURE
Ground
Bank Sta
Elevation (ft)
Station (ft)
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Happy Canyon - FHAD Model Plan: Corrected Effective (FHAD) 4/19/2019
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Legend
WS 100YR FUTURE
Ground
Bank Sta
Elevation (ft)
Station (ft)
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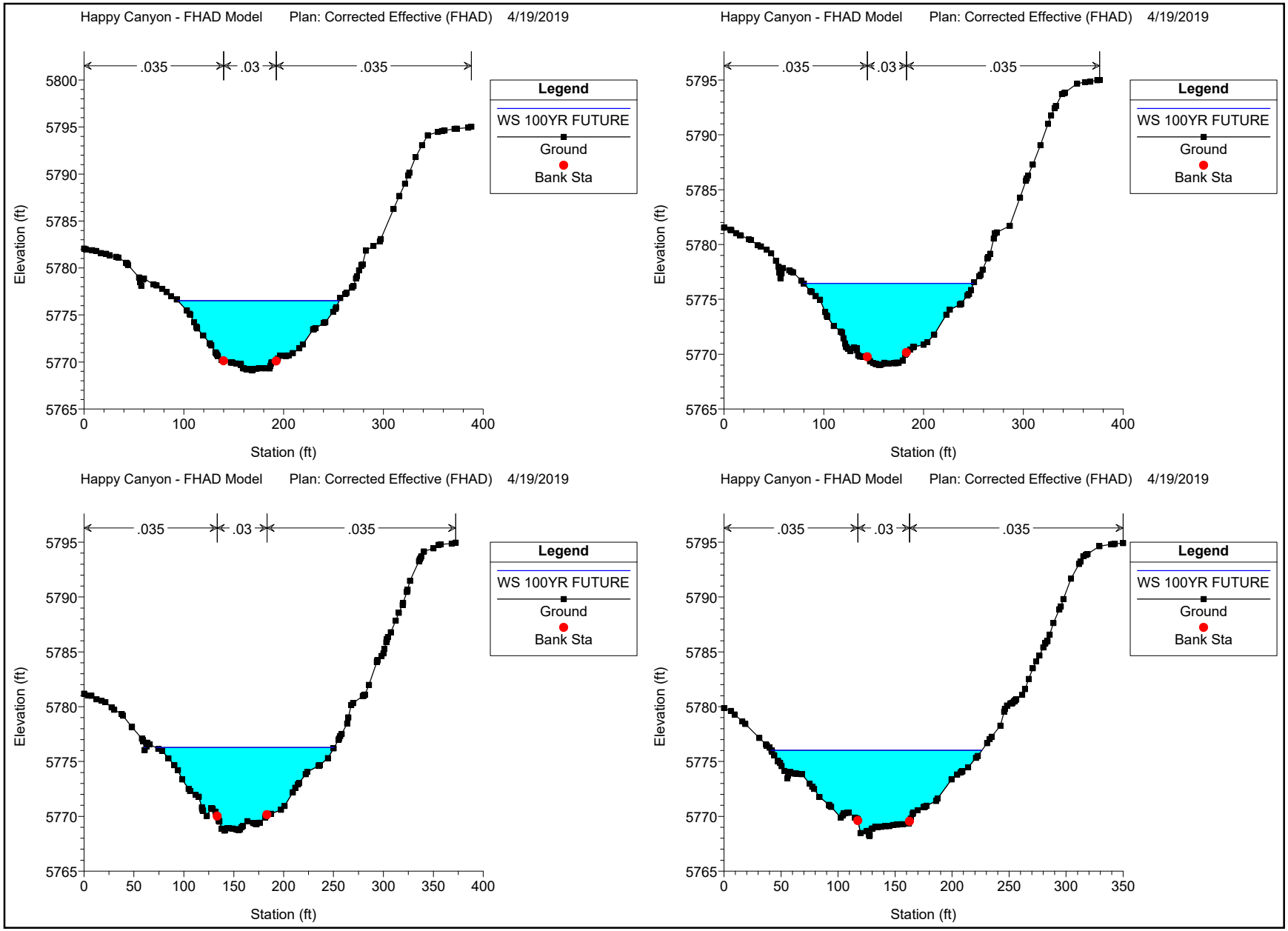
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Legend
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Ground
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Happy Canyon - FHAD Model Plan: Corrected Effective (FHAD) 4/19/2019
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Legend
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Ground
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Happy Canyon - FHAD Model Plan: Corrected Effective (FHAD) 4/19/2019
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Legend
WS 100YR FUTURE
Ground
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Station (ft)
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350
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Happy Canyon - FHAD Model Plan: Corrected Effective (FHAD) 4/19/2019
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Legend
WS 100YR FUTURE
Ground
Bank Sta
Elevation (ft)
Station (ft)
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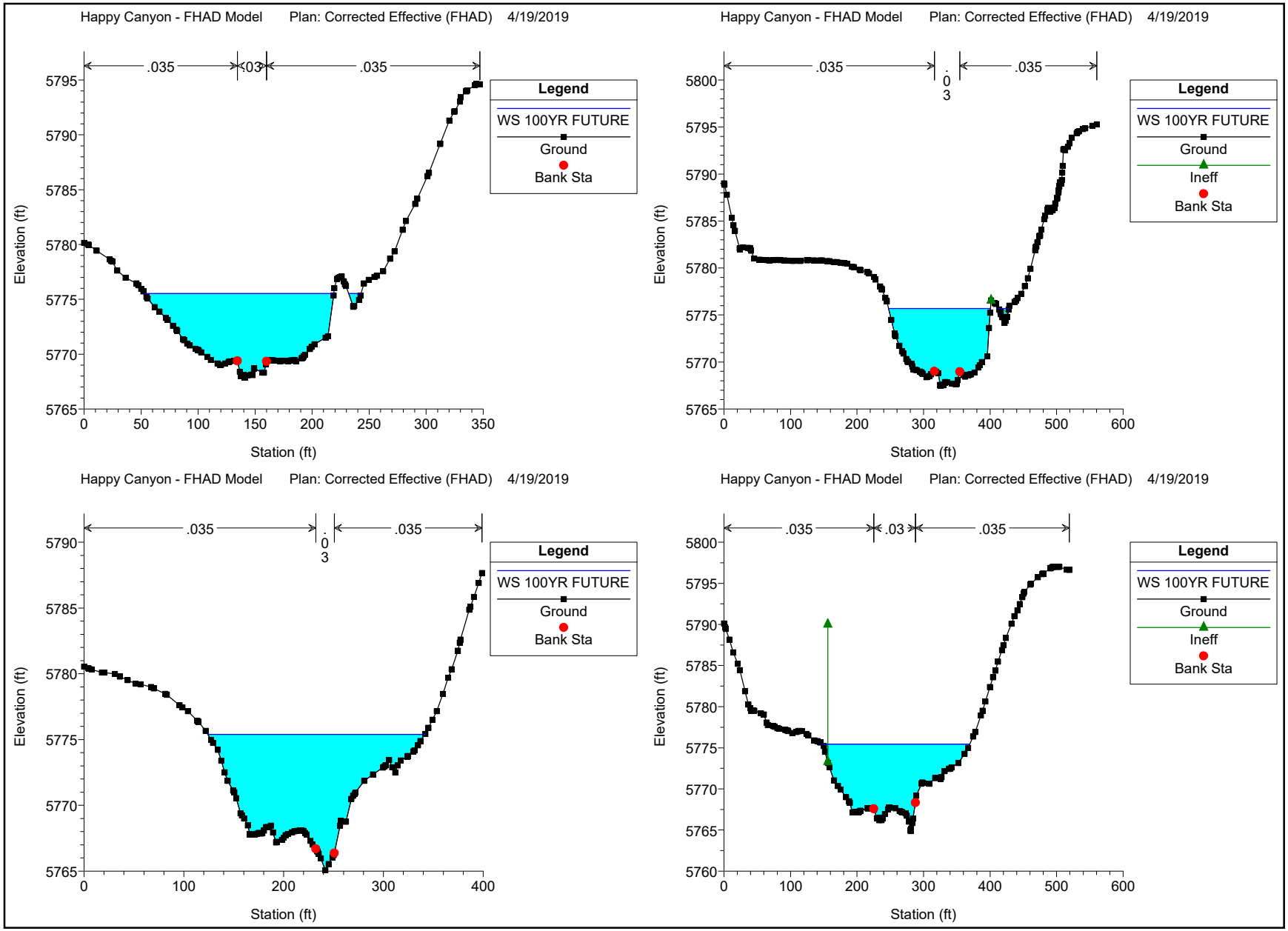
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WS 100YR FUTURE
Ground
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Elevation (ft)
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Happy Canyon - FHAD Model Plan: Corrected Effective (FHAD) 4/19/2019
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Legend
WS 100YR FUTURE
Ground
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Bank Sta
Elevation (ft)
Station (ft)
Happy Canyon - FHAD Model Plan: Corrected Effective (FHAD) 4/19/2019
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Legend
WS 100YR FUTURE
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Elevation (ft)
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Happy Canyon - FHAD Model Plan: Corrected Effective (FHAD) 4/19/2019
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Legend
WS 100YR FUTURE
Ground
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Elevation (ft)
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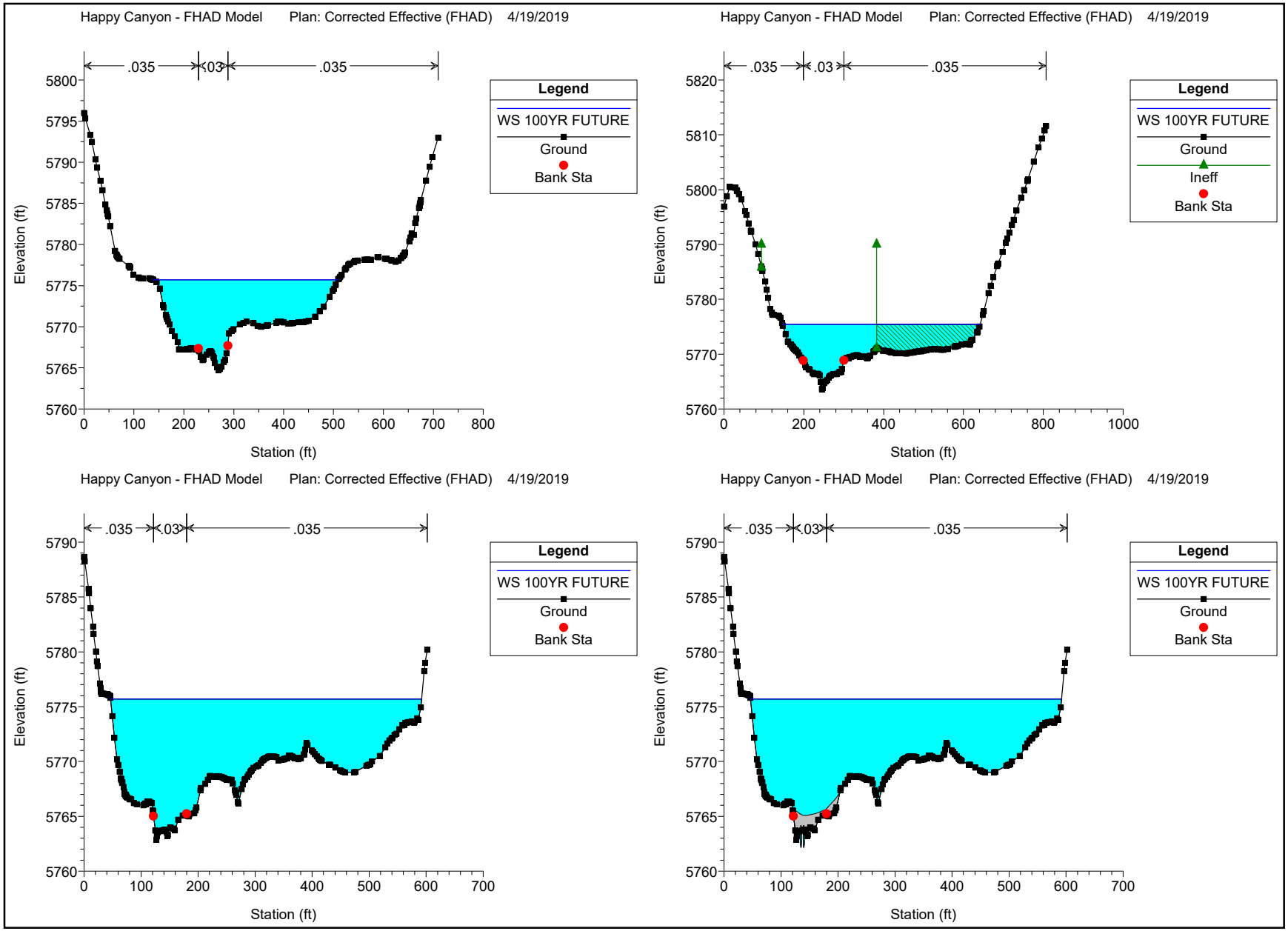
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Happy Canyon - FHAD Model Plan: Corrected Effective (FHAD) 4/19/2019
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Legend
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Happy Canyon - FHAD Model Plan: Corrected Effective (FHAD) 4/19/2019
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Legend
WS 100YR FUTURE
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Elevation (ft)
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Happy Canyon - FHAD Model Plan: Corrected Effective (FHAD) 4/19/2019
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Legend
WS 100YR FUTURE
Ground
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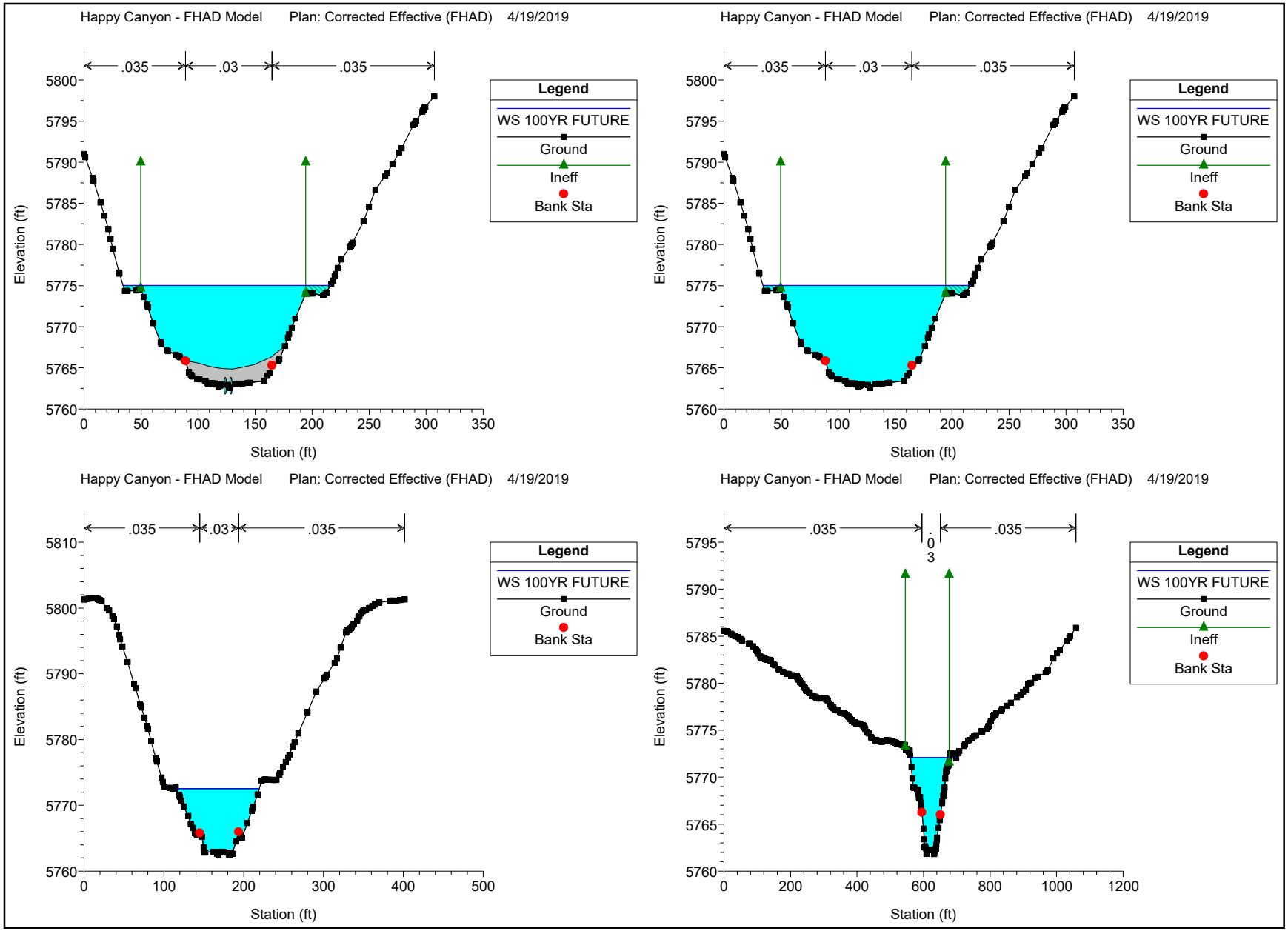
Elevation (ft)
Station (ft)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Happy Canyon - FHAD Model Plan: Corrected Effective (FHAD) 4/19/2019
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Legend
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Happy Canyon - FHAD Model Plan: Corrected Effective (FHAD) 4/19/2019
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Happy Canyon - FHAD Model Plan: Corrected Effective (FHAD) 4/19/2019
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WS 100YR FUTURE
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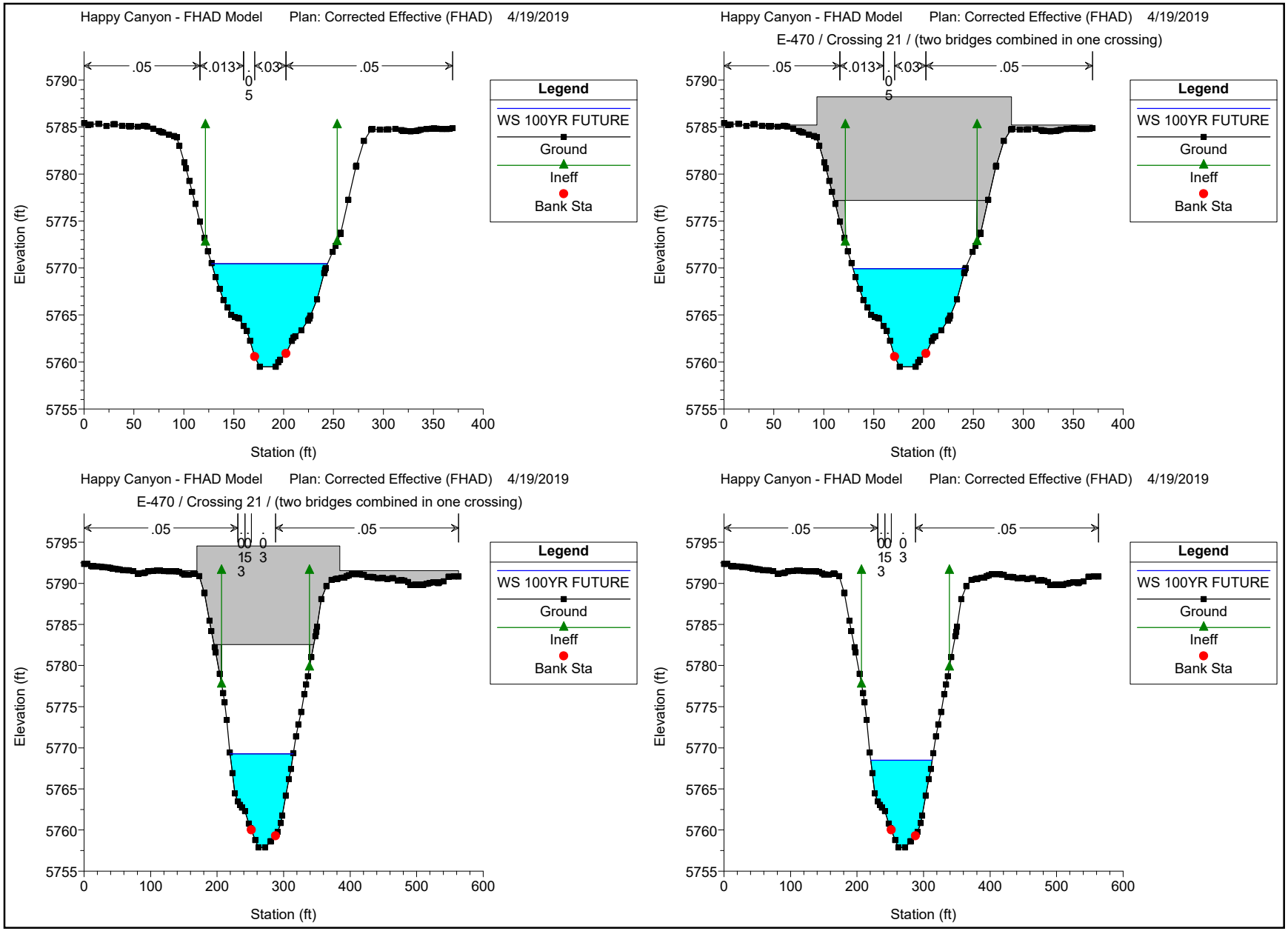
Elevation (ft)
Station (ft)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Legend
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Ground
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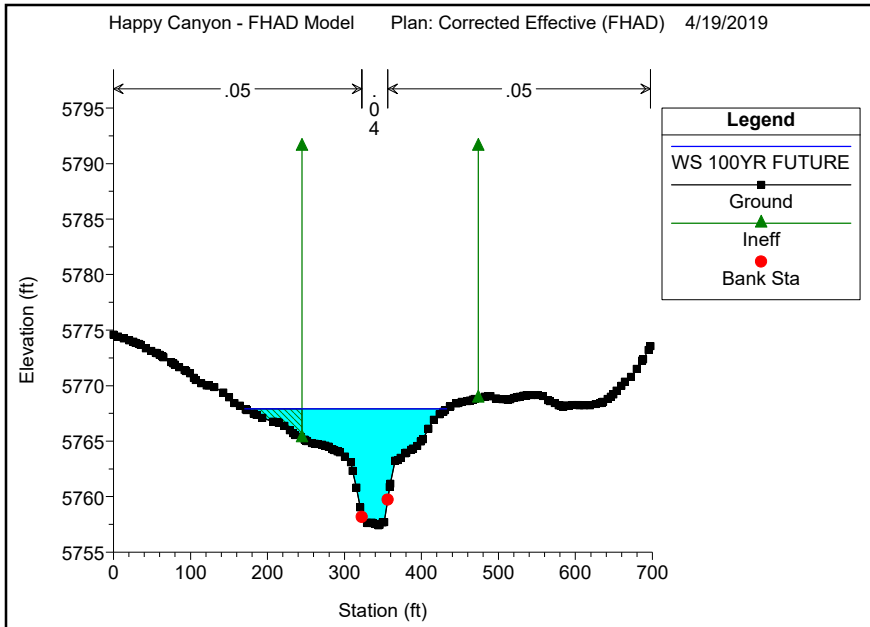
Elevation (ft)
Station (ft)
Happy Canyon - FHAD Model Plan: Corrected Effective (FHAD) 4/19/2019
E-470 / Crossing 21 / (two bridges combined in one crossing)
Happy Canyon - FHAD Model Plan: Corrected Effective (FHAD) 4/19/2019
E-470 / Crossing 21 / (two bridges combined in one crossing)
Happy Canyon - FHAD Model Plan: Corrected Effective (FHAD) 4/19/2019


Happy Canyon - FHAD Model Plan: Corrected Effective (FHAD) 4/19/2019
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Legend
WS 100YR FUTURE
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
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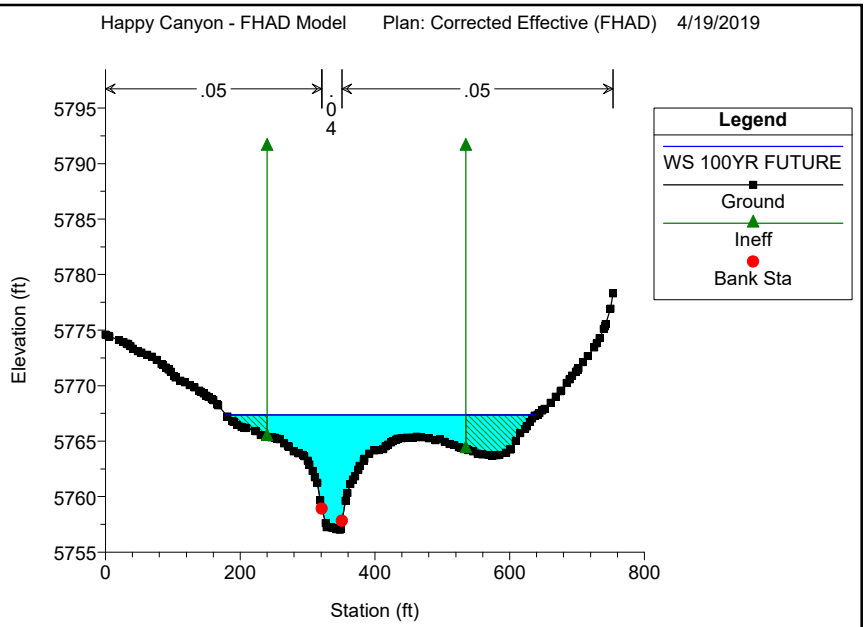
Happy Canyon - FHAD Model Plan: Corrected Effective (FHAD) 4/19/2019
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Legend
WS 100YR FUTURE
Ground
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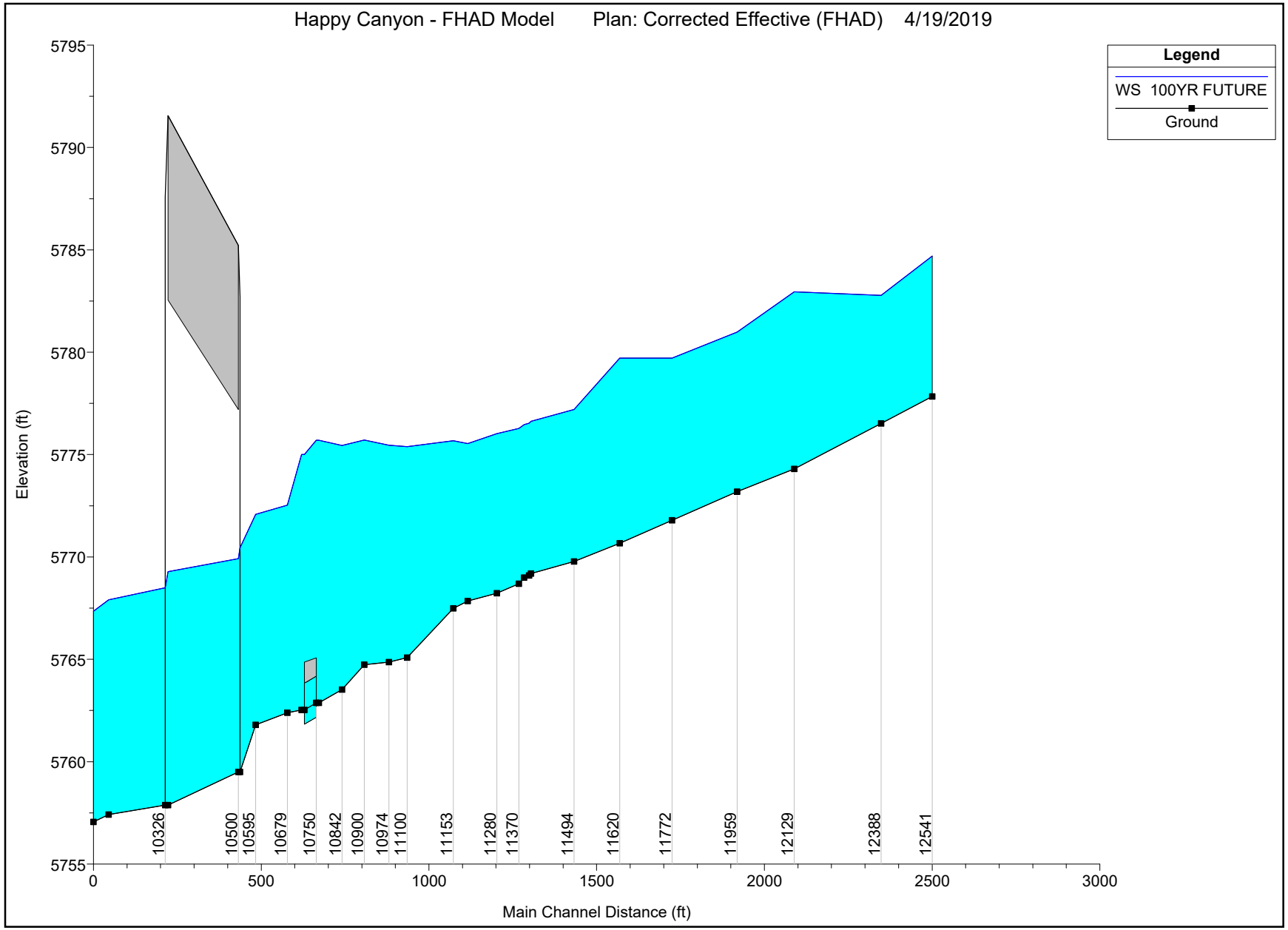
Happy Canyon - FHAD Model Plan: Corrected Effective (FHAD) 4/19/2019
Legend
WS 100YR FUTURE
Ground
Elevation (ft)
5795
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5770
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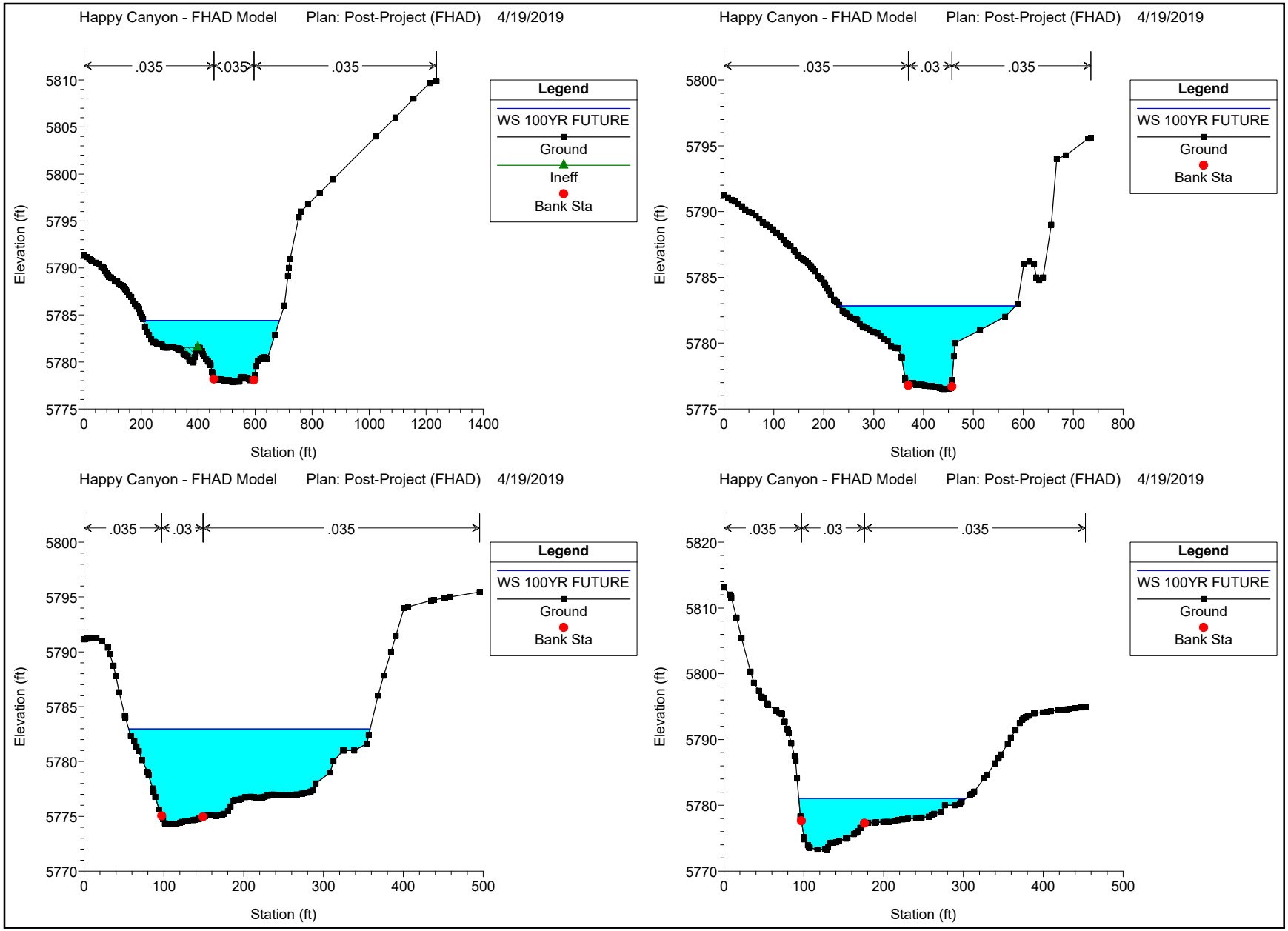
5760
5755
0
500
1000
1500
2000
2500
3000
Main Channel Distance (ft)
10326
10500
10595
10679
10750
10842
10900
10974
11100
11153
11280
11370
11494
11620
11772
11959
12129
12388
12541

HEC-RAS Plan: Corr Eff FHAD River: HCC Reach: Mainstem_1 Profile: 100YR FUTURE

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Mainstem_1	10111	100YR FUTURE	8475.00	5757.06	5767.35	5767.31	5768.88	0.006178	13.40	1168.60	459.21	0.75
Mainstem_1	10157	100YR FUTURE	8475.00	5757.42	5767.91	5767.91	5770.22	0.007552	14.95	896.55	262.44	0.83
Mainstem_1	10326	100YR FUTURE	8475.00	5757.88	5768.49	5768.07	5771.59	0.004442	15.25	661.44	92.27	0.85
Mainstem_1	10500		Bridge									
Mainstem_1	10548	100YR FUTURE	8475.00	5759.50	5770.45	5769.53	5772.81	0.003237	13.54	785.63	116.03	0.73
Mainstem_1	10595	100YR FUTURE	8475.00	5761.80	5772.08	5772.08	5775.01	0.004819	14.58	691.00	120.73	0.86
Mainstem_1	10679	100YR FUTURE	8475.00	5762.39	5772.53	5772.19	5775.47	0.004940	14.96	681.19	103.80	0.87
Mainstem_1	10725	100YR FUTURE	8355.00	5762.52	5775.00	5770.36	5775.76	0.000892	7.53	1298.48	181.53	0.39
Mainstem_1	10750		Culvert									
Mainstem_1	10775	100YR FUTURE	8303.00	5762.88	5775.70	5770.43	5775.79	0.000189	3.46	3698.02	545.42	0.18
Mainstem_1	10842	100YR FUTURE	8303.00	5763.53	5775.45		5775.94	0.000856	6.25	1603.77	494.99	0.37
Mainstem_1	10900	100YR FUTURE	8303.00	5764.74	5775.71		5776.01	0.000654	5.67	2152.75	371.46	0.32
Mainstem_1	10974	100YR FUTURE	8303.00	5764.87	5775.46		5776.25	0.001660	8.28	1274.59	222.58	0.50
Mainstem_1	11100	100YR FUTURE	8303.00	5765.08	5775.39		5776.46	0.002758	11.61	1127.33	217.59	0.66
Mainstem_1	11153	100YR FUTURE	8303.00	5767.48	5775.68		5777.04	0.003473	11.28	936.91	168.37	0.72
Mainstem_1	11180	100YR FUTURE	8303.00	5767.85	5775.53	5775.01	5777.27	0.005718	13.68	840.37	176.75	0.90
Mainstem_1	11280	100YR FUTURE	8303.00	5768.23	5776.02	5776.02	5778.17	0.006284	14.27	805.38	184.56	0.95
Mainstem_1	11370	100YR FUTURE	8303.00	5768.69	5776.28	5776.27	5778.64	0.006437	14.56	775.99	180.31	0.97
Mainstem_1	11385	100YR FUTURE	8303.00	5768.99	5776.46	5776.46	5778.77	0.006665	15.04	771.76	170.31	0.99
Mainstem_1	11400	100YR FUTURE	8303.00	5769.10	5776.53	5776.48	5778.89	0.006314	14.30	756.05	161.82	0.96
Mainstem_1	11410	100YR FUTURE	8303.00	5769.19	5776.63	5776.60	5778.93	0.007012	15.50	756.77	160.54	1.01
Mainstem_1	11494	100YR FUTURE	8303.00	5769.78	5777.21	5777.12	5779.91	0.006538	13.58	660.90	129.09	0.95
Mainstem_1	11620	100YR FUTURE	8303.00	5770.67	5779.71		5780.50	0.001693	8.07	1295.90	236.61	0.50
Mainstem_1	11772	100YR FUTURE	8303.00	5771.79	5779.72		5781.00	0.003280	10.00	993.99	196.28	0.68
Mainstem_1	11959	100YR FUTURE	8303.00	5773.19	5780.98	5780.98	5782.96	0.005533	12.49	841.30	208.60	0.87
Mainstem_1	12129	100YR FUTURE	8303.00	5774.30	5782.95		5783.33	0.000947	6.30	1799.65	302.44	0.38
Mainstem_1	12388	100YR FUTURE	8303.00	5776.52	5782.78	5782.78	5784.62	0.005354	12.04	884.78	242.38	0.86
Mainstem_1	12541	100YR FUTURE	8303.00	5777.84	5784.70		5785.04	0.000999	5.51	2025.70	483.55	0.38

APPENDIX E. POST-PROJECT MODEL (HEC-RAS MODEL)


Happy Canyon - FHAD Model Plan: Post-Project (FHAD) 4/19/2019
.035
.035
.035
Legend
WS 100YR FUTURE
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
Happy Canyon - FHAD Model Plan: Post-Project (FHAD) 4/19/2019
.035
.03
.035
Legend
WS 100YR FUTURE
Ground
Bank Sta
Elevation (ft)
Station (ft)
Happy Canyon - FHAD Model Plan: Post-Project (FHAD) 4/19/2019
.035
.03
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Legend
WS 100YR FUTURE
Ground
Bank Sta
Elevation (ft)
Station (ft)
Happy Canyon - FHAD Model Plan: Post-Project (FHAD) 4/19/2019
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.03
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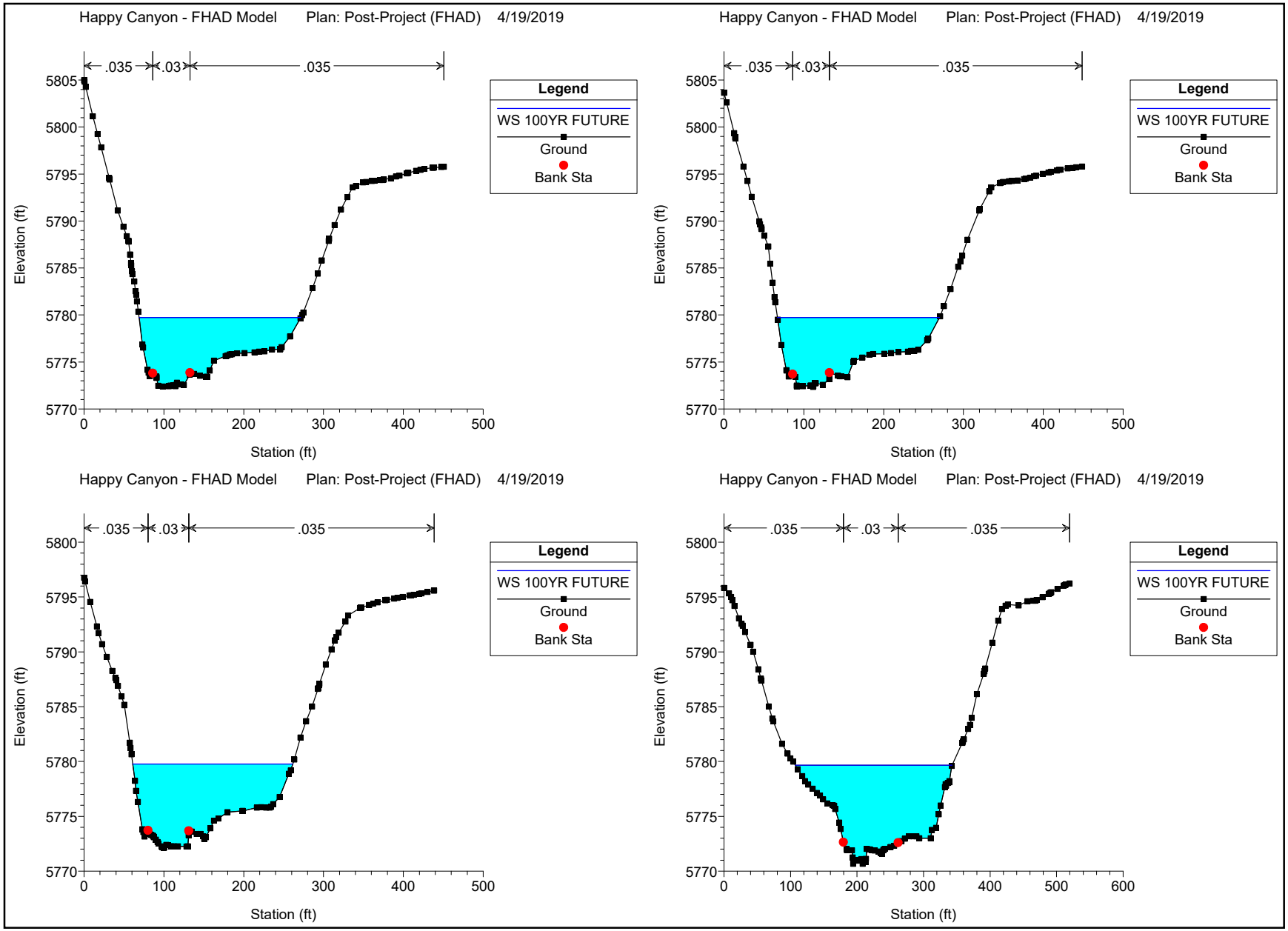
Legend
WS 100YR FUTURE
Ground
Bank Sta
Elevation (ft)
Station (ft)


Happy Canyon - FHAD Model Plan: Post-Project (FHAD) 4/19/2019
.035
.03
.035
Legend
WS 100YR FUTURE
Ground
Bank Sta
Elevation (ft)
Station (ft)
5805
5800
5795
5790
5785
5780
5775
5770
0
100
200
300
400
500
Happy Canyon - FHAD Model Plan: Post-Project (FHAD) 4/19/2019
.035
.03
.035
Legend
WS 100YR FUTURE
Ground
Bank Sta
Elevation (ft)
Station (ft)
5805
5800
5795
5790
5785
5780
5775
5770
0
100
200
300
400
500
Happy Canyon - FHAD Model Plan: Post-Project (FHAD) 4/19/2019
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.03
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Legend
WS 100YR FUTURE
Ground
Bank Sta
Elevation (ft)
Station (ft)
5800
5795
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400
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Happy Canyon - FHAD Model Plan: Post-Project (FHAD) 4/19/2019
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Legend
WS 100YR FUTURE
Ground
Bank Sta
Elevation (ft)
Station (ft)
5800
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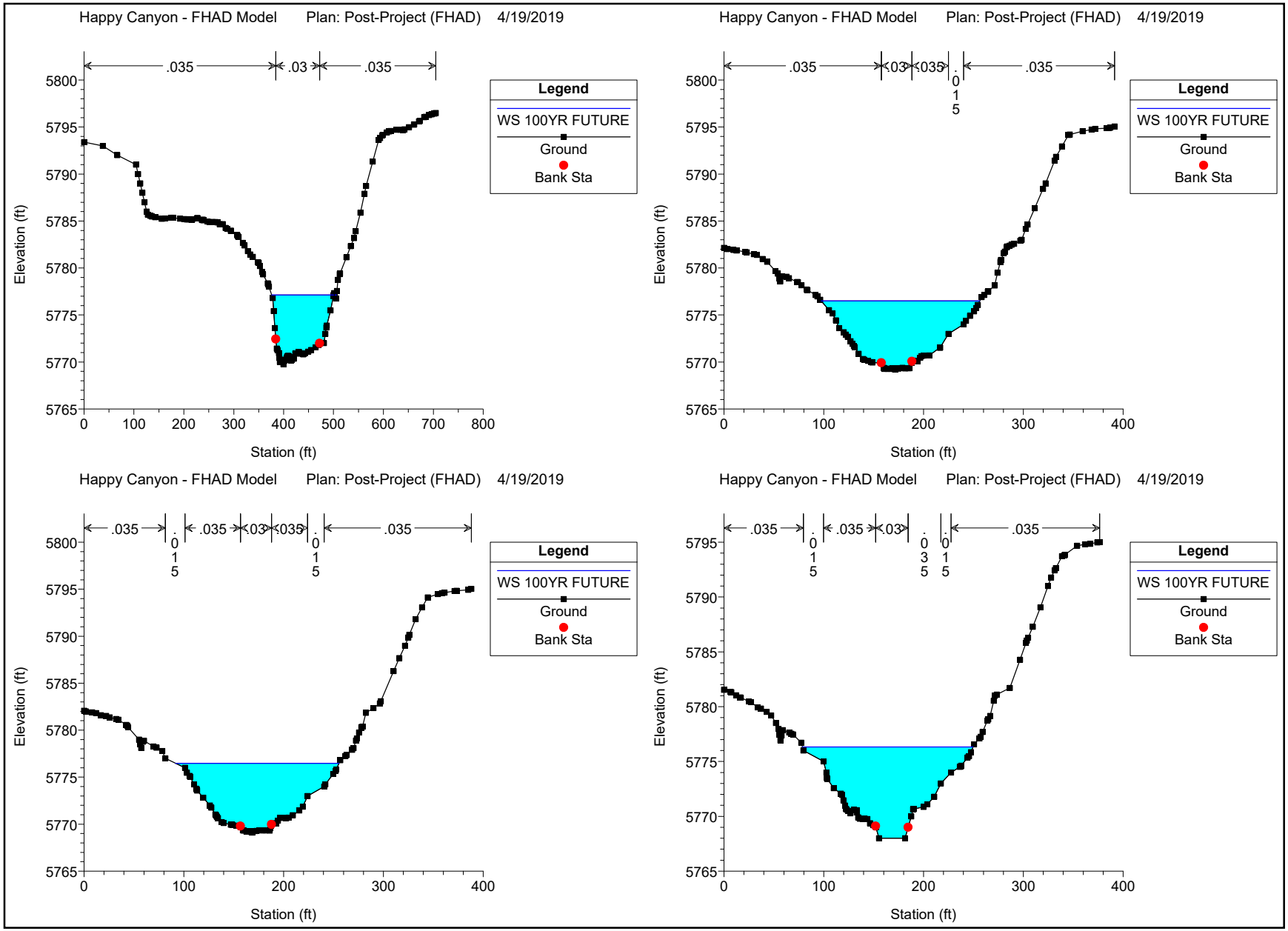
Happy Canyon - FHAD Model Plan: Post-Project (FHAD) 4/19/2019
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Legend
WS 100YR FUTURE
Ground
Bank Sta
Elevation (ft)
Station (ft)
Happy Canyon - FHAD Model Plan: Post-Project (FHAD) 4/19/2019
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Legend
WS 100YR FUTURE
Ground
Bank Sta
Elevation (ft)
Station (ft)
Happy Canyon - FHAD Model Plan: Post-Project (FHAD) 4/19/2019
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Legend
WS 100YR FUTURE
Ground
Bank Sta
Elevation (ft)
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Happy Canyon - FHAD Model Plan: Post-Project (FHAD) 4/19/2019
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Legend
WS 100YR FUTURE
Ground
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Elevation (ft)
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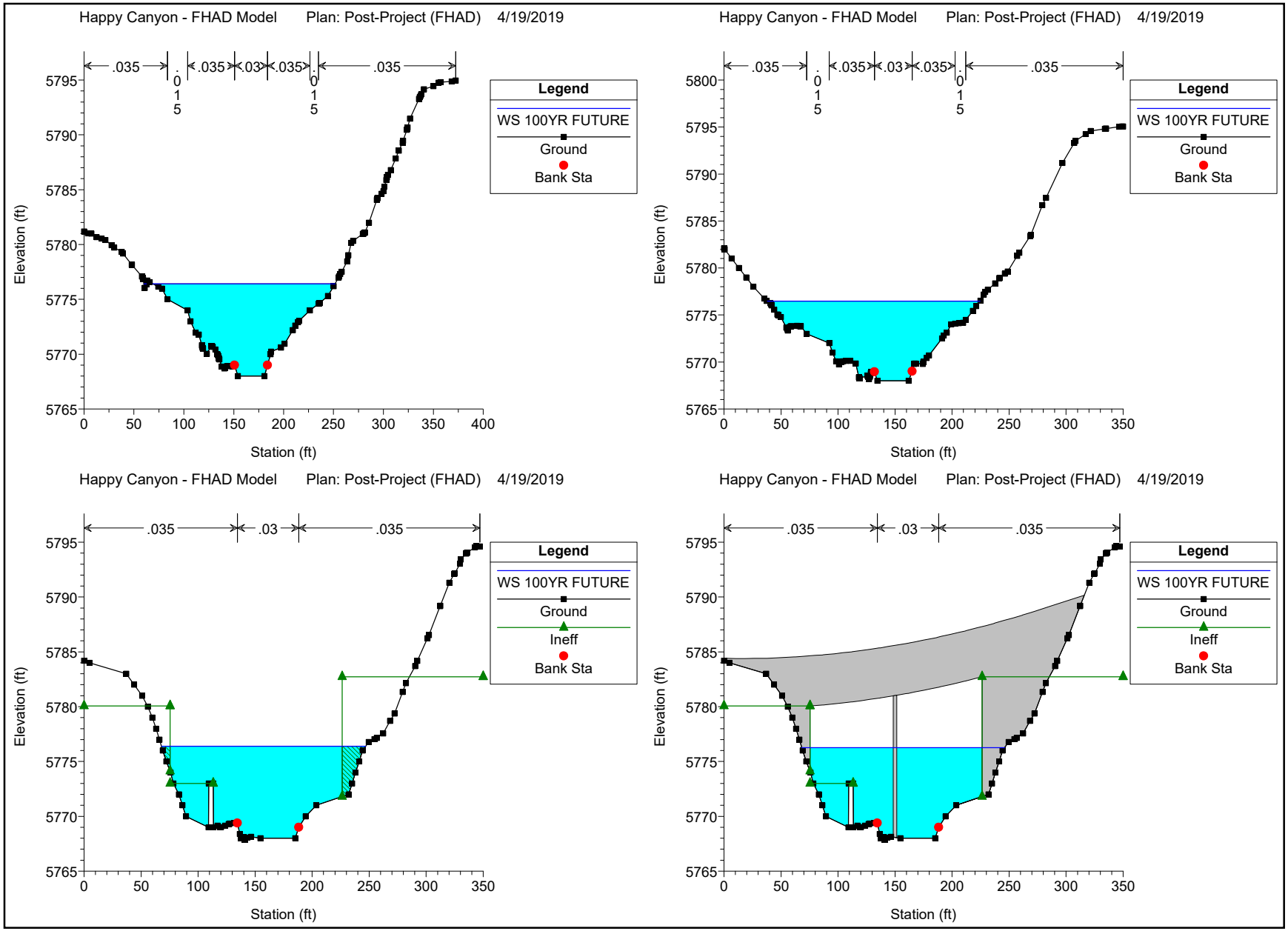
Happy Canyon - FHAD Model Plan: Post-Project (FHAD) 4/19/2019
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Legend
WS 100YR FUTURE
Ground
Bank Sta
Elevation (ft)
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Happy Canyon - FHAD Model Plan: Post-Project (FHAD) 4/19/2019
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Legend
WS 100YR FUTURE
Ground
Bank Sta
Elevation (ft)
Station (ft)
Happy Canyon - FHAD Model Plan: Post-Project (FHAD) 4/19/2019
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Legend
WS 100YR FUTURE
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
Happy Canyon - FHAD Model Plan: Post-Project (FHAD) 4/19/2019
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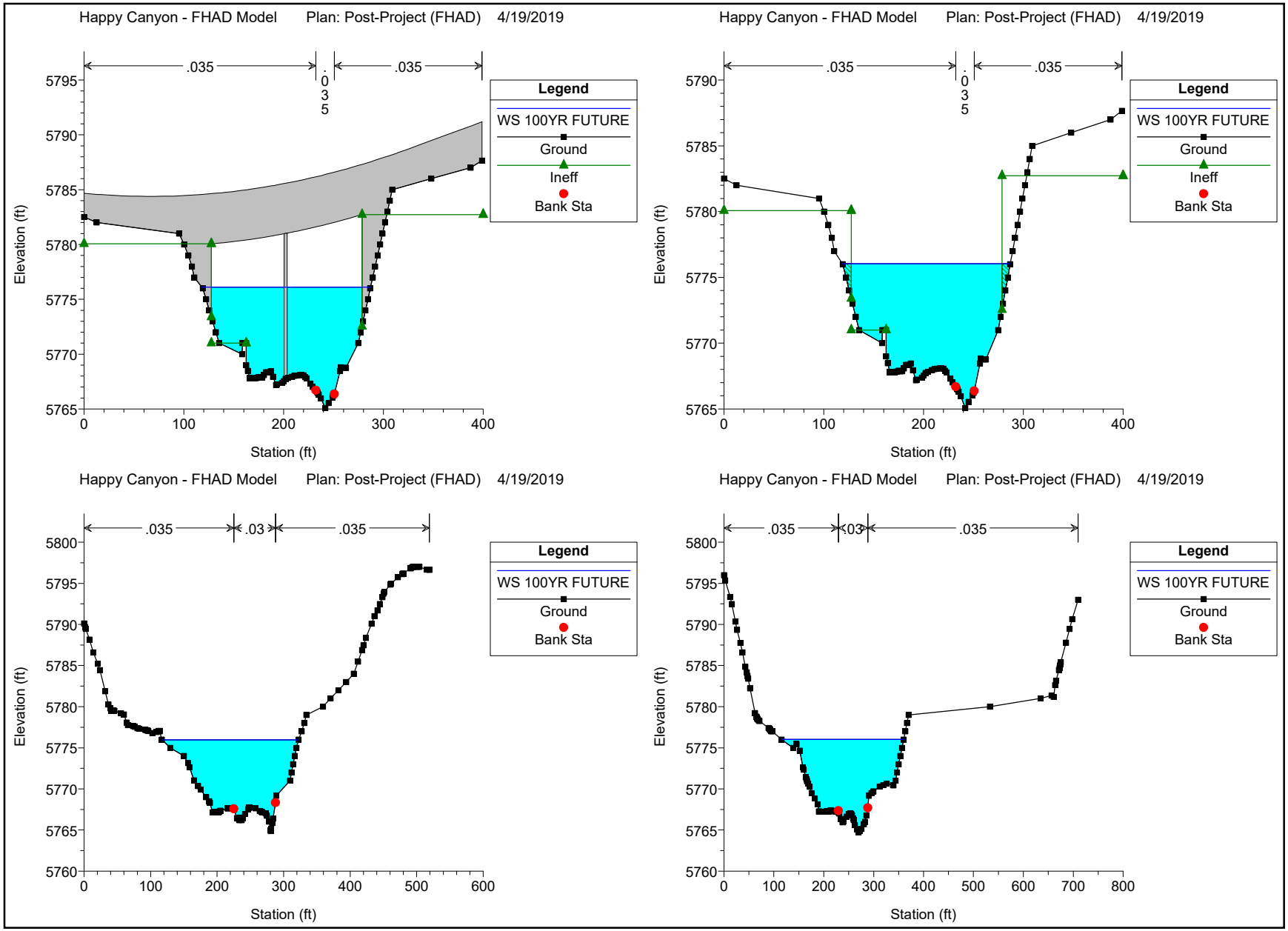
Legend
WS 100YR FUTURE
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)


Happy Canyon - FHAD Model Plan: Post-Project (FHAD) 4/19/2019
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Legend
WS 100YR FUTURE
Ground
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Bank Sta
Elevation (ft)
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Happy Canyon - FHAD Model Plan: Post-Project (FHAD) 4/19/2019
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Legend
WS 100YR FUTURE
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
Happy Canyon - FHAD Model Plan: Post-Project (FHAD) 4/19/2019
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Legend
WS 100YR FUTURE
Ground
Bank Sta
Elevation (ft)
Station (ft)
Happy Canyon - FHAD Model Plan: Post-Project (FHAD) 4/19/2019
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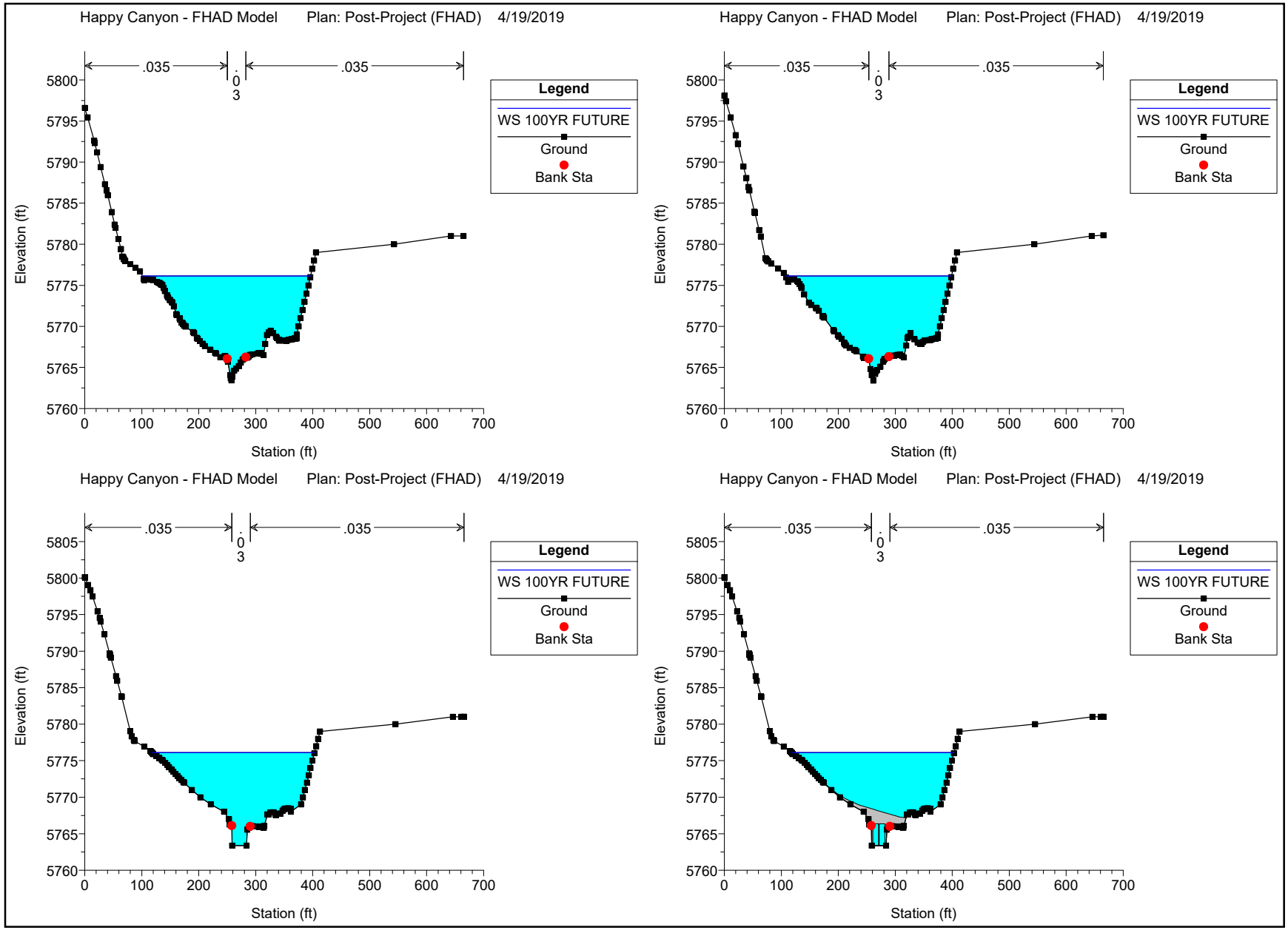
Legend
WS 100YR FUTURE
Ground
Bank Sta
Elevation (ft)
Station (ft)


Happy Canyon - FHAD Model Plan: Post-Project (FHAD) 4/19/2019
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Legend
WS 100YR FUTURE
Ground
Bank Sta
Elevation (ft)
Station (ft)
Happy Canyon - FHAD Model Plan: Post-Project (FHAD) 4/19/2019
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Legend
WS 100YR FUTURE
Ground
Bank Sta
Elevation (ft)
Station (ft)
Happy Canyon - FHAD Model Plan: Post-Project (FHAD) 4/19/2019
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Legend
WS 100YR FUTURE
Ground
Bank Sta
Elevation (ft)
Station (ft)
Happy Canyon - FHAD Model Plan: Post-Project (FHAD) 4/19/2019
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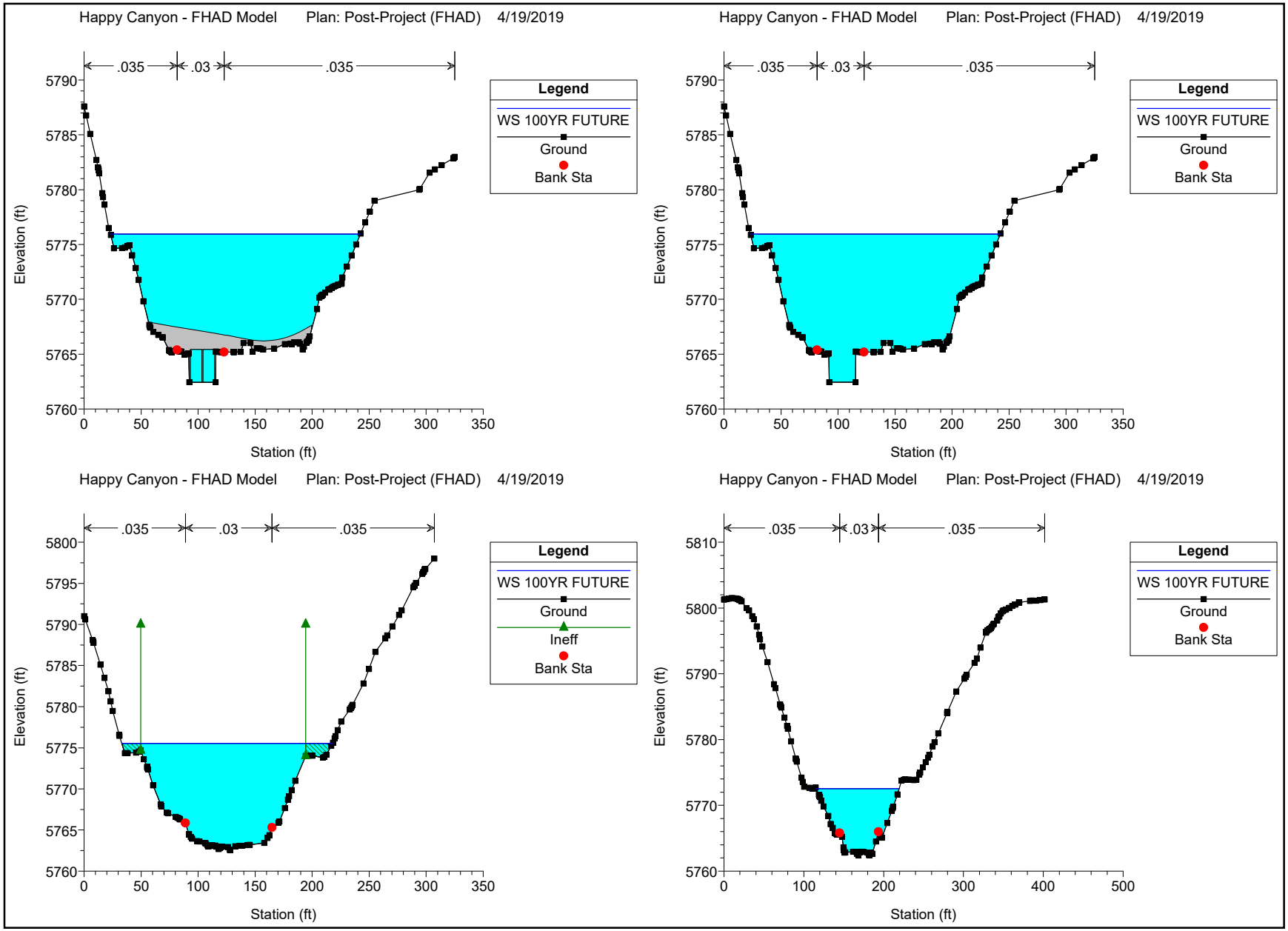
Legend
WS 100YR FUTURE
Ground
Bank Sta
Elevation (ft)
Station (ft)


Happy Canyon - FHAD Model Plan: Post-Project (FHAD) 4/19/2019
.035
.03
.035
Legend
WS 100YR FUTURE
Ground
Bank Sta
Elevation (ft)
Station (ft)
Happy Canyon - FHAD Model Plan: Post-Project (FHAD) 4/19/2019
.035
.03
.035
Legend
WS 100YR FUTURE
Ground
Bank Sta
Elevation (ft)
Station (ft)
Happy Canyon - FHAD Model Plan: Post-Project (FHAD) 4/19/2019
.035
.03
.035
Legend
WS 100YR FUTURE
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
Happy Canyon - FHAD Model Plan: Post-Project (FHAD) 4/19/2019
.035
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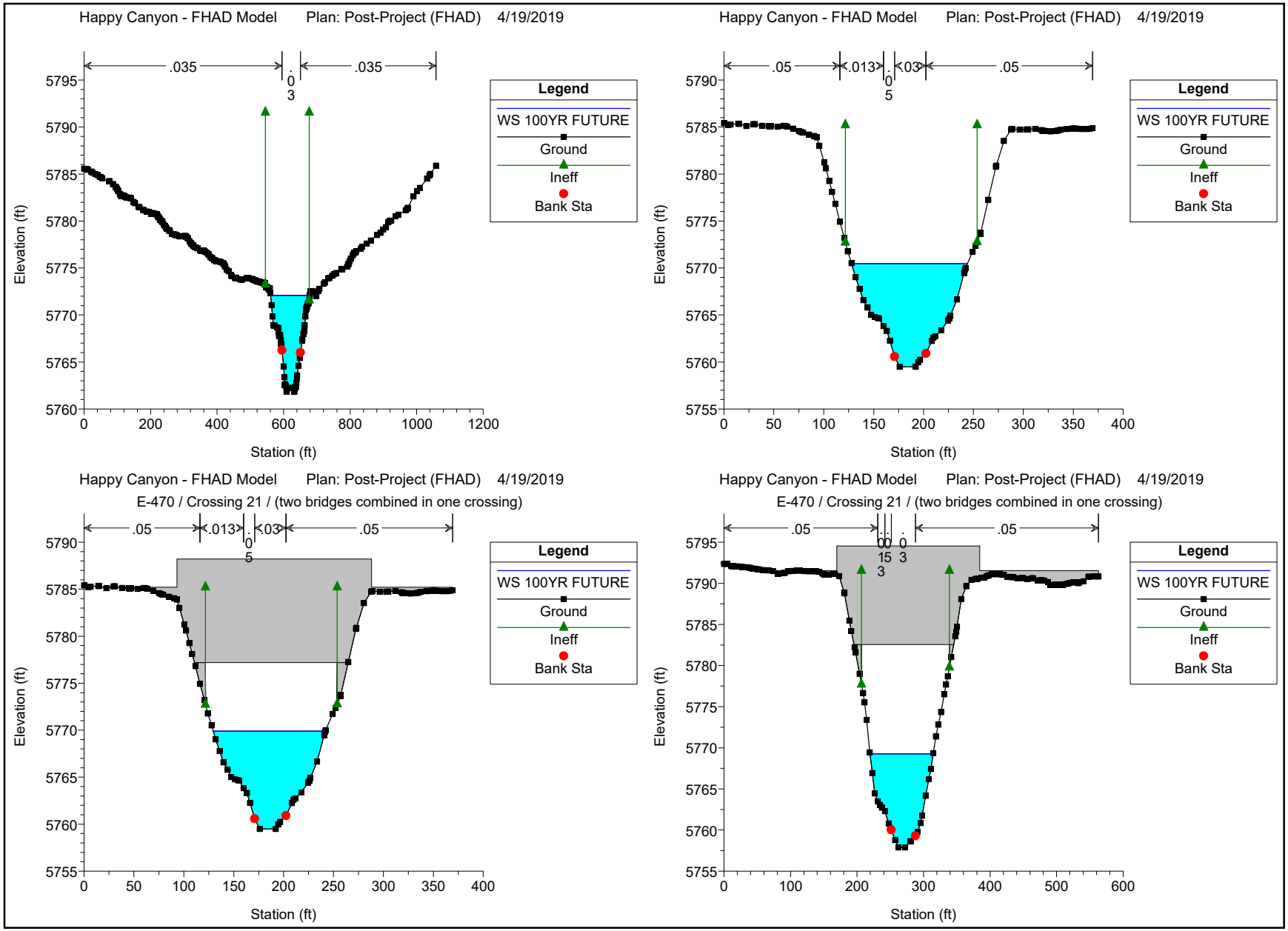
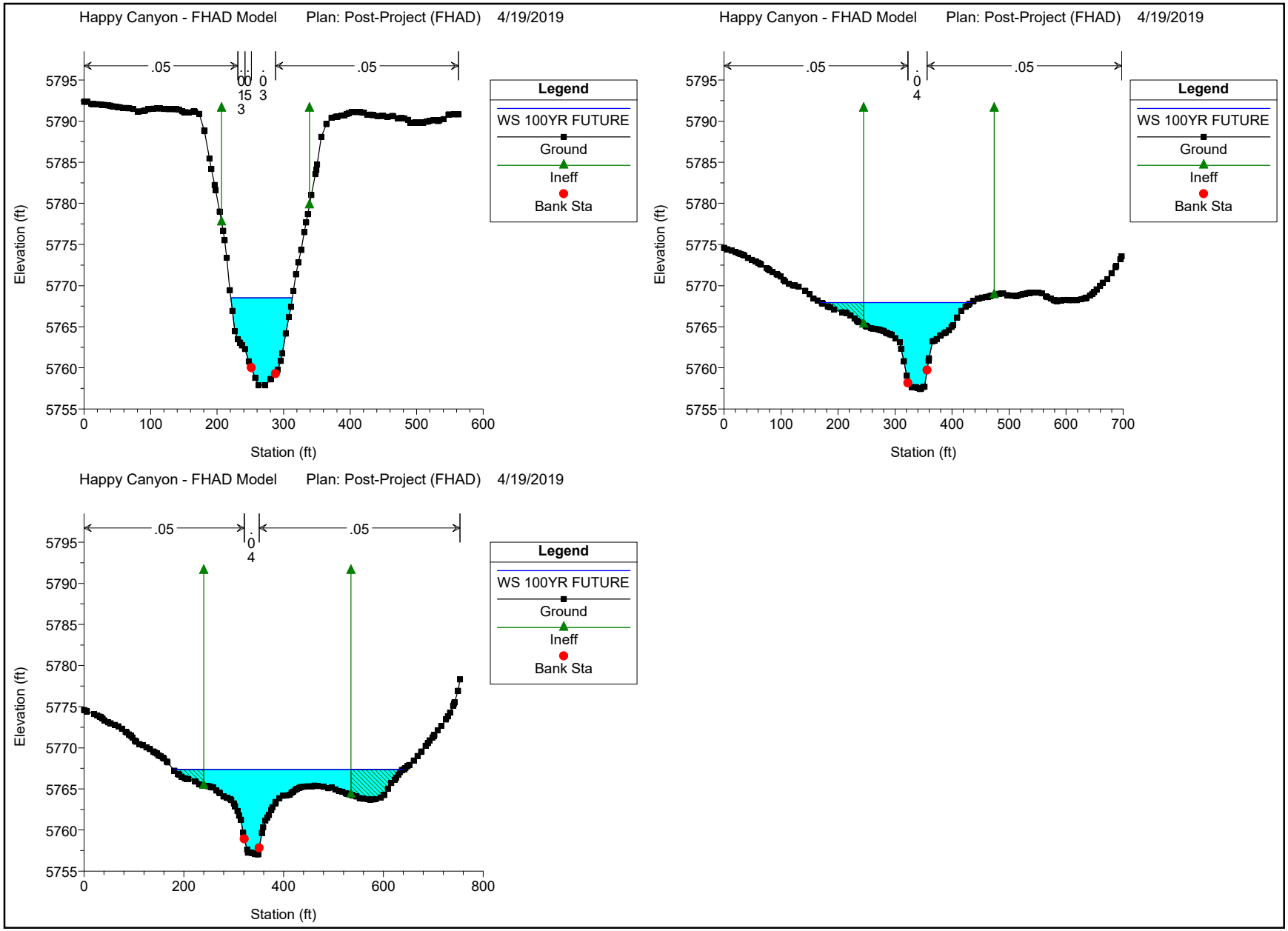
Legend
WS 100YR FUTURE
Ground
Bank Sta
Elevation (ft)
Station (ft)


Happy Canyon - FHAD Model Plan: Post-Project (FHAD) 4/19/2019
.035
.03
.035
Legend
WS 100YR FUTURE
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
Happy Canyon - FHAD Model Plan: Post-Project (FHAD) 4/19/2019
.05
.013
.05
.05
Legend
WS 100YR FUTURE
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
Happy Canyon - FHAD Model Plan: Post-Project (FHAD) 4/19/2019
E-470 / Crossing 21 / (two bridges combined in one crossing)
.05
.013
.05
Legend
WS 100YR FUTURE
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
Happy Canyon - FHAD Model Plan: Post-Project (FHAD) 4/19/2019
E-470 / Crossing 21 / (two bridges combined in one crossing)
.05
.05
Legend
WS 100YR FUTURE
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)


Happy Canyon - FHAD Model Plan: Post-Project (FHAD) 4/19/2019
.05
.05
Legend
WS 100YR FUTURE
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
Happy Canyon - FHAD Model Plan: Post-Project (FHAD) 4/19/2019
.05
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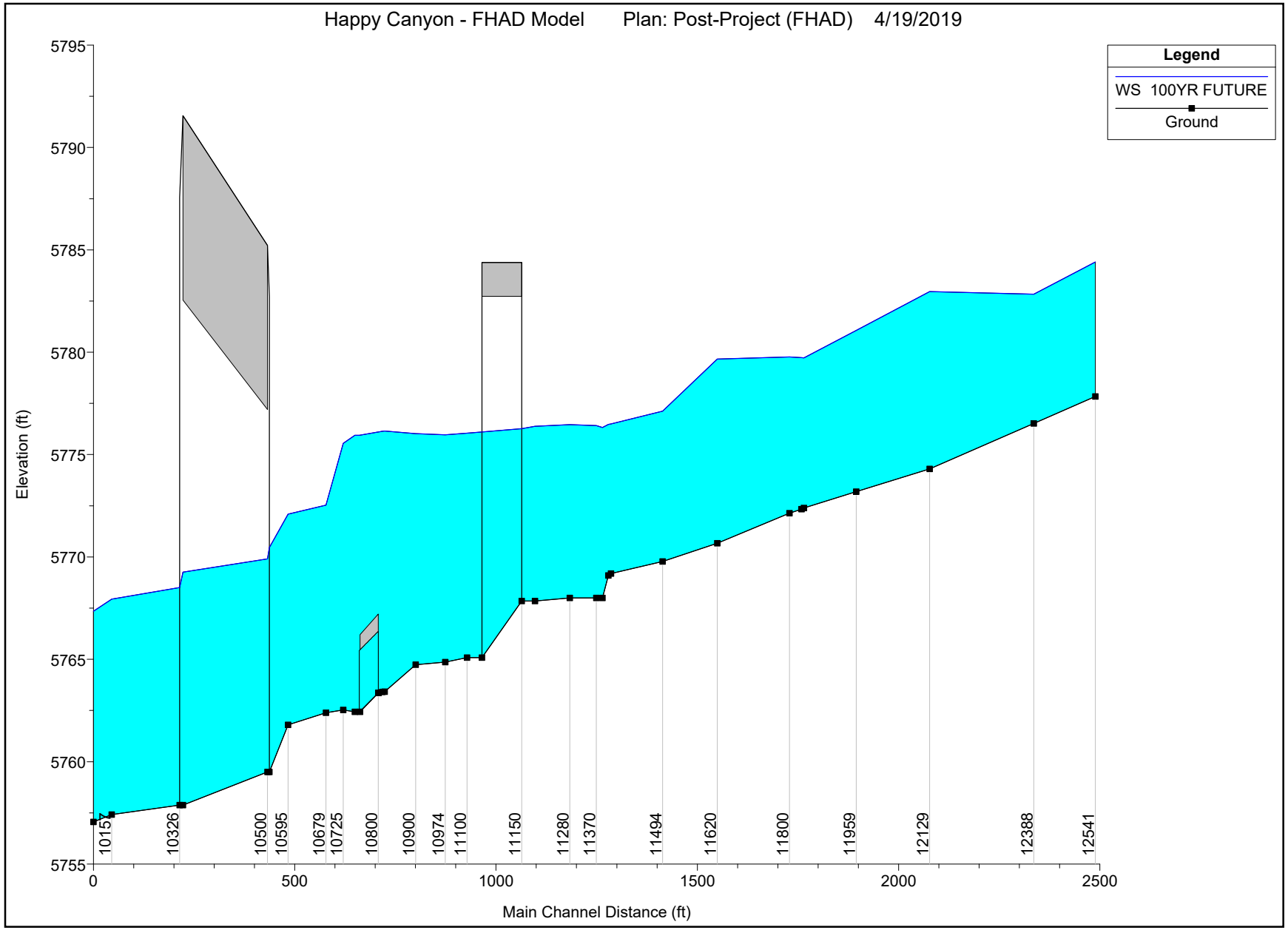
Legend
WS 100YR FUTURE
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
Happy Canyon - FHAD Model Plan: Post-Project (FHAD) 4/19/2019
.05
.05
Legend
WS 100YR FUTURE
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)


Happy Canyon - FHAD Model Plan: Post-Project (FHAD) 4/19/2019
Legend
WS 100YR FUTURE
Ground
Elevation (ft)
5795
5790
5785
5780
5775
5770
5765
5760
5755
0
500
1000
1500
2000
2500
Main Channel Distance (ft)
10157
10326
10500
10595
10679
10725
10800
10900
10974
11100
11150
11280
11370
11494
11620
11800
11959
12129
12388
12541

HEC-RAS Plan: Post-Proj River: HCC Reach: Mainstem_1 Profile: 100YR FUTURE

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Mainstem_1	10111	100YR FUTURE	8475.00	5757.06	5767.35	5767.35	5768.88	0.006178	13.40	1168.60	459.21	0.75
Mainstem_1	10157	100YR FUTURE	8475.00	5757.42	5767.94	5767.94	5770.22	0.007438	14.87	902.15	263.69	0.82
Mainstem_1	10326	100YR FUTURE	8475.00	5757.88	5768.50	5768.13	5771.59	0.004422	15.23	662.43	92.31	0.85
Mainstem_1	10500		Bridge									
Mainstem_1	10548	100YR FUTURE	8475.00	5759.50	5770.46	5769.54	5772.82	0.003218	13.51	787.21	116.13	0.73
Mainstem_1	10595	100YR FUTURE	8475.00	5761.80	5772.09	5772.09	5775.01	0.004806	14.56	691.68	120.95	0.86
Mainstem_1	10679	100YR FUTURE	8475.00	5762.39	5772.53	5772.21	5775.47	0.004929	14.95	681.70	103.83	0.87
Mainstem_1	10725	100YR FUTURE	8355.00	5762.52	5775.55	5770.36	5776.21	0.000744	7.10	1377.20	184.88	0.36
Mainstem_1	10750	100YR FUTURE	8303.00	5762.44	5775.94		5776.32	0.000618	6.11	1813.31	219.15	0.31
Mainstem_1	10800		Culvert									
Mainstem_1	10810	100YR FUTURE	8303.00	5763.36	5776.10	5771.88	5776.46	0.000681	6.44	1926.39	284.89	0.32
Mainstem_1	10819	100YR FUTURE	8303.00	5763.41	5776.14		5776.47	0.000647	6.18	1989.84	291.70	0.33
Mainstem_1	10825	100YR FUTURE	8303.00	5763.42	5776.15		5776.48	0.000670	6.28	1983.10	295.28	0.33
Mainstem_1	10900	100YR FUTURE	8303.00	5764.74	5776.02		5776.61	0.001111	7.55	1525.61	245.08	0.42
Mainstem_1	10974	100YR FUTURE	8303.00	5764.87	5775.96		5776.79	0.001648	8.58	1264.59	204.96	0.50
Mainstem_1	11100	100YR FUTURE	8303.00	5765.08	5776.05	5773.39	5776.92	0.002109	9.10	1126.62	168.27	0.50
Mainstem_1	11150		Bridge									
Mainstem_1	11180	100YR FUTURE	8303.00	5767.85	5776.38	5774.62	5777.56	0.002529	10.15	1019.26	178.99	0.62
Mainstem_1	11280	100YR FUTURE	8303.00	5768.00	5776.47		5777.87	0.003120	11.34	919.55	186.41	0.69
Mainstem_1	11370	100YR FUTURE	8303.00	5768.00	5776.42	5776.15	5778.21	0.004241	13.16	836.46	185.12	0.80
Mainstem_1	11385	100YR FUTURE	8303.00	5768.00	5776.33	5776.27	5778.35	0.004896	14.02	789.62	170.97	0.86
Mainstem_1	11400	100YR FUTURE	8303.00	5769.10	5776.48	5776.48	5778.61	0.005946	14.14	746.89	163.73	0.93
Mainstem_1	11410	100YR FUTURE	8303.00	5769.19	5776.50	5776.50	5778.78	0.006461	14.71	732.52	158.97	0.97
Mainstem_1	11494	100YR FUTURE	8303.00	5769.78	5777.12	5777.12	5779.86	0.006786	13.75	656.38	127.42	0.97
Mainstem_1	11620	100YR FUTURE	8303.00	5770.67	5779.67		5780.45	0.001705	8.06	1292.77	235.81	0.51
Mainstem_1	11800	100YR FUTURE	8303.00	5772.14	5779.77		5781.00	0.003480	10.85	1019.10	200.48	0.71
Mainstem_1	11830	100YR FUTURE	8303.00	5772.34	5779.74		5781.18	0.004366	11.92	954.73	202.98	0.79
Mainstem_1	11835	100YR FUTURE	8303.00	5772.39	5779.72		5781.23	0.004591	12.18	937.17	202.42	0.81
Mainstem_1	11959	100YR FUTURE	8303.00	5773.19	5781.07	5781.07	5783.00	0.005337	12.37	850.35	209.47	0.86
Mainstem_1	12129	100YR FUTURE	8303.00	5774.30	5782.97		5783.42	0.001144	6.93	1688.63	302.56	0.42
Mainstem_1	12388	100YR FUTURE	8303.00	5776.52	5782.84	5782.84	5784.31	0.004532	11.15	1055.52	352.81	0.79
Mainstem_1	12541	100YR FUTURE	8303.00	5777.84	5784.41		5784.77	0.001476	5.57	1885.59	476.82	0.39

HEC-RAS Plan: Post-Proj River: HCC Reach: Mainstem_1

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Mainstem_1	10111	10YR FUTURE	2691.00	5757.06	5764.59	5763.41	5765.72	0.004881	9.59	425.18	231.80	0.63
Mainstem_1	10111	50YR FUTURE	6345.00	5757.06	5766.77	5766.77	5768.06	0.005291	11.91	997.48	441.06	0.69
Mainstem_1	10111	2YR FUTURE	652.00	5757.06	5760.68	5759.87	5761.25	0.005865	6.23	115.14	45.04	0.61
Mainstem_1	10111	5YR FUTURE	1728.00	5757.06	5762.96	5762.08	5763.98	0.005700	8.73	251.21	77.54	0.65
Mainstem_1	10157	10YR FUTURE	2691.00	5757.42	5764.68	5763.23	5766.05	0.005698	10.05	363.15	125.01	0.68
Mainstem_1	10157	50YR FUTURE	6345.00	5757.42	5766.98	5766.98	5768.98	0.007002	13.50	729.88	218.62	0.79
Mainstem_1	10157	2YR FUTURE	652.00	5757.42	5761.01		5761.51	0.005237	5.79	119.98	44.22	0.57
Mainstem_1	10157	5YR FUTURE	1728.00	5757.42	5763.22		5764.26	0.005662	8.54	233.24	59.43	0.65
Mainstem_1	10326	10YR FUTURE	2691.00	5757.88	5765.99		5766.69	0.001474	7.25	442.22	82.98	0.47
Mainstem_1	10326	50YR FUTURE	6345.00	5757.88	5767.71		5769.88	0.003481	12.79	590.40	89.59	0.74
Mainstem_1	10326	2YR FUTURE	652.00	5757.88	5761.71		5762.12	0.002377	5.24	138.44	53.45	0.51
Mainstem_1	10326	5YR FUTURE	1728.00	5757.88	5764.26		5764.89	0.001825	6.78	304.44	75.88	0.50
Mainstem_1	10500		Bridge									
Mainstem_1	10548	10YR FUTURE	2691.00	5759.50	5766.37	5765.79	5767.58	0.003238	9.80	361.71	91.68	0.68
Mainstem_1	10548	50YR FUTURE	6345.00	5759.50	5769.48	5768.44	5771.26	0.002836	11.89	676.82	110.00	0.68
Mainstem_1	10548	2YR FUTURE	652.00	5759.50	5762.77	5762.26	5763.46	0.004561	6.81	106.48	47.28	0.70
Mainstem_1	10548	5YR FUTURE	1728.00	5759.50	5765.33	5764.41	5766.24	0.002929	8.30	270.96	82.50	0.62
Mainstem_1	10595	10YR FUTURE	2691.00	5761.80	5767.36	5767.36	5769.33	0.007766	11.26	243.45	64.93	0.96
Mainstem_1	10595	50YR FUTURE	6345.00	5761.80	5770.56	5770.56	5773.33	0.005602	13.89	521.94	102.50	0.90
Mainstem_1	10595	2YR FUTURE	652.00	5761.80	5764.42	5764.42	5765.36	0.010661	7.77	83.92	43.66	0.99
Mainstem_1	10595	5YR FUTURE	1728.00	5761.80	5766.22	5766.22	5767.76	0.009107	9.93	174.09	56.45	0.99
Mainstem_1	10679	10YR FUTURE	2691.00	5762.39	5768.69	5767.86	5769.89	0.003812	9.18	328.20	79.31	0.70
Mainstem_1	10679	50YR FUTURE	6345.00	5762.39	5771.71	5770.88	5773.83	0.003968	12.60	598.04	98.94	0.77
Mainstem_1	10679	2YR FUTURE	652.00	5762.39	5765.49		5766.06	0.005031	6.05	108.27	49.05	0.70
Mainstem_1	10679	5YR FUTURE	1728.00	5762.39	5767.40	5766.79	5768.38	0.004287	8.12	231.16	71.75	0.71
Mainstem_1	10725	10YR FUTURE	2656.00	5762.52	5769.88	5766.82	5770.22	0.000794	4.83	613.53	120.18	0.33
Mainstem_1	10725	50YR FUTURE	6249.00	5762.52	5773.79	5769.28	5774.35	0.000765	6.48	1123.53	141.77	0.35
Mainstem_1	10725	2YR FUTURE	633.00	5762.52	5766.13	5764.62	5766.27	0.000987	3.03	211.82	85.80	0.32
Mainstem_1	10725	5YR FUTURE	1708.00	5762.52	5768.40	5765.93	5768.66	0.000855	4.21	441.16	111.70	0.33
Mainstem_1	10750	10YR FUTURE	2647.00	5762.44	5770.02		5770.27	0.000900	4.76	706.25	154.42	0.33
Mainstem_1	10750	50YR FUTURE	6212.00	5762.44	5774.12		5774.45	0.000656	5.65	1431.71	193.14	0.31
Mainstem_1	10750	2YR FUTURE	625.00	5762.44	5766.03	5765.72	5766.48	0.004583	5.61	136.65	118.73	0.64
Mainstem_1	10750	5YR FUTURE	1705.00	5762.44	5768.45		5768.69	0.001289	4.72	468.68	147.14	0.38

HEC-RAS Plan: Post-Proj River: HCC Reach: Mainstem_1 (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Mainstem_1	10800		Culvert									
Mainstem_1	10810	10YR FUTURE	2647.00	5763.36	5771.07	5769.34	5771.37	0.001030	5.56	712.81	199.48	0.36
Mainstem_1	10810	50YR FUTURE	6212.00	5763.36	5774.23	5771.12	5774.61	0.000856	6.46	1427.89	250.46	0.35
Mainstem_1	10810	2YR FUTURE	625.00	5763.36	5769.06	5766.33	5769.14	0.000348	2.60	350.68	159.75	0.20
Mainstem_1	10810	5YR FUTURE	1705.00	5763.36	5770.28	5768.27	5770.49	0.000800	4.54	561.86	185.23	0.32
Mainstem_1	10819	10YR FUTURE	2647.00	5763.41	5771.14		5771.38	0.000999	5.14	755.17	207.97	0.37
Mainstem_1	10819	50YR FUTURE	6212.00	5763.41	5774.30		5774.62	0.000792	6.05	1492.53	254.95	0.35
Mainstem_1	10819	2YR FUTURE	625.00	5763.41	5769.08		5769.14	0.000420	2.52	356.83	176.16	0.22
Mainstem_1	10819	5YR FUTURE	1705.00	5763.41	5770.33		5770.50	0.000828	4.25	592.36	196.54	0.33
Mainstem_1	10825	10YR FUTURE	2647.00	5763.42	5771.14		5771.39	0.001034	5.23	758.86	214.84	0.37
Mainstem_1	10825	50YR FUTURE	6212.00	5763.42	5774.31		5774.62	0.000789	6.04	1491.37	249.54	0.35
Mainstem_1	10825	2YR FUTURE	625.00	5763.42	5769.08		5769.15	0.000433	2.57	349.91	169.03	0.23
Mainstem_1	10825	5YR FUTURE	1705.00	5763.42	5770.33		5770.51	0.000888	4.41	588.78	204.16	0.34
Mainstem_1	10900	10YR FUTURE	2647.00	5764.74	5771.08		5771.56	0.001909	6.24	534.64	178.33	0.49
Mainstem_1	10900	50YR FUTURE	6212.00	5764.74	5774.20		5774.77	0.001310	7.16	1128.31	200.78	0.44
Mainstem_1	10900	2YR FUTURE	625.00	5764.74	5769.09		5769.20	0.000791	2.85	254.18	110.68	0.29
Mainstem_1	10900	5YR FUTURE	1705.00	5764.74	5770.31		5770.64	0.001554	5.04	407.50	141.82	0.43
Mainstem_1	10974	10YR FUTURE	2647.00	5764.87	5771.14		5771.75	0.002996	6.94	454.22	144.88	0.60
Mainstem_1	10974	50YR FUTURE	6212.00	5764.87	5774.14		5774.96	0.002108	8.34	920.35	169.83	0.55
Mainstem_1	10974	2YR FUTURE	625.00	5764.87	5769.13		5769.29	0.001827	3.50	199.67	106.58	0.42
Mainstem_1	10974	5YR FUTURE	1705.00	5764.87	5770.37		5770.80	0.002656	5.71	347.61	131.53	0.54
Mainstem_1	11100	10YR FUTURE	2647.00	5765.08	5771.30	5770.48	5772.05	0.004811	9.05	418.73	141.04	0.68
Mainstem_1	11100	50YR FUTURE	6212.00	5765.08	5774.27	5772.56	5775.13	0.002885	9.36	857.58	158.03	0.57
Mainstem_1	11100	2YR FUTURE	625.00	5765.08	5769.21	5768.72	5769.48	0.002893	5.09	173.54	102.29	0.49
Mainstem_1	11100	5YR FUTURE	1705.00	5765.08	5770.51	5769.82	5771.05	0.003842	7.29	310.70	121.23	0.59
Mainstem_1	11150		Bridge									
Mainstem_1	11180	10YR FUTURE	2647.00	5767.85	5773.35	5771.99	5773.78	0.001645	6.04	562.56	158.61	0.46
Mainstem_1	11180	50YR FUTURE	6212.00	5767.85	5774.86	5773.75	5776.00	0.003199	9.97	789.30	168.29	0.68
Mainstem_1	11180	2YR FUTURE	625.00	5767.85	5770.45	5769.75	5770.72	0.002469	4.34	160.31	106.49	0.50
Mainstem_1	11180	5YR FUTURE	1705.00	5767.85	5772.11	5771.01	5772.63	0.002501	6.23	324.78	145.66	0.55
Mainstem_1	11280	10YR FUTURE	2647.00	5768.00	5773.28		5774.08	0.003269	8.44	404.05	125.40	0.65
Mainstem_1	11280	50YR FUTURE	6212.00	5768.00	5774.80	5774.80	5776.57	0.005272	12.72	627.48	164.32	0.86
Mainstem_1	11280	2YR FUTURE	625.00	5768.00	5770.60		5771.02	0.003977	5.74	135.61	82.48	0.64

HEC-RAS Plan: Post-Proj River: HCC Reach: Mainstem_1 (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Mainstem_1	11280	5YR FUTURE	1705.00	5768.00	5772.24		5772.93	0.003621	7.66	284.40	102.02	0.66
Mainstem_1	11370	10YR FUTURE	2647.00	5768.00	5773.41		5774.34	0.003686	9.10	387.92	114.11	0.70
Mainstem_1	11370	50YR FUTURE	6212.00	5768.00	5775.27	5775.27	5777.06	0.005065	13.03	640.84	161.80	0.86
Mainstem_1	11370	2YR FUTURE	625.00	5768.00	5770.84		5771.26	0.003366	5.60	137.89	81.99	0.60
Mainstem_1	11370	5YR FUTURE	1705.00	5768.00	5772.44		5773.17	0.003582	7.85	283.80	101.23	0.66
Mainstem_1	11385	10YR FUTURE	2647.00	5768.00	5773.38		5774.44	0.004241	9.71	369.21	117.34	0.74
Mainstem_1	11385	50YR FUTURE	6212.00	5768.00	5775.29	5775.29	5777.19	0.005379	13.43	620.68	149.44	0.88
Mainstem_1	11385	2YR FUTURE	625.00	5768.00	5770.81		5771.35	0.004278	6.25	119.88	75.89	0.67
Mainstem_1	11385	5YR FUTURE	1705.00	5768.00	5772.38		5773.28	0.004446	8.64	260.10	101.19	0.74
Mainstem_1	11400	10YR FUTURE	2647.00	5769.10	5773.41	5773.41	5774.72	0.007627	11.02	316.26	115.96	0.96
Mainstem_1	11400	50YR FUTURE	6212.00	5769.10	5775.50	5775.50	5777.42	0.006581	13.49	596.55	147.93	0.96
Mainstem_1	11400	2YR FUTURE	625.00	5769.10	5771.31	5771.31	5771.95	0.008420	7.17	110.09	83.91	0.90
Mainstem_1	11400	5YR FUTURE	1705.00	5769.10	5772.55	5772.55	5773.65	0.008397	9.88	224.76	100.46	0.97
Mainstem_1	11410	10YR FUTURE	2647.00	5769.19	5773.49	5773.49	5774.82	0.007627	11.09	314.94	115.59	0.96
Mainstem_1	11410	50YR FUTURE	6212.00	5769.19	5775.60	5775.60	5777.54	0.006624	13.61	593.50	147.28	0.96
Mainstem_1	11410	2YR FUTURE	625.00	5769.19	5771.36	5771.35	5772.01	0.008449	7.22	109.31	82.22	0.90
Mainstem_1	11410	5YR FUTURE	1705.00	5769.19	5772.65	5772.65	5773.73	0.008091	9.81	225.80	98.73	0.95
Mainstem_1	11494	10YR FUTURE	2647.00	5769.78	5774.72		5775.53	0.003771	7.41	376.09	109.58	0.67
Mainstem_1	11494	50YR FUTURE	6212.00	5769.78	5776.31	5776.08	5778.40	0.006189	11.97	557.84	118.55	0.91
Mainstem_1	11494	2YR FUTURE	625.00	5769.78	5772.49		5772.78	0.004197	4.38	145.56	97.76	0.61
Mainstem_1	11494	5YR FUTURE	1705.00	5769.78	5773.87		5774.45	0.003693	6.21	285.53	104.58	0.63
Mainstem_1	11620	10YR FUTURE	2647.00	5770.67	5775.41		5776.03	0.003415	6.82	449.13	155.34	0.63
Mainstem_1	11620	50YR FUTURE	6212.00	5770.67	5778.19		5778.99	0.002208	8.00	958.82	216.53	0.56
Mainstem_1	11620	2YR FUTURE	625.00	5770.67	5773.14	5772.99	5773.58	0.007815	5.40	121.14	120.11	0.81
Mainstem_1	11620	5YR FUTURE	1705.00	5770.67	5774.42		5775.01	0.004755	6.52	300.02	147.10	0.70
Mainstem_1	11800	10YR FUTURE	2647.00	5772.14	5776.40	5776.40	5777.42	0.005836	9.27	385.46	173.40	0.83
Mainstem_1	11800	50YR FUTURE	6212.00	5772.14	5778.37		5779.71	0.004918	11.18	745.43	190.16	0.81
Mainstem_1	11800	2YR FUTURE	625.00	5772.14	5774.35		5774.79	0.005962	5.68	125.80	89.22	0.74
Mainstem_1	11800	5YR FUTURE	1705.00	5772.14	5775.38	5775.38	5776.43	0.008285	9.01	227.76	110.27	0.94
Mainstem_1	11830	10YR FUTURE	2647.00	5772.34	5776.78	5776.78	5777.81	0.005645	9.44	389.76	176.48	0.82
Mainstem_1	11830	50YR FUTURE	6212.00	5772.34	5778.40	5778.40	5780.03	0.006343	12.49	689.39	192.37	0.92
Mainstem_1	11830	2YR FUTURE	625.00	5772.34	5774.47	5774.40	5775.04	0.007941	6.43	111.54	82.33	0.85
Mainstem_1	11830	5YR FUTURE	1705.00	5772.34	5775.67	5775.67	5776.82	0.008655	9.46	219.28	104.31	0.97

HEC-RAS Plan: Post-Proj River: HCC Reach: Mainstem_1 (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Mainstem_1	11835	10YR FUTURE	2647.00	5772.39	5776.90	5776.90	5777.89	0.005317	9.27	397.81	177.69	0.80
Mainstem_1	11835	50YR FUTURE	6212.00	5772.39	5778.48	5778.48	5780.10	0.006252	12.47	691.29	192.38	0.92
Mainstem_1	11835	2YR FUTURE	625.00	5772.39	5774.51	5774.46	5775.09	0.008175	6.50	109.67	80.86	0.86
Mainstem_1	11835	5YR FUTURE	1705.00	5772.39	5775.78	5775.78	5776.90	0.008166	9.32	223.41	106.06	0.94
Mainstem_1	11959	10YR FUTURE	2647.00	5773.19	5778.16	5778.16	5779.44	0.006584	9.21	314.39	152.33	0.86
Mainstem_1	11959	50YR FUTURE	6212.00	5773.19	5780.20	5780.20	5781.95	0.005621	11.52	671.69	199.18	0.86
Mainstem_1	11959	2YR FUTURE	625.00	5773.19	5775.66	5775.64	5776.35	0.010995	6.68	93.62	63.64	0.97
Mainstem_1	11959	5YR FUTURE	1705.00	5773.19	5777.05	5777.05	5778.27	0.009560	8.86	192.44	76.55	0.99
Mainstem_1	12129	10YR FUTURE	2647.00	5774.30	5779.63		5779.85	0.001029	4.70	780.69	235.00	0.37
Mainstem_1	12129	50YR FUTURE	6212.00	5774.30	5781.99		5782.37	0.001134	6.36	1396.77	293.57	0.41
Mainstem_1	12129	2YR FUTURE	625.00	5774.30	5776.88		5777.09	0.002121	4.02	198.57	140.84	0.46
Mainstem_1	12129	5YR FUTURE	1705.00	5774.30	5778.58		5778.78	0.001245	4.43	539.86	219.10	0.39
Mainstem_1	12388	10YR FUTURE	2647.00	5776.52	5779.61	5779.61	5781.02	0.009414	9.76	288.59	113.00	1.01
Mainstem_1	12388	50YR FUTURE	6212.00	5776.52	5782.18	5782.18	5783.49	0.004412	10.20	833.40	320.22	0.77
Mainstem_1	12388	2YR FUTURE	625.00	5776.52	5777.88	5777.88	5778.41	0.011865	5.95	107.94	97.79	0.97
Mainstem_1	12388	5YR FUTURE	1705.00	5776.52	5778.92	5778.92	5779.96	0.009872	8.33	213.59	104.35	0.99
Mainstem_1	12541	10YR FUTURE	2647.00	5777.84	5781.47		5781.80	0.002569	4.84	613.54	326.25	0.46
Mainstem_1	12541	50YR FUTURE	6212.00	5777.84	5783.62		5783.94	0.001541	5.21	1517.40	461.12	0.39
Mainstem_1	12541	2YR FUTURE	625.00	5777.84	5779.35		5779.53	0.004845	3.44	185.71	156.30	0.54
Mainstem_1	12541	5YR FUTURE	1705.00	5777.84	5780.55		5780.87	0.003620	4.65	397.40	248.60	0.52

HEC-RAS Plan: Post-Proj River: HCC Reach: Mainstem_1

Reach	River Sta	Profile	Vel Chnl	Shear LOB	Shear Chan	Shear ROB
			(ft/s)	(lb/sq ft)	(lb/sq ft)	(lb/sq ft)
Mainstem_1	10111	10YR FUTURE	9.59	0.49	2.16	0.48
Mainstem_1	10111	50YR FUTURE	11.91	0.99	3.06	0.85
Mainstem_1	10111	100YR FUTURE	13.40	1.37	3.79	1.21
Mainstem_1	10111	2YR FUTURE	6.23	0.31	1.19	0.44
Mainstem_1	10111	5YR FUTURE	8.73	0.55	1.96	0.67
Mainstem_1	10157	10YR FUTURE	10.05	0.54	2.41	0.46
Mainstem_1	10157	50YR FUTURE	13.50	1.41	3.96	1.20
Mainstem_1	10157	100YR FUTURE	14.87	1.94	4.64	1.40
Mainstem_1	10157	2YR FUTURE	5.79	0.43	1.03	0.18
Mainstem_1	10157	5YR FUTURE	8.54	0.75	1.89	0.55
Mainstem_1	10326	10YR FUTURE	7.25	0.30	0.69	0.34
Mainstem_1	10326	50YR FUTURE	12.79	0.98	1.99	0.98
Mainstem_1	10326	100YR FUTURE	15.23	1.39	2.74	1.37
Mainstem_1	10326	2YR FUTURE	5.24	0.13	0.47	0.21
Mainstem_1	10326	5YR FUTURE	6.78	0.22	0.65	0.32
Mainstem_1	10500		Bridge			
Mainstem_1	10548	10YR FUTURE	9.80	0.46	1.31	0.57
Mainstem_1	10548	50YR FUTURE	11.89	0.77	1.70	0.87
Mainstem_1	10548	100YR FUTURE	13.51	1.00	2.12	1.09
Mainstem_1	10548	2YR FUTURE	6.81	0.29	0.83	0.23
Mainstem_1	10548	5YR FUTURE	8.30	0.30	1.00	0.40
Mainstem_1	10595	10YR FUTURE	11.26	0.26	2.01	0.33
Mainstem_1	10595	50YR FUTURE	13.89	0.72	2.54	0.87
Mainstem_1	10595	100YR FUTURE	14.56	0.96	2.62	0.87
Mainstem_1	10595	2YR FUTURE	7.77		1.25	
Mainstem_1	10595	5YR FUTURE	9.93		1.73	0.06
Mainstem_1	10679	10YR FUTURE	9.18	0.48	1.24	0.50
Mainstem_1	10679	50YR FUTURE	12.60	0.88	2.01	0.91
Mainstem_1	10679	100YR FUTURE	14.95	1.21	2.74	1.27
Mainstem_1	10679	2YR FUTURE	6.05		0.71	0.06
Mainstem_1	10679	5YR FUTURE	8.12	0.34	1.06	0.37
Mainstem_1	10725	10YR FUTURE	4.83	0.13	0.32	0.13
Mainstem_1	10725	50YR FUTURE	6.48	0.25	0.49	0.22
Mainstem_1	10725	100YR FUTURE	7.10	0.30	0.56	0.29
Mainstem_1	10725	2YR FUTURE	3.03	0.01	0.17	0.03
Mainstem_1	10725	5YR FUTURE	4.21	0.08	0.26	0.10
Mainstem_1	10750	10YR FUTURE	4.76	0.18	0.32	0.23
Mainstem_1	10750	50YR FUTURE	5.65	0.24	0.39	0.27
Mainstem_1	10750	100YR FUTURE	6.11	0.21	0.43	0.31
Mainstem_1	10750	2YR FUTURE	5.61	0.18	0.62	0.13
Mainstem_1	10750	5YR FUTURE	4.72	0.17	0.35	0.21
Mainstem_1	10800		Culvert			

HEC-RAS Plan: Post-Proj River: HCC Reach: Mainstem_1 (Continued)

Reach	River Sta	Profile	Vel Chnl	Shear LOB	Shear Chan	Shear ROB
			(ft/s)	(lb/sq ft)	(lb/sq ft)	(lb/sq ft)
Mainstem_1	10810	10YR FUTURE	5.56	0.14	0.42	0.22
Mainstem_1	10810	50YR FUTURE	6.46	0.21	0.50	0.32
Mainstem_1	10810	100YR FUTURE	6.44	0.20	0.47	0.32
Mainstem_1	10810	2YR FUTURE	2.60	0.02	0.10	0.03
Mainstem_1	10810	5YR FUTURE	4.54	0.08	0.29	0.13
Mainstem_1	10819	10YR FUTURE	5.14	0.19	0.37	0.20
Mainstem_1	10819	50YR FUTURE	6.05	0.24	0.45	0.29
Mainstem_1	10819	100YR FUTURE	6.18	0.22	0.44	0.29
Mainstem_1	10819	2YR FUTURE	2.52	0.05	0.10	0.04
Mainstem_1	10819	5YR FUTURE	4.25	0.13	0.27	0.13
Mainstem_1	10825	10YR FUTURE	5.23	0.19	0.38	0.20
Mainstem_1	10825	50YR FUTURE	6.04	0.25	0.45	0.28
Mainstem_1	10825	100YR FUTURE	6.28	0.22	0.45	0.30
Mainstem_1	10825	2YR FUTURE	2.57	0.05	0.11	0.04
Mainstem_1	10825	5YR FUTURE	4.41	0.14	0.29	0.13
Mainstem_1	10900	10YR FUTURE	6.24	0.36	0.58	0.11
Mainstem_1	10900	50YR FUTURE	7.16	0.44	0.65	0.29
Mainstem_1	10900	100YR FUTURE	7.55	0.35	0.68	0.35
Mainstem_1	10900	2YR FUTURE	2.85	0.08	0.14	0.03
Mainstem_1	10900	5YR FUTURE	5.04	0.24	0.40	0.06
Mainstem_1	10974	10YR FUTURE	6.94	0.52	0.77	0.21
Mainstem_1	10974	50YR FUTURE	8.34	0.62	0.92	0.44
Mainstem_1	10974	100YR FUTURE	8.58	0.51	0.91	0.46
Mainstem_1	10974	2YR FUTURE	3.50	0.17	0.24	0.04
Mainstem_1	10974	5YR FUTURE	5.71	0.37	0.55	0.11
Mainstem_1	11100	10YR FUTURE	9.05	0.78	1.62	0.64
Mainstem_1	11100	50YR FUTURE	9.36	0.94	1.50	0.85
Mainstem_1	11100	100YR FUTURE	9.10	0.91	1.33	0.85
Mainstem_1	11100	2YR FUTURE	5.09	0.25	0.60	0.17
Mainstem_1	11100	5YR FUTURE	7.29	0.63	1.11	0.40
Mainstem_1	11150		Bridge			
Mainstem_1	11180	10YR FUTURE	6.04	0.29	0.54	0.25
Mainstem_1	11180	50YR FUTURE	9.97	0.81	1.34	0.79
Mainstem_1	11180	100YR FUTURE	10.15	0.85	1.30	0.87
Mainstem_1	11180	2YR FUTURE	4.34	0.18	0.36	0.10
Mainstem_1	11180	5YR FUTURE	6.23	0.40	0.62	0.19
Mainstem_1	11280	10YR FUTURE	8.44	0.53	1.05	0.45
Mainstem_1	11280	50YR FUTURE	12.72	1.09	2.19	0.86
Mainstem_1	11280	100YR FUTURE	11.34	0.86	1.62	0.71
Mainstem_1	11280	2YR FUTURE	5.74	0.30	0.62	0.17
Mainstem_1	11280	5YR FUTURE	7.66	0.53	0.93	0.38

HEC-RAS Plan: Post-Proj River: HCC Reach: Mainstem_1 (Continued)

Reach	River Sta	Profile	Vel Chnl	Shear LOB	Shear Chan	Shear ROB
			(ft/s)	(lb/sq ft)	(lb/sq ft)	(lb/sq ft)
Mainstem_1	11370	10YR FUTURE	9.10	0.69	1.21	0.47
Mainstem_1	11370	50YR FUTURE	13.03	1.10	2.25	0.85
Mainstem_1	11370	100YR FUTURE	13.16	1.01	2.18	0.92
Mainstem_1	11370	2YR FUTURE	5.60	0.24	0.57	0.12
Mainstem_1	11370	5YR FUTURE	7.85	0.52	0.96	0.36
Mainstem_1	11385	10YR FUTURE	9.71	0.67	1.38	0.54
Mainstem_1	11385	50YR FUTURE	13.43	1.25	2.39	0.95
Mainstem_1	11385	100YR FUTURE	14.02	1.19	2.49	1.08
Mainstem_1	11385	2YR FUTURE	6.25	0.23	0.72	0.11
Mainstem_1	11385	5YR FUTURE	8.64	0.55	1.17	0.40
Mainstem_1	11400	10YR FUTURE	11.02	1.14	1.94	0.98
Mainstem_1	11400	50YR FUTURE	13.49	1.53	2.53	1.32
Mainstem_1	11400	100YR FUTURE	14.14	1.46	2.64	1.46
Mainstem_1	11400	2YR FUTURE	7.17	0.59	1.04	0.36
Mainstem_1	11400	5YR FUTURE	9.88	1.01	1.68	0.86
Mainstem_1	11410	10YR FUTURE	11.09	1.12	1.95	0.98
Mainstem_1	11410	50YR FUTURE	13.61	1.51	2.56	1.34
Mainstem_1	11410	100YR FUTURE	14.71	1.63	2.86	1.57
Mainstem_1	11410	2YR FUTURE	7.22	0.58	1.05	0.39
Mainstem_1	11410	5YR FUTURE	9.81	0.99	1.65	0.85
Mainstem_1	11494	10YR FUTURE	7.41	0.25	0.90	0.44
Mainstem_1	11494	50YR FUTURE	11.97	0.68	2.08	1.04
Mainstem_1	11494	100YR FUTURE	13.75	0.77	2.62	1.20
Mainstem_1	11494	2YR FUTURE	4.38	0.01	0.42	0.12
Mainstem_1	11494	5YR FUTURE	6.21	0.15	0.68	0.33
Mainstem_1	11620	10YR FUTURE	6.82	0.26	0.77	0.46
Mainstem_1	11620	50YR FUTURE	8.00	0.26	0.88	0.57
Mainstem_1	11620	100YR FUTURE	8.06	0.30	0.83	0.57
Mainstem_1	11620	2YR FUTURE	5.40	0.12	0.67	0.09
Mainstem_1	11620	5YR FUTURE	6.52	0.26	0.78	0.38
Mainstem_1	11800	10YR FUTURE	9.27	0.76	1.40	0.53
Mainstem_1	11800	50YR FUTURE	11.18	1.00	1.77	0.97
Mainstem_1	11800	100YR FUTURE	10.85	0.87	1.55	0.94
Mainstem_1	11800	2YR FUTURE	5.68	0.28	0.67	0.32
Mainstem_1	11800	5YR FUTURE	9.01	0.76	1.46	0.69
Mainstem_1	11830	10YR FUTURE	9.44	0.78	1.42	0.51
Mainstem_1	11830	50YR FUTURE	12.49	1.28	2.23	1.12
Mainstem_1	11830	100YR FUTURE	11.92	1.09	1.90	1.08
Mainstem_1	11830	2YR FUTURE	6.43	0.36	0.87	0.41
Mainstem_1	11830	5YR FUTURE	9.46	0.84	1.59	0.73
Mainstem_1	11835	10YR FUTURE	9.27	0.72	1.37	0.49
Mainstem_1	11835	50YR FUTURE	12.47	1.24	2.22	1.11
Mainstem_1	11835	100YR FUTURE	12.18	1.12	1.98	1.11

HEC-RAS Plan: Post-Proj River: HCC Reach: Mainstem_1 (Continued)

Reach	River Sta	Profile	Vel Chnl	Shear LOB	Shear Chan	Shear ROB
			(ft/s)	(lb/sq ft)	(lb/sq ft)	(lb/sq ft)
Mainstem_1	11835	2YR FUTURE	6.50	0.35	0.89	0.42
Mainstem_1	11835	5YR FUTURE	9.32	0.78	1.53	0.68
Mainstem_1	11959	10YR FUTURE	9.21	0.09	1.43	0.20
Mainstem_1	11959	50YR FUTURE	11.52	0.38	1.92	0.68
Mainstem_1	11959	100YR FUTURE	12.37	0.46	2.11	0.87
Mainstem_1	11959	2YR FUTURE	6.68		1.00	
Mainstem_1	11959	5YR FUTURE	8.86		1.48	
Mainstem_1	12129	10YR FUTURE	4.70	0.14	0.33	0.19
Mainstem_1	12129	50YR FUTURE	6.36	0.23	0.53	0.31
Mainstem_1	12129	100YR FUTURE	6.93	0.26	0.60	0.37
Mainstem_1	12129	2YR FUTURE	4.02	0.12	0.31	0.11
Mainstem_1	12129	5YR FUTURE	4.43	0.14	0.31	0.15
Mainstem_1	12388	10YR FUTURE	9.76	0.85	1.70	0.59
Mainstem_1	12388	50YR FUTURE	10.20	0.49	1.50	0.35
Mainstem_1	12388	100YR FUTURE	11.15	0.62	1.73	0.48
Mainstem_1	12388	2YR FUTURE	5.95	0.51	0.86	0.21
Mainstem_1	12388	5YR FUTURE	8.33	0.81	1.36	0.45
Mainstem_1	12541	10YR FUTURE	4.84	0.22	0.54	0.20
Mainstem_1	12541	50YR FUTURE	5.21	0.21	0.53	0.27
Mainstem_1	12541	100YR FUTURE	5.57	0.26	0.58	0.30
Mainstem_1	12541	2YR FUTURE	3.44	0.17	0.38	0.21
Mainstem_1	12541	5YR FUTURE	4.65	0.19	0.56	0.11

APPENDIX F. SUPPLEMENTAL INFORMATION AND PLAN SHEETS

FEDERAL EMERGENCY MANAGEMENT AGENCY

PAYMENT INFORMATION FORM

Community Name:

Project Identifier: 115360-01 Compark at Belford Ave

THIS FORM MUST BE MAILED, ALONG WITH THE APPROPRIATE FEE, TO THE ADDRESS BELOW OR FAXED TO THE FAX NUMBER BELOW.

Please make check or money order payable to the National Flood Insurance Program.

Type of Request:

☐ MT-1 application
☒ MT-2 application

LOMC Clearinghouse
3601 Eisenhower Ave. Suite 500
Alexandria, VA 22304-6426
Attn.: LOMC Manager

☐ EDR application

FEMA Project Library
3601 Eisenhower Ave. Suite 500
Alexandria, VA 22304-6426
FAX (703) 960-9125

Request No. (if known): _____ **Check No.:** _____ **Amount:** $6500

☒ INITIAL FEE* ☐ FINAL FEE ☐ FEE BALANCE** ☐ MASTER CARD ☐ VISA ☐ CHECK ☐ MONEY ORDER

*Note: Check only for EDR and/or Alluvial Fan requests (as appropriate).

****Note: Check only if submitting a corrected fee for an ongoing request.**

COMPLETE THIS SECTION *ONLY* IF PAYING BY CREDIT CARD

CARD NUMBER EXP. DATE

				–				–				–					–		
1	2	3	4		5	6	7	8	9	10	11	12	13	14	15	16	Month		Year

_____ _____
Date Signature

NAME *(AS IT APPEARS ON CARD)*: _____
(please print or type)

ADDRESS: _____
(*for your credit card receipt-please print or type*) _____

DAYTIME PHONE: _____

U.S. DEPARTMENT OF HOMELAND SECURITY
FEDERAL EMERGENCY MANAGEMENT AGENCY

OVERVIEW & CONCURRENCE FORM

O.M.B No. 1660-0016
Expires February 28, 2014

PAPERWORK BURDEN DISCLOSURE NOTICE

Public reporting burden for this form is estimated to average 1 hours per response. The burden estimate includes the time for reviewing instructions, searching existing data sources, gathering and maintaining the needed data, and completing, reviewing, and submitting the form. You are not required to respond to this collection of information unless it displays a valid OMB control number. Send comments regarding the accuracy of the burden estimate and any suggestions for reducing this burden to: Information Collections Management, Department of Homeland Security, Federal Emergency Management Agency, 1800 South Bell Street, Arlington, VA 20958-3005, Paperwork Reduction Project (1660-0016). Submission of the form is required to obtain or retain benefits under the National Flood Insurance Program. **Please do not send your completed survey to the above address.**

PRIVACY ACT STATEMENT

AUTHORITY: The National Flood Insurance Act of 1968, Public Law 90-448, as amended by the Flood Disaster Protection Act of 1973, Public Law 93-234.

PRINCIPAL PURPOSE(S): This information is being collected for the purpose of determining an applicant's eligibility to request changes to National Flood Insurance Program (NFIP) Flood Insurance Rate Maps (FIRM).

ROUTINE USE(S): The information on this form may be disclosed as generally permitted under 5 U.S.C § 552a(b) of the Privacy Act of 1974, as amended. This includes using this information as necessary and authorized by the routine uses published in DHS/FEMA/NFIP/LOMA-1 National Flood Insurance Program (NFIP); Letter of Map Amendment (LOMA) February 15, 2006, 71 FR 7990.

DISCLOSURE: The disclosure of information on this form is voluntary; however, failure to provide the information requested may delay or prevent FEMA from processing a determination regarding a requested change to a (NFIP) Flood Insurance Rate Maps (FIRM).

A. REQUESTED RESPONSE FROM DHS-FEMA

This request is for a (check one):

☒ CLOMR: A letter from DHS-FEMA commenting on whether a proposed project, if built as proposed, would justify a map revision, or proposed hydrology changes (See 44 CFR Ch. 1, Parts 60, 65 & 72).

☐ LOMR: A letter from DHS-FEMA officially revising the current NFIP map to show the changes to floodplains, regulatory floodway or flood elevations. (See 44 CFR Ch. 1, Parts 60, 65 & 72)

B. OVERVIEW

1. The NFIP map panel(s) affected for all impacted communities is (are):

Community No.	Community Name	State	Map No.	Panel No.	Effective Date
Example: 480301 480287	City of Katy Harris County	TX TX	48473C 48201C	0005D 0220G	02/08/83 09/28/90
080310	Town of Parker	CO	08035C	0062G	03/16/16
080310	Town of Parker	CO	08035C	0066G	03/16/16

2. a. Flooding Source: Happy Canyon Creek

   b. Types of Flooding: ☒ Riverine ☐ Coastal ☐ Shallow Flooding (e.g., Zones AO and AH)
   ☐ Alluvial fan ☐ Lakes ☐ Other (Attach Description)

3. Project Name/Identifier: Compark at Belford Avenue

4. FEMA zone designations affected: AE, X (choices: A, AH, AO, A1-A30, A99, AE, AR, V, V1-V30, VE, B, C, D, X)

5. Basis for Request and Type of Revision:

   a. The basis for this revision request is (check all that apply)

   ☒ Physical Change ☐ Improved Methodology/Data ☒ Regulatory Floodway Revision ☒ Base Map Changes
   ☐ Coastal Analysis ☒ Hydraulic Analysis ☐ Hydrologic Analysis ☐ Corrections
   ☐ Weir-Dam Changes ☐ Levee Certification ☐ Alluvial Fan Analysis ☐ Natural Changes
   ☒ New Topographic Data ☐ Other (Attach Description)

   Note: A photograph and narrative description of the area of concern is not required, but is very helpful during review.

b. The area of revision encompasses the following structures (check all that apply)

Structures: ☒ Channelization ☐ Levee/Floodwall ☒ Bridge/Culvert

☐ Dam ☒ Fill ☐ Other (Attach Description)

6. ☒ Documentation of ESA compliance is submitted (required to initiate CLOMR review). Please refer to the instructions for more information.

C. REVIEW FEE

Has the review fee for the appropriate request category been included? ☒ Yes Fee amount: $6500

☐ No, Attach Explanation

Please see the DHS-FEMA Web site at http://www.fema.gov/plan/prevent/fhm/frm_fees.shtm **for Fee Amounts and Exemptions.**

D. SIGNATURE

All documents submitted in support of this request are correct to the best of my knowledge. I understand that any false statement may be punishable by fine or imprisonment under Title 18 of the United States Code, Section 1001.

Name: Zachary Grady	Company: Felsburg Holt & Ullevig	
Mailing Address: 6300 South Syracuse Way, Suite 600 Centennial, CO 80111	Daytime Telephone No.: 3037211440	Fax No.: 3037210832
	E-Mail Address: Zach.grady@fhueng.com	
Signature of Requester (required):	Date: 4/30/19	

As the community official responsible for floodplain management, I hereby acknowledge that we have received and reviewed this Letter of Map Revision (LOMR) or conditional LOMR request. Based upon the community's review, we find the completed or proposed project meets or is designed to meet all of the community floodplain management requirements, including the requirements for when fill is placed in the regulatory floodway, and that all necessary Federal, State, and local permits have been, or in the case of a conditional LOMR, will be obtained. For Conditional LOMR requests, the applicant has documented Endangered Species Act (ESA) compliance to FEMA prior to FEMA's review of the Conditional LOMR application. For LOMR requests, I acknowledge that compliance with Sections 9 and 10 of the ESA has been achieved independently of FEMA's process. For actions authorized, funded, or being carried out by Federal or State agencies, documentation from the agency showing its compliance with Section 7(a)(2) of the ESA will be submitted. In addition, we have determined that the land and any existing or proposed structures to be removed from the SFHA are or will be reasonably safe from flooding as defined in 44CFR 65.2(c), and that we have available upon request by FEMA, all analyses and documentation used to make this determination.

Community Official's Name and Title: TOM WILLIAMS, P.E., DIRECTOR OF PUBLIC WORKS/ENGINEERING	Community Name: TOWN OF PARKER	
Mailing Address: 20120 EAST MAINSTREET PARKER, CO 80138	Daytime Telephone No.: 303.840.9546	Fax No.:
	E-Mail Address: twilliams@parkeronline.org	
Community Official's Signature (required):	Date: 05/03/19	

CERTIFICATION BY REGISTERED PROFESSIONAL ENGINEER AND/OR LAND SURVEYOR

This certification is to be signed and sealed by a licensed land surveyor, registered professional engineer, or architect authorized by law to certify elevation information data, hydrologic and hydraulic analysis, and any other supporting information as per NFIP regulations paragraph 65.2(b) and as described in the MT-2 Forms Instructions. All documents submitted in support of this request are correct to the best of my knowledge. I understand that any false statement may be punishable by fine or imprisonment under Title 18 of the United States Code, Section 1001.

Certifier's Name: Kendra Gabbert	License No.: 45344	Expiration Date: 10/31/2019	
Company Name: Felsburg Holt & Ullevig	Telephone No.: 303-721-1440	Fax No.: 303-721-0832	
Signature: Kendra Gabbert	Date: 4/29/19	E-Mail Address: kendra.gabbert@fhueng.com	

Ensure the forms that are appropriate to your revision request are included in your submittal.

Form Name and (Number)	Required if …
☒ Riverine Hydrology and Hydraulics Form (Form 2)	New or revised discharges or water-surface elevations
☒ Riverine Structures Form (Form 3)	Channel is modified, addition/revision of bridge/culverts, addition/revision of levee/floodwall, addition/revision of dam
☐ Coastal Analysis Form (Form 4)	New or revised coastal elevations
☐ Coastal Structures Form (Form 5)	Addition/revision of coastal structure
☐ Alluvial Fan Flooding Form (Form 6)	Flood control measures on alluvial fans

Seal (Optional)

U.S. DEPARTMENT OF HOMELAND SECURITY
FEDERAL EMERGENCY MANAGEMENT AGENCY

RIVERINE HYDROLOGY & HYDRAULICS FORM

O.M.B No. 1660-0016
Expires February 28, 2014

PAPERWORK BURDEN DISCLOSURE NOTICE

Public reporting burden for this form is estimated to average 3.5 hours per response. The burden estimate includes the time for reviewing instructions, searching existing data sources, gathering and maintaining the needed data, and completing, reviewing, and submitting the form. You are not required to respond to this collection of information unless a valid OMB control number appears in the upper right corner of this form. Send comments regarding the accuracy of the burden estimate and any suggestions for reducing this burden to: Information Collections Management, Department of Homeland Security, Federal Emergency Management Agency, 1800 South Bell Street, Arlington VA 20958-3005, Paperwork Reduction Project (1660-0016). Submission of the form is required to obtain or retain benefits under the National Flood Insurance Program. **Please do not send your completed survey to the above address.**

PRIVACY ACT STATEMENT

AUTHORITY: The National Flood Insurance Act of 1968, Public Law 90-448, as amended by the Flood Disaster Protection Act of 1973, Public Law 93-234.

PRINCIPAL PURPOSE(S): This information is being collected for the purpose of determining an applicant's eligibility to request changes to National Flood Insurance Program (NFIP) Flood Insurance Rate Maps (FIRM).

ROUTINE USE(S): The information on this form may be disclosed as generally permitted under 5 U.S.C § 552a(b) of the Privacy Act of 1974, as amended. This includes using this information as necessary and authorized by the routine uses published in DHS/FEMA/NFIP/LOMA-1 National Flood Insurance Program (NFIP); Letter of Map Amendment (LOMA) February 15, 2006, 71 FR 7990.

DISCLOSURE: The disclosure of information on this form is voluntary; however, failure to provide the information requested may delay or prevent FEMA from processing a determination regarding a requested change to a NFIP Flood Insurance Rate Maps (FIRM).

Flooding Source: Happy Canyon Creek

Note: Fill out one form for each flooding source studied

A. HYDROLOGY

1. Reason for New Hydrologic Analysis (check all that apply)

☒ Not revised (skip to section B) ☐ No existing analysis ☐ Improved data
☐ Alternative methodology ☐ Proposed Conditions (CLOMR) ☐ Changed physical condition of watershed

2. Comparison of Representative 1%-Annual-Chance Discharges

Location	Drainage Area (Sq. Mi.)	Effective/FIS (cfs)	Revised (cfs)

3. Methodology for New Hydrologic Analysis (check all that apply)

☐ Statistical Analysis of Gage Records ☐ Precipitation/Runoff Model → Specify Model: _____
☐ Regional Regression Equations ☐ Other (please attach description)

Please enclose all relevant models in digital format, maps, computations (including computation of parameters), and documentation to support the new analysis.

4. Review/Approval of Analysis

If your community requires a regional, state, or federal agency to review the hydrologic analysis, please attach evidence of approval/review.

5. Impacts of Sediment Transport on Hydrology

Is the hydrology for the revised flooding source(s) affected by sediment transport? ☐ Yes ☐ No

If yes, then fill out Section F (Sediment Transport) of Form 3. If No, then attach your explanation..

B. HYDRAULICS

1. Reach to be Revised

	Description	Cross Section	Water-Surface Elevations (ft.)	
			Effective	Proposed/Revised
Downstream Limit*	FIS Section E	10111	5767.4	5767.4
Upstream Limit*	FIS Section G/Preliminary Firm Section M	12541	5784.7	5784.3

*Proposed/Revised elevations must tie-into the Effective elevations within 0.5 foot at the downstream and upstream limits of revision.

2. Hydraulic Method/Model Used: HEC-RAS 4.1.0

3. Pre-Submittal Review of Hydraulic Models*

DHS-FEMA has developed two review programs, CHECK-2 and CHECK-RAS, to aid in the review of HEC-2 and HEC-RAS hydraulic models, respectively. We recommend that you review your HEC-2 and HEC-RAS models with CHECK-2 and CHECK-RAS.

4.

Models Submitted	Natural Run		Floodway Run		Datum
Duplicate Effective Model*	File Name: Happy Canyon	Plan Name: Duplicate Effective	File Name: N/A	Plan Name: N/A	NAVD 88
Corrected Effective Model*	File Name: Happy Canyon	Plan Name: Corrected Effective	File Name: N/A	Plan Name: N/A	NAVD 88
Existing or Pre-Project Conditions Model	File Name: N/A	Plan Name: N/A	File Name: N/A	Plan Name: N/A	N/A
Revised or Post-Project Conditions Model	File Name: Happy Canyon	Plan Name: Post-Project	File Name: Happy Canyon	Plan Name: Post-Project Floodwa	NAVD 88
Other - (attach description)	File Name: N/A	Plan Name: N/A	File Name: N/A	Plan Name: N/A	N/A

* For details, refer to the corresponding section of the instructions.

☒ Digital Models Submitted? (Required)

C. MAPPING REQUIREMENTS

A **certified topographic work map** must be submitted showing the following information (where applicable): the boundaries of the effective, existing, and proposed conditions 1%-annual-chance floodplain (for approximate Zone A revisions) or the boundaries of the 1%- and 0.2%-annual-chance floodplains and regulatory floodway (for detailed Zone AE, AO, and AH revisions); location and alignment of all cross sections with stationing control indicated; stream, road, and other alignments (e.g., dams, levees, etc.); current community easements and boundaries; boundaries of the requester's property; certification of a registered professional engineer registered in the subject State; location and description of reference marks; and the referenced vertical datum (NGVD, NAVD, etc.).

☐ Digital Mapping (GIS/CADD) Data Submitted (preferred)

Topographic Information: Flown Aerial Survey for Belford Ave.

Source: Manhard Consultants Date: 03-31-16

Accuracy: 1-Foot Interval Contours

Note that the boundaries of the existing or proposed conditions floodplains and regulatory floodway to be shown on the revised FIRM and/or FBFM must tie-in with the effective floodplain and regulatory floodway boundaries. Please attach **a copy of the effective FIRM and/or FBFM**, at the same scale as the original, annotated to show the boundaries of the revised 1%-and 0.2%-annual-chance floodplains and regulatory floodway that tie-in with the boundaries of the effective 1%-and 0.2%-annual-chance floodplain and regulatory floodway at the upstream and downstream limits of the area on revision.

☒ Annotated FIRM and/or FBFM (Required)

D. COMMON REGULATORY REQUIREMENTS*

1. For LOMR/CLOMR requests, do Base Flood Elevations (BFEs) increase? ☒ Yes ☐ No

   a. For CLOMR requests, if either of the following is true, please submit **evidence of compliance with Section 65.12 of the NFIP regulations**:

   - The proposed project encroaches upon a regulatory floodway and would result in increases above 0.00 foot compared to pre-project conditions.
   - The proposed project encroaches upon a SFHA with or without BFEs established and would result in increases above 1.00 foot compared to pre-project conditions.

   b. Does this LOMR request cause increase in the BFE and/or SFHA compared with the effective BFEs and/or SFHA? ☐ Yes ☒ No
   If Yes, please attach **proof of property owner notification and acceptance (if available)**. Elements of and examples of property owner notifications can be found in the MT-2 Form 2 Instructions.

2. Does the request involve the placement or proposed placement of fill? ☒ Yes ☐ No

   If Yes, the community must be able to certify that the area to be removed from the special flood hazard area, to include any structures or proposed structures, meets all of the standards of the local floodplain ordinances, and is reasonably safe from flooding in accordance with the NFIP regulations set forth at 44 CFR 60.3(A)(3), 65.5(a)(4), and 65.6(a)(14). Please see the MT-2 instructions for more information.

3. For LOMR requests, is the regulatory floodway being revised? ☐ Yes ☒ No

   If Yes, attach **evidence of regulatory floodway revision notification**. As per Paragraph 65.7(b)(1) of the NFIP Regulations, notification is required for requests involving revisions to the regulatory floodway. (Not required for revisions to approximate 1%-annual-chance floodplains [studied Zone A designation] unless a regulatory floodway is being established. Elements and examples of regulatory floodway revision notification can be found in the MT-2 Form 2 Instructions.)

4. For CLOMR requests, please submit documentation to FEMA and the community to show that you have complied with Sections 9 and 10 of the Endangered Species Act (ESA).

For actions authorized, funded, or being carried out by Federal or State agencies, please submit documentation from the agency showing its compliance with Section 7(a)(2) of the ESA. Please see the MT-2 instructions for more detail.

* Not inclusive of all applicable regulatory requirements. For details, see 44 CFR parts 60 and 65.

DEPARTMENT OF HOMELAND SECURITY
FEDERAL EMERGENCY MANAGEMENT AGENCY

RIVERINE STRUCTURES FORM

O.M.B. NO. 1660-0016
Expires February 28, 2014

PAPERWORK BURDEN DISCLOSURE NOTICE

Public reporting burden for this form is estimated to average 7 hours per response. The burden estimate includes the time for reviewing instructions, searching existing data sources, gathering and maintaining the needed data, and completing, reviewing, and submitting the form. You are not required to respond to this collection of information unless a valid OMB control number appears in the upper right corner of this form. Send comments regarding the accuracy of the burden estimate and any suggestions for reducing this burden to: Information Collections Management, Department of Homeland Security, Federal Emergency Management Agency, 1800 South Bell Street, Arlington, VA 20598-3005, Paperwork Reduction Project (1660-0016). Submission of the form is required to obtain or retain benefits under the National Flood Insurance Program. **Please do not send your completed survey to the above address.**

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AUTHORITY: The National Flood Insurance Act of 1968, Public Law 90-448, as amended by the Flood Disaster Protection Act of 1973, Public Law 93-234.

PRINCIPAL PURPOSE(S): This information is being collected for the purpose of determining an applicant's eligibility to request changes to National Flood Insurance Program (NFIP) Flood Insurance Rate Maps (FIRM).

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DISCLOSURE: The disclosure of information on this form is voluntary; however, failure to provide the information requested may delay or prevent FEMA from processing a determination regarding a requested change to a NFIP Flood Insurance Rate Maps (FIRM).

Flooding Source: Happy Canyon Creek

Note**:** Fill out one form for each flooding source studied.

A. GENERAL

Complete the appropriate section(s) for each Structure listed below:

Channelization.....complete Section B
Bridge/Culvert.....complete Section C
Dam.....complete Section D
Levee/Floodwall.....complete Section E
Sediment Transport.....complete Section F (if required)

Description Of Modeled Structure

1. Name of Structure: Belford Avenue Bridge

   Type (check one): ☒ Channelization ☒ Bridge/Culvert ☐ Levee/Floodwall ☐ Dam

   Location of Structure: _____

   Downstream Limit/Cross Section: 11100

   Upstream Limit/Cross Section: 11180

2. Name of Structure: E-470 Pedestrian Train Crossing

   Type (check one): ☒ Channelization ☒ Bridge/Culvert ☐ Levee/Floodwall ☐ Dam

   Location of Structure: _____

   Downstream Limit/Cross Section: 10750

   Upstream Limit/Cross Section: 10810

3. Name of Structure: _____

   Type (check one) ☐ Channelization ☐ Bridge/Culvert ☐ Levee/Floodwall ☐ Dam

   Location of Structure: _____

   Downstream Limit/Cross Section: _____

   Upstream Limit/Cross Section: _____

NOTE: FOR MORE STRUCTURES, ATTACH ADDITIONAL PAGES AS NEEDED.

B. CHANNELIZATION

Flooding Source: Happy Canyon Creek

Name of Structure: Belford Avenue Bridge

1. Hydraulic Considerations

The channel was designed to carry _____ (cfs) and/or the _____-year flood.

The design elevation in the channel is based on (check one):

☒ Subcritical flow ☐ Critical flow ☐ Supercritical flow ☐ Energy grade line

If there is the potential for a hydraulic jump at the following locations, check all that apply and attach an explanation of how the hydraulic jump is controlled without affecting the stability of the channel.

☐ Inlet to channel ☐ Outlet of channel ☒ At Drop Structures ☐ At Transitions

☐ Other locations (specify): _____

2. Channel Design Plans

Attach the plans of the channelization certified by a registered professional engineer, as described in the instructions.

3. Accessory Structures

The channelization includes (check one):

☐ Levees [Attach Section E (Levee/Floodwall)] ☒ Drop structures ☐ Superelevated sections

☒ Transitions in cross sectional geometry ☐ Debris basin/detention basin [Attach Section D (Dam/Basin)] ☐ Energy dissipator

☐ Weir ☐ Other (Describe):

4. Sediment Transport Considerations

Are the hydraulics of the channel affected by sediment transport? ☐ Yes ☒ No

If yes, then fill out Section F (Sediment Transport) of Form 3. If No, then attach your explanation for why sediment transport was not considered.

C. BRIDGE/CULVERT

Flooding Source: Happy Canyon Creek

Name of Structure: Belford Avenue Bridge

1. This revision reflects (check one):

☒ Bridge/culvert not modeled in the FIS

☐ Modified bridge/culvert previously modeled in the FIS

☐ Revised analysis of bridge/culvert previously modeled in the FIS

2. Hydraulic model used to analyze the structure (e.g., HEC-2 with special bridge routine, WSPRO, HY8): HEC-RAS 4.1.0
If different than hydraulic analysis for the flooding source, justify why the hydraulic analysis used for the flooding source could not analyze the structures. Attach justification.

3. Attach plans of the structures certified by a registered professional engineer. The plan detail and information should include the following (check the information that has been provided):

☒ Dimensions (height, width, span, radius, length)
☐ Shape (culverts only)
☒ Material
☒ Beveling or Rounding
☒ Wing Wall Angle
☐ Skew Angle
☐ Distances Between Cross Sections
☐ Erosion Protection
☒ Low Chord Elevations – Upstream and Downstream
☒ Top of Road Elevations – Upstream and Downstream
☐ Structure Invert Elevations – Upstream and Downstream
☐ Stream Invert Elevations – Upstream and Downstream
☐ Cross-Section Locations

4. Sediment Transport Considerations

Are the hydraulics of the structure affected by sediment transport? ☐ Yes ☒ No

If Yes, then fill out Section F (Sediment Transport) of Form 3. If no, then attach an explanation.

B. CHANNELIZATION

Flooding Source: Happy Canyon Creek

Name of Structure: E-470 Pedestrian Trail Crossing

1. Hydraulic Considerations

The channel was designed to carry _____ (cfs) and/or the 2-year flood.

The design elevation in the channel is based on (check one):

☒ Subcritical flow ☐ Critical flow ☐ Supercritical flow ☐ Energy grade line

If there is the potential for a hydraulic jump at the following locations, check all that apply and attach an explanation of how the hydraulic jump is controlled without affecting the stability of the channel.

☐ Inlet to channel ☐ Outlet of channel ☒ At Drop Structures ☐ At Transitions

☐ Other locations (specify): _____

2. Channel Design Plans

Attach the plans of the channelization certified by a registered professional engineer, as described in the instructions.

3. Accessory Structures

The channelization includes (check one):

☐ Levees [Attach Section E (Levee/Floodwall)] ☒ Drop structures ☐ Superelevated sections

☒ Transitions in cross sectional geometry ☐ Debris basin/detention basin [Attach Section D (Dam/Basin)] ☐ Energy dissipator

☐ Weir ☐ Other (Describe):

4. Sediment Transport Considerations

Are the hydraulics of the channel affected by sediment transport? ☐ Yes ☒ No

If yes, then fill out Section F (Sediment Transport) of Form 3. If No, then attach your explanation for why sediment transport was not considered.

C. BRIDGE/CULVERT

Flooding Source: Happy Canyon Creek

Name of Structure: E-470 Pedestrian Trail Crossing

1. This revision reflects (check one):

☒ Bridge/culvert not modeled in the FIS

☐ Modified bridge/culvert previously modeled in the FIS

☐ Revised analysis of bridge/culvert previously modeled in the FIS

2. Hydraulic model used to analyze the structure (e.g., HEC-2 with special bridge routine, WSPRO, HY8): HEC-RAS 4.1.0
If different than hydraulic analysis for the flooding source, justify why the hydraulic analysis used for the flooding source could not analyze the structures. Attach justification.

3. Attach plans of the structures certified by a registered professional engineer. The plan detail and information should include the following (check the information that has been provided):

☒ Dimensions (height, width, span, radius, length)
☒ Shape (culverts only)
☒ Material
☐ Beveling or Rounding
☒ Wing Wall Angle
☒ Skew Angle
☐ Distances Between Cross Sections
☐ Erosion Protection
☒ Low Chord Elevations – Upstream and Downstream
☒ Top of Road Elevations – Upstream and Downstream
☒ Structure Invert Elevations – Upstream and Downstream
☒ Stream Invert Elevations – Upstream and Downstream
☐ Cross-Section Locations

4. Sediment Transport Considerations

Are the hydraulics of the structure affected by sediment transport? ☐ Yes ☒ No

If Yes, then fill out Section F (Sediment Transport) of Form 3. If no, then attach an explanation.

SMITH ENVIRONMENTAL & ENGINEERING
Delivering Sustainable Environmental Solutions

RECEIVED
APR 14 2016

U.S. FISH AND WILDLIFE SERVICE
☒ NO CONCERNS
☐ CONCUR NOT LIKELY TO ADVERSELY AFFECT
☐ NO COMMENT
5/9/16
DRUE L. DEBERRY — DATE
ACTING COLORADO FIELD SUPERVISOR

MAIL TRANSMITTAL SHEET

TO: US Fish and Wildlife Service, Colorado Field Office

ATTN: Drue DeBerry

FROM: Darrin Masters, Smith Environmental and Engineering

DATE: April 11, 2016

RE: Happy Canyon Creek Project

Attached please find one copy of the following:

- Habitat Suitability Assessment for the Happy Canyon Creek Improvement Project, Douglas County, Colorado

WWW.SMITHDELIVERS.COM
1490 W. 121st Avenue Suite 101 Westminster, CO 80234 phone: 720.887.4928 fax: 720.887.4680

SMITH ENVIRONMENTAL AND ENGINEERING
Delivering Smart Solutions for Planning, Permitting, & Design

January 5, 2016

Mr. Drue DeBerry
Colorado State Supervisor
U.S. Fish and Wildlife Service
Colorado Field Office
P.O. Box 25486, DFC (MS65412)
Denver, CO 80225-0486

Re: Habitat Suitability Assessment for Federally Threatened and Endangered Species for the Happy Canyon Creek Improvement Project.

Dear Mr. DeBerry:

This letter presents the results of a habitat suitability assessment (HSA) for federally listed threatened and endangered species (TES) completed by Smith Environmental and Engineering (SMITH) for the Compark development's proposed improvements to Happy Canyon Creek. The purpose of this HSA is to: 1) determine whether the selected species' habitat is currently in the Study Area, and 2) the likelihood of the selected species occurring in the Study Area.

STUDY AREA AND PROJECT DESCRIPTION

The Study Area consists of approximately 7.3 ac located along Happy Canyon Creek in unincorporated Douglas County, Colorado (see Figure 1). The Study Area is located south of E-470 and west of S Chambers Road. The Study Area is located in Sections 6 and 7 of Township 6 South, Range 66 West of the 6th Principal Meridian on the Parker, Colorado, U.S. Geological Survey (USGS) quadrangle. The center of the Study Area is located at 39.553 degrees north, 104.817 degrees west at an elevation of approximately 5,800 ft.

Compark proposes to construct a new bridge and roadway approaches over Happy Canyon Creek as a part of an access road that will connect S. Chambers Road with a future development area to the west. These improvements will also include permanent bank stabilization in and adjacent to Happy Canyon Creek.

EXISTING HABITAT

Happy Canyon Creek is identified on the USGS topographic map as a sand wash within the Study Area, though it is marked as an intermittent stream farther downstream. Historically, the natural course of Happy Canyon Creek led to a confluence with Cherry Creek, but development along the Front Range altered this hydrology. Happy Canyon Creek is a tributary to Cherry Creek, but the connection is now facilitated by means of pipes and culverts. Within the Study Area, the Happy Canyon Creek floodplain is broad, flat and sandy, and some water was flowing at the time of the investigation (see photos in Appendix A).

SMITH ENVIRONMENTAL AND ENGINEERING
1490 W 121st Avenue, Suite 101
Westminster, Colorado 80234
(720) 887-4928, (720) 887-4680 (fax)

HAPPY CANYON CREEK IMPROVEMENTS

0 300 600 Feet

Figure 1
Study Area

Douglas County, Colorado
January 2016

Vegetation along the creek corridor varied significantly in the Study Area. The sharpest contrast occurred between the upstream segment, located near the private residences, and the downstream segment near E-470. The downstream banks were very steep and eroded, and upland grasses were growing up to the edge of the cut. Species observed included smooth brome (*Bromus inermis*), field brome (*Bromus arvensis*), sideoats grama (*Bouteloua curtipendula*), yucca (*Yucca* spp.), common mullein (*Verbascum thapsus*), sweetclover (*Melilotus officinalis*) and horseweed (*Conyza canadensis*).

Farther upstream, the erosion was less extreme and wetland vegetation was able to establish along the edge of the banks. Species observed in these areas included plains cottonwood (*Populus deltoides*), sandbar willow (*Salix exigua*), redtop (*Agrostis gigantea*), common threesquare (*Schoenoplectus pungens*), arctic rush (*Juncus arcticus*) and Torrey's rush (*Juncus torreyi*). Species observed on the fringes included Canada thistle (*Cirsium arvense*), Wood's rose (*Rosa woodsii*), wild licorice (*Glycyrrhiza lepidota*) and curly dock (*Rumex crispus*). In one area, the wetland extended inland nearly 50 ft from the edge of the bank. Portions of this area were so wet that cattails (*Typha* spp.) and Nebraska sedge (*Carex nebrascensis*) were thriving.

Soils in the Study Area have been mapped by the Natural Resource Conservation Service (NRCS). The creek drainage consists primarily of loamy alluvial land which is a well-drained soil found in floodplains. The NRCS also maps smaller areas of Newlin gravelly sandy loam and Santana loam. Newlin soils are well drained soils that occur on plateaus, terraces and mesas. Santana loams occur terraces and ridges and are also well drained (NRCS 2015).

HABITAT SUITABILITY ASSESSMENT

Ten TES were investigated for this HSA, because the U.S. Fish and Wildlife Service (USFWS) Information for Planning and Conservation (IPaC) lists them as potentially being impacted by projects occurring the Study Area (USFWS 2015). These species are listed in Table 1 with an explanation of their potential to occur in the Study Area and their potential to be affected by the Project.

Table 1. Habitat Suitability Assessment for Federally Listed Species

Species	Listing Status	Potential for Species to Occur in the Study Area
BIRDS		
Least Tern (*Sterna antillarum*)	FE	Habitat for the tern does not occur in the Study Area., and this Project does not propose to deplete water from the South Platte River or its alluvium. Therefore SMITH believes the proposed Project will have no effect on this species.
Mexican Spotted Owl (*Strix occidentalis lucida*)	FT	The owl is known to occur in Douglas County, and critical habitat has been established approximately 17 miles southwest of the Study Area. However, the Study Area does not provide suitable habitat of old growth forests and rock outcrops in steep canyon areas. SMITH believes there is no potential for the owl to occur in the Study Area, and the proposed Project will have no effect on this species.
Piping Plover (*Charadrius melodus*)	FT	Habitat for the plover does not occur in the Study Area., and this Project does not propose to deplete water from the South Platte River or its alluvium. Therefore SMITH believes the proposed Project will have no effect on this species.

Whooping Crane (*Grus americana*)	FE	Habitat for the crane does not occur in the Study Area., and this Project does not propose to deplete water from the South Platte River or its alluvium. Therefore SMITH believes the proposed Project will have no effect on this species.
FISH		
Greenback cutthroat trout (*Oncorhynchus clarki stomias*)	FT	Happy Canyon Creek is an intermittent stream with a sandy bed that was very shallow at the time of the investigation. It does not provide the necessary habitat conditions to support trout. Also, recent genetic analysis has shown that the only true population of the trout currently survives in Bear Creek west of Colorado Springs (Metcalf et al. 2012). SMITH believes there is no potential for the trout to occur in the Study Area, and the proposed Project will have no effect on this species.
Pallid sturgeon (*Scaphirhynchus albus*)	FE	Habitat for the sturgeon does not occur in the Study Area., and this Project does not propose to deplete water from the South Platte River or its alluvium. Therefore SMITH believes the proposed Project will have no effect on this species.
MAMMALS		
Preble's meadow jumping mouse (*Zapus hudsonius preblei*)	FT	Typical habitat for the Preble's meadow jumping mouse includes well-developed plains riparian vegetation with adjacent, undisturbed grasslands and a nearby water source. The Study Area occurs within the Denver Metropolitan Block Clearance Area for the Preble's meadow jumping mouse (*Zapus hudsonius preblei*) (Urban Drainage and Flood Control District 2010). Therefore SMITH believes the proposed Project will have no effect on this species.
PLANTS		
Colorado butterfly plant (*Gaura neomexicana* var. *coloradensis*)	FT	The Colorado butterfly plant is known to occur in subirrigated, alluvial soils with mesic moisture regimes in early- to mid-successional plant communities. The Study Area does provide these habitat conditions along Happy Canyon Creek; the banks are not steeply eroded in most areas and there are areas where the canopy is open. Although the plant has been historically documented in Douglas County, it is now believed that those occurrences have been extirpated (Colorado Natural Heritage Program 1997+). Although the plant could potentially thrive in the Study Area, the proposed Project will not alter the character of the existing habitat. Furthermore, SMITH believes that this species does not occur in Douglas County, and therefore the proposed Project will have no effect on this species.
Ute ladies'-tresses orchid (*Spiranthes diluvialis*)	FT	The Ute ladies'-tresses orchid (ULTO) is known to occur in seasonally moist soils and wet meadows between 4,500 and 6,500 ft. The orchid thrives in areas that do not experience high flow events, and Happy Canyon Creek is subject to seasonal flooding. Furthermore, there are currently no known current or historically documented populations in Douglas County (Colorado Natural Heritage Program 1997+). SMITH believes that there is no potential for the orchid to occur in the Study Area, and the proposed Project will have no effect on this species.
Western prairie fringed orchid	FT	Habitat for the orchid does not occur in the Study Area., and this Project does not propose to deplete water from the South Platte River or

(*Platanthera praeclara*)		its alluvium. Therefore SMITH believes the proposed Project will have no effect on this species.

FT = Federally Threatened; FE = Federally Endangered

CONCLUSIONS

SMITH concludes that the proposed Project should have no effect on any federally listed threatened or endangered species. SMITH requests concurrence on these opinions from the USFWS on behalf of the Project sponsor.

REFERENCES

Colorado Natural Heritage Program. 1997+. Colorado Rare Plant Guide. Available at: www.cnhp.colostate.edu. Latest update: June 30, 2014.

Metcalf, J. L., Love Stowell, S., Kennedy, C. M., Rogers, K. B., McDonald, D., Epp, J., Keepers, K., Cooper, A., Austin, J. J. and Martin, A. P. 2012. Historical stocking data and 19th century DNA reveal human-induced changes to native diversity and distribution of cutthroat trout. Molecular Ecology 21:21, pp. 5194-5207.

NRCS. 2015. United States Department of Agriculture, Web Soil Survey. Available online at http://websoilsurvey.nrcs.usda.gov/. Accessed November 17, 2015.

Urban Drainage and Flood Control District. 2010. Preble's Meadow Jumping Mouse, Ute-ladies' Tresses Orchid and Colorado Butterfly Plant Block Clearances for the Denver Metropolitan Area – Revised 2010. Denver, Colorado.

USFWS. 2015. IPaC - Information, Planning and Conservation System. Available online at: http://ecos.fws.gov/ipac/. Accessed November 17, 2015.

PERSONNEL

Rebecca Hannon, Environmental Scientist II of SMITH investigated this site.

SMITH requests concurrence on the opinions in this assessment from USFWS on behalf of the project sponsor. If you have any questions about this assessment, please call me at (303) 551-7980.

Sincerely,
Smith Environmental and Engineering

Darrin Masters, Certified Wildlife Biologist®
Senior Environmental Scientist

cc: Russell Burrows, Manhard Consulting, Ltd.

APPENDIX A - PHOTOS OF THE STUDY AREA

Photo1. A portion of Happy Canyon Creek where wetlands are supported, especially on the far bank. The shallow water that was flowing is also visible.

Photo 2. View of wetland vegetation that has established in the floodplain bench along Happy Canyon Creek. Willows occur above an understory of common threesquare, rushes and wetland grasses.

Photo 3. View looking south at wet area that extends inland from Happy Canyon Creek. Cattails and sedges are growing in the wettest areas.

Photo4. View of the upstream segment of Happy Canyon Creek near the private residences. The cut bank and the sandy soils are precluding the establishment of wetland vegetation.

DEPARTMENT OF THE ARMY
CORPS OF ENGINEERS, OMAHA DISTRICT
DENVER REGULATORY OFFICE, 9307 SOUTH WADSWORTH BOULEVARD
LITTLETON, COLORADO 80128-6901

November 13, 2017

SUBJECT: Nationwide Permit Verification – Corps File No. NWO-2017-01897-DEN, Compark South Project, Douglas County, Colorado

Michael Vickers
Belford South Metropolitan District
8390 East Crescent Parkway, Suite 500
Greenwood Village, CO 80111

Dear Mr. Vickers:

This letter is in reference to the proposed project located at approximately 39.553041°N, -104.821996°W, in Douglas County, Colorado. The work as described in your submittal will consist of constructing a road bridge crossing over Happy Canyon Creek, replacing an existing pedestrian bridge over Happy Canyon Creek, and installing three buried channel stabilization structures in Happy Canyon Creek, all in direct support of a residential development. This project will cause temporary impacts to 0.486 acre of Happy Canyon Creek and to 0.1657 acre of adjacent wetlands, and will cause permanent impacts to 0.049 acre of Happy Canyon Creek.

Based on the information provided, this office has determined that the work is authorized by the **Department of the Army Nationwide Permit (NWP) 29, Residential Developments**, found in the January 6, 2017, Federal Register. Enclosed is a fact sheet, which fully describes this Nationwide Permit and lists the General Conditions, and Colorado Regional Conditions, which must be adhered to for this authorization to remain valid. In addition, the following Special Conditions must be followed:

1. In order for this Nationwide Permit verification to be valid, 0.1657 acre of wetland shall be restored where impacted.
2. The created wetlands will be considered successful and self-sustaining when the following conditions have been met without intervention in the form of irrigation, removal of undesirable vegetation or replanting of desirable vegetation for a period of two consecutive years, as determined by the Corps of Engineers:
    a) At least 80 % (determined by ocular estimate of herbaceous and shrub foliar cover) of the mitigation site is vegetated, with at least 50% of the total number of dominant species present will consist of species rated as facultative or wetter.
    b) Those species shown on the Colorado Noxious Weed Inventory list-A shall be 100% eradicated. Those species shown on list-B shall be no more than 5% or less of the total cover in the mitigation area. The lists can be found at http://www.colorado.gov/cs/Satellite/ag_Conservation/CBON/1251618874438

3. A mitigation monitoring report documenting growing season conditions shall be sent to the Denver Regulatory Office prior to December 31st of each year, for a period of at least three years, or until the Corps of Engineers determines that the 0.1657 acre of wetlands has successfully developed.

4. Annual reports shall be formatted per the attached Annual Mitigation Monitoring Report Formatting Requirements. If the authorized work has not yet started, please state so in the annual mitigation monitoring report.

Although an Individual Department of the Army permit will not be required for this work, this does not eliminate the requirement that any other applicable federal, state, tribal or local permits be obtained as required. Please be advised that deviations from the original plans and specifications of this project could require additional authorization from this office.

The applicant is responsible for all work accomplished in accordance with the terms and conditions of the nationwide permit. If a contractor or other authorized representative will be accomplishing the work authorized by the nationwide permit on behalf of the applicant, it is strongly recommended that they be provided a copy of this letter and the enclosed conditions so that they are aware of the limitations of the applicable nationwide permit. Any activity which fails to comply with all the terms and conditions of the nationwide permit will be considered unauthorized and subject to appropriate enforcement action.

This verification will be valid until March 18, 2022. In compliance with General Condition 30, the enclosed "Certification of Completed Work" form (blue) must be signed and returned to this office upon completion of the authorized work and any required mitigation.

If there are any questions please feel free to contact Angelle Greer at (303) 979-4120 or by e-mail at Angelle.V.Greer@usace.army.mil, and reference **Corps File No. NWO-2017-01897-DEN**.

Sincerely,

Aaron Eilers
Chief, Denver Regulatory Office

Enclosure(s)
Nationwide Permit 29, Residential Developments
Certification of Completed Work
Annual Mitigation Monitoring Report Format Requirements

Copies Furnished:
Esa Crumb, ERO Resources Corporation, 1842 Clarkson Street, Denver, CO/80218

DRAFT

April 11, 2019

470 Compark LLC
C/O MPV Compark Management LLC 290
Fillmore St. STE 2
Denver, CO. 80206

Re: Notification of proposed changes to the FEMA Flood Insurance Rate Map (FIRM) and proposed changes to the floodway for Happy Canyon Creek associated with the Belford Avenue Bridge and Happy Canyon Creek Project.

Notice for Property: No Address, Parcel #: 2233-064-00-012

To Whom It May Concern,

The Flood Insurance Rate Map (FIRM) for a community depicts the Special Flood Hazard Area (SFHA), the area which has been determined to be subject to a 1% (100-year) or greater chance of flooding in any given year. The floodway is the portion of the floodplain that includes the channel of a river or other watercourse and the adjacent land area that must be reserved in order to discharge the 1% annual chance (base) flood without cumulatively increasing the water-surface elevation by more than a designated height. The FIRM is used to determine flood insurance rates and to help the community with floodplain management.

Belford South Metropolitan District is applying for a Conditional Letter of Map Revision (CLOMR) from the Federal Emergency Management Agency (FEMA) to revise FIRM's 08035C0062G and 08035C0066G for the Town of Parker, Douglas County, Colorado. Manhard Consulting Ltd is proposing a new bridge structure over Happy Canyon Creek that will connect Belford Avenue from S. Peoria St. to the west to S. Chambers Road to the east. The Belford Ave. Bridge structure will be built in phases. The first phase includes the eastbound roadway lanes, sidewalk and southern half of the bridge structure. A future phase will include the westbound lanes, sidewalk and remaining north half of the bridge structure.

The proposed project will result in increases in the 1% annual chance (base) water-surface elevations for a portion of Happy Canyon Creek, when comparing existing conditions to proposed conditions. A rise does occur on your property.

Once the project has been completed, a Letter of Map Revision (LOMR) request should be submitted that will, in part, revise the following flood hazards along Happy Canyon Creek.

1. The floodway will be revised from downstream (north) of E-470 to north of Filbert Avenue along Happy Canyon Creek.
2. Base Flood Elevations (BFEs) will both increase and decrease along Happy Canyon Creek. On your property, the BFEs will both increase and decrease.
3. The SFHA will both increase and decrease along Happy Canyon Creek. On your property, the SFHA will both increase about 0.8 feet and decrease about 1.4 feet.

This letter is to inform you of the proposed project that may affect flood elevations on your property at Parcel #: 2233-064-00-012 located in Douglas County, Colorado. This letter is also to inform you of the potential changes to the effective flood hazard information that would result after the project is completed and a LOMR request is submitted to FEMA.

Maps and detailed analysis of the proposed flood hazard revisions can be reviewed at the Town of Parker at 20120 E. Mainstreet, Parker, CO 80138. If you have any questions or concerns about the proposed project or its effect on your property, you may contact Mr. Rick Moore at either 303-708-

0500 or by email at rick.moore@manhard.com or Mr. Jacob James at the Town of Parker at 303-840-9546.

Sincerely,

Michael Vickers
Belford South Metropolitan District 8390
East Crescent Parkway, Suite 500
Greenwood Village, CO 80111

DRAFT

April 11, 2019

Compark 190 LLC
Attn: Steve Gruenler
4600 S. Ulster St. STE 1400
Denver, CO. 80237

Re: Notification of proposed changes to the FEMA Flood Insurance Rate Map (FIRM) and proposed changes to the floodway for Happy Canyon Creek associated with the Belford Avenue Bridge and Happy Canyon Creek Project.

Notice for Property: No Address, Parcel #: 2233-053-00-001

To Whom It May Concern,

The Flood Insurance Rate Map (FIRM) for a community depicts the Special Flood Hazard Area (SFHA), the area which has been determined to be subject to a 1% (100-year) or greater chance of flooding in any given year. The floodway is the portion of the floodplain that includes the channel of a river or other watercourse and the adjacent land area that must be reserved in order to discharge the 1% annual chance (base) flood without cumulatively increasing the water-surface elevation by more than a designated height. The FIRM is used to determine flood insurance rates and to help the community with floodplain management.

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0500 or by email at rick.moore@manhard.com or Mr. Jacob James at the Town of Parker at 303-840-9546.

Sincerely,

Michael Vickers
Belford South Metropolitan District 8390
East Crescent Parkway, Suite 500
Greenwood Village, CO 80111

DRAFT

April 11, 2019

E470 Public Highway Authority
22470 E. 6th Pkwy STE 100
Aurora, CO. 80018

Re: Notification of proposed changes to the FEMA Flood Insurance Rate Map (FIRM) and proposed changes to the floodway for Happy Canyon Creek associated with the Belford Avenue Bridge and Happy Canyon Creek Project.

Notice for Property: No Address, Parcel #: 2233-064-99-002

To Whom It May Concern,

The Flood Insurance Rate Map (FIRM) for a community depicts the Special Flood Hazard Area (SFHA), the area which has been determined to be subject to a 1% (100-year) or greater chance of flooding in any given year. The floodway is the portion of the floodplain that includes the channel of a river or other watercourse and the adjacent land area that must be reserved in order to discharge the 1% annual chance (base) flood without cumulatively increasing the water-surface elevation by more than a designated height. The FIRM is used to determine flood insurance rates and to help the community with floodplain management.

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3. The SFHA will both increase and decrease along Happy Canyon Creek. On your property, the SFHA will increase about 0.5 feet.

This letter is to inform you of the proposed project that may affect flood elevations on your property at Parcel #: 2233-064-99-002 located in Douglas County, Colorado. This letter is also to inform you of the potential changes to the effective flood hazard information that would result after the project is completed and a LOMR request is submitted to FEMA.

Maps and detailed analysis of the proposed flood hazard revisions can be reviewed at the Town of Parker at 20120 E. Mainstreet, Parker, CO 80138. If you have any questions or concerns about the proposed project or its effect on your property, you may contact Mr. Rick Moore at either 303-708-

0500 or by email at rick.moore@manhard.com or Mr. Jacob James at the Town of Parker at 303-840-9546.

Sincerely,

Michael Vickers
Belford South Metropolitan District 8390
East Crescent Parkway, Suite 500
Greenwood Village, CO 80111

DRAFT

April 11, 2019

Platte Valley Commercial Corp.
4900 Main St.
Kansas City, MO. 64112

Re: Notification of proposed changes to the FEMA Flood Insurance Rate Map (FIRM) and proposed changes to the floodway for Happy Canyon Creek associated with the Belford Avenue Bridge and Happy Canyon Creek Project.

Notice for Property: No Address, Parcel #: 2233-050-00-009

To Whom It May Concern,

The Flood Insurance Rate Map (FIRM) for a community depicts the Special Flood Hazard Area (SFHA), the area which has been determined to be subject to a 1% (100-year) or greater chance of flooding in any given year. The floodway is the portion of the floodplain that includes the channel of a river or other watercourse and the adjacent land area that must be reserved in order to discharge the 1% annual chance (base) flood without cumulatively increasing the water-surface elevation by more than a designated height. The FIRM is used to determine flood insurance rates and to help the community with floodplain management.

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3. The SFHA will both increase and decrease along Happy Canyon Creek. On your property, the SFHA will increase about 0.5 feet.

This letter is to inform you of the proposed project that may affect flood elevations on your property at Parcel #: 2233-050-00-009 located in Douglas County, Colorado. This letter is also to inform you of the potential changes to the effective flood hazard information that would result after the project is completed and a LOMR request is submitted to FEMA.

Maps and detailed analysis of the proposed flood hazard revisions can be reviewed at the Town of Parker at 20120 E. Mainstreet, Parker, CO 80138. If you have any questions or concerns about the proposed project or its effect on your property, you may contact Mr. Rick Moore at either 303-708-

0500 or by email at rick.moore@manhard.com or Mr. Jacob James at the Town of Parker at 303-840-9546.

Sincerely,

Michael Vickers
Belford South Metropolitan District 8390
East Crescent Parkway, Suite 500
Greenwood Village, CO 80111

UDFCD DLOMC Submittal - BFE Comparison Table

Project Name :	**115360-01 Compark/Belford Avenue**
Flooding Source:	**Happy Canyon Creek**
Company:	**Felsburg Holt & Ullevig**
Completed By:	**ZJG**

SOURCE DATA											COMPARISONS				
HYDRAULIC CROSS-SECTION INFO.						BASE FLOOD ELEVATIONS (NAVD)									
Effective Cross-Section ID (Letter)	Corrected Effective Cross-Section ID	Corrected Effective Stream Station	Existing Cross-Section ID	Proposed Cross-Section ID	Proposed Stream Station	EFFECTIVE	DUP. EFF.	COR. EFF.	EXISTING	PROPOSED	DUP. EFF vs. EFF.	COR. EFF. vs. EFF.	EX. vs. COR. EFF.	PP. vs. COR. EFF.	PP. vs. EFF.
						BFE	BFE	BFE	BFE	BFE	BFE	BFE	BFE	BFE	BFE
10111	10111	10111	10111	10111	10111	5767.4	5767.4	5767.4	5767.4	5767.4	0.0	0.0	0.0	0.0	0.0
10157	10157	10157	10157	10157	10157	5767.9	5767.9	5767.9	5767.9	5767.9	0.0	0.0	0.0	0.0	0.0
10326	10326	10326	10326	10326	10326	5768.5	5768.5	5768.5	5768.5	5768.5	0.0	0.0	0.0	0.0	0.0
10548	10548	10548	10548	10548	10548	5770.4	5770.4	5770.5	5770.5	5770.5	0.0	0.0	0.0	0.0	0.1
10595	10595	10597	10595	10595	10597	5771.3	5771.3	5772.1	5772.1	5772.1	0.0	0.8	0.0	0.0	0.8
10679	10679	10691	10679	10679	10691	5772.1	5772.1	5772.5	5772.5	5772.5	0.0	0.4	0.0	0.0	0.4
-	10725	10735	10725	10725	10735	*5773.8*	*5773.8*	5775.0	5775.0	5775.6	0.0	1.3	0.0	0.6	1.8
10749	-	-	-	-	-	5774.9	5774.9	*5775.4*	*5775.4*	*5775.9*	0.0	0.4	0.0	0.5	1.0
-	-	-	-	10750	10764	*5774.9*	*5774.9*	*5775.4*	*5775.4*	5775.9	0.0	0.4	0.0	0.6	1.0
-	10775	10786	10775	-	-	*5774.9*	*5774.9*	5775.7	5775.7	*5776.0*	0.0	0.8	0.0	0.3	1.1
-	-	-	-	10810	10823	*5774.9*	*5774.9*	*5775.6*	*5775.6*	5776.1	0.0	0.6	0.0	0.6	1.2
-	-	-	-	10819	10833	*5775.0*	*5775.0*	*5775.6*	*5775.6*	5776.1	0.0	0.6	0.0	0.6	1.2
-	-	-	-	10825	10838	*5775.0*	*5775.0*	*5775.5*	*5775.5*	5776.2	0.0	0.5	0.0	0.6	1.2
10842	10842	10856	10842	-	-	5775.0	5775.0	5775.5	5775.5	*5776.1*	0.0	0.5	0.0	0.7	1.2
-	10900	10922	10900	10900	10915	*5774.9*	*5774.9*	5775.7	5775.7	5776.0	0.0	0.8	0.0	0.3	1.1
10974 (K)	10974	10995	10974	10974	10989	5774.9	5774.9	5775.5	5775.5	5776.0	0.0	0.6	0.0	0.5	1.1
-	11100	11050	11100	11100	11043	*5774.9*	*5774.9*	5775.4	5775.4	5776.1	0.0	0.5	0.0	0.7	1.2
11153	11153	11187	11153	-	-	5774.8	5774.8	5775.7	5775.7	*5776.3*	0.0	0.9	0.0	0.6	1.5
-	11180	11230	11180	11180	11215	*5774.9*	*5774.9*	5775.5	5775.5	5776.4	0.0	0.6	0.0	0.9	1.5
-	11280	11321	11280	11280	11312	*5775.0*	*5775.0*	5776.0	5776.0	5776.5	0.0	1.0	0.0	0.4	1.5
-	11370	11424	11370	11370	11411	*5775.4*	*5775.4*	5776.3	5776.3	5776.4	0.0	0.9	0.0	0.1	1.0
-	11385	11440	11385	11385	11426	*5775.8*	*5775.8*	5776.5	5776.5	5776.3	0.0	0.7	0.0	-0.1	0.5
-	11400	11458	11400	11400	11441	*5775.8*	*5775.8*	5776.5	5776.5	5776.5	0.0	0.7	0.0	-0.1	0.7
-	11410	11465	11410	11410	11447	*5775.9*	*5775.9*	5776.6	5776.6	5776.5	0.0	0.7	0.0	-0.1	0.6
11494	11494	11544	11494	11494	11526	5776.8	5776.8	5777.2	5777.2	5777.1	0.0	0.4	0.0	-0.1	0.3
11620	11620	11680	11620	11620	11662	5779.3	5779.3	5779.7	5779.7	5779.7	0.0	0.4	0.0	0.0	0.3
11772 (L)	11772	11836	11772	-	-	5779.4	5779.4	5779.7	5779.7	*5779.7*	0.0	0.3	0.0	0.0	0.3
-	-	-	-	11800	11818	*5779.5*	*5779.5*	*5779.8*	*5779.8*	5779.8	0.0	0.3	0.0	0.0	0.3
-	-	-	-	11830	11979	*5779.6*	*5779.6*	*5779.9*	*5779.9*	5779.7	0.0	0.3	0.0	-0.2	0.1
-	-	-	-	11835	12011	*5779.7*	*5779.7*	*5780.0*	*5780.0*	5779.7	0.0	0.3	0.0	-0.2	0.1
11959	11959	12030	11959	11959	12017	5780.1	5780.1	5781.0	5781.0	5781.1	0.0	0.9	0.0	0.1	1.0
12129	12129	12213	12129	12129	12194	5781.6	5781.6	5783.0	5783.0	5783.0	0.0	1.3	0.0	0.0	1.3
12388	12388	12478	12388	12388	12460	5782.8	5782.8	5782.8	5782.8	5782.8	0.0	0.0	0.0	0.1	0.0
12541 (M)	12541	12631	12541	12541	12613	5784.7	5784.7	5784.7	5784.7	5784.4	0.0	0.0	0.0	-0.3	-0.3

-- = Not applicable or no direct comparison available

In anticipation, the FHAD Model was taken to be Effective in this comparison. Flows used were the 100-yr Future Flows (Q=8355 cfs @ E-470)

UDFCD LOMC AGREEMENT TABLE

PROJECT NAME:	115360-01 Compark/Belford Avenue
COMPANY:	Felsburg Holt & Ullevig
COMPLETED BY:	ZJG

Community(ies): Town of Parker & Douglas County, CO
Flooding Source(s): Happy Canyon Creek

Date: 4/19/2019

Reference Location	Stream Station	Cross Section #	Channel Distance (ft)			Cumulative Channel Distance (ft)			Base Floodplain Width (ft)			Floodway Width (ft)			Comments
			Model	Map	% Difference	Model	Map	% Difference	Model	Map	Difference (ft)	Model	Map	Difference (ft)	
		10111	0	0	#DIV/0!	0	0	#DIV/0!	459	448	11	459	448	11	*
		10157	45	45	0%	45	45	0%	264	241	23	264	241	23	*
D/S XS - E-470 Bridge		10326	169	169	0%	214	214	0%	92	91	1	92	91	1	*
U/S XS - E-470 Bridge		10548	223	223	0%	437	437	0%	116	117	1	116	117	1	*
		10595	46	48	4%	484	486	0%	121	140	19	121	140	19	*
		10679	94	94	0%	578	580	0%	104	110	6	104	110	6	*
		10725	43	44	2%	620	623	1%	185	185	0	185	185	0	*
D/S XS - E-470 Trail Crossing		10750	29	29	0%	650	653	1%	219	221	1	219	221	1	*
U/S XS - E-470 Trail Crossing		10810	59	59	0%	708	711	0%	285	284	1	285	284	1	*
		10819	9	9	5%	717	721	1%	292	291	0	292	291	0	*
		10825	6	6	4%	723	727	0%	295	291	4	295	291	4	*
		10900	77	76	1%	800	803	0%	245	250	5	245	250	5	*
		10974	74	74	0%	874	877	0%	205	211	6	205	211	6	*
D/S XS - Belford Avenue		11100	54	54	0%	928	931	0%	168	168	0	168	168	0	*
U/S XS - Belford Avenue		11180	168	169	0%	1097	1100	0%	179	183	4	179	183	4	*
		11280	87	86	1%	1183	1186	0%	186	187	0	186	187	0	*
		11370	66	66	0%	1249	1252	0%	185	192	7	185	192	7	*
		11385	15	15	0%	1264	1267	0%	171	172	1	171	172	1	*
		11400	15	15	0%	1279	1282	0%	164	162	2	164	162	2	*
		11410	6	6	0%	1285	1288	0%	159	159	0	159	159	0	*
		11494	128	129	0%	1414	1416	0%	127	124	3	127	124	3	*
		11620	136	136	0%	1550	1552	0%	236	240	4	236	240	4	*
		11800	179	179	0%	1729	1732	0%	200	200	1	200	200	1	*
		11830	30	32	5%	1759	1763	0%	203	203	0	203	203	0	*
		11835	6	6	0%	1765	1769	0%	202	203	1	202	203	1	*
		11959	130	130	0%	1895	1899	0%	209	209	1	209	209	1	*
		12129	182	182	0%	2077	2082	0%	303	295	8	303	295	8	*
		12388	259	266	3%	2336	2347	0%	353	342	11	353	342	11	*
		12541	153	153	0%	2489	2500	0%	477	487	10	477	487	10	*
ACCEPTABLE TOLERANCES =			**+/- 5% of Model**			**+/- 5% of Model**			**+/- 25 Feet**						

* - Floodway = Floodplain

Revised Area

NOTE: MAP AREA SHOWN ON THIS PANEL IS LOCATED WITHIN TOWNSHIP 6 SOUTH, RANGE 66 WEST.

LIMIT OF STUDY

1%-ANNUAL-CHANCE FLOOD DISCHARGE CONTAINED IN STRUCTURE

FLOOD HAZARD INFORMATION

SEE FIS REPORT FOR ZONE DESCRIPTIONS AND INDEX MAP

THE INFORMATION DEPICTED ON THIS MAP AND SUPPORTING DOCUMENTATION ARE ALSO AVAILABLE IN DIGITAL FORMAT AT

HTTP://MSC.FEMA.GOV

SPECIAL FLOOD HAZARD AREAS
- Without Base Flood Elevation (BFE) *Zone A,V, A99*
- With BFE or Depth *Zone AE, AO, AH, VE, AR*
- Regulatory Floodway

OTHER AREAS OF FLOOD HAZARD
- 0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile *Zone X*
- Future Conditions 1% Annual Chance Flood Hazard *Zone X*
- Area with Reduced Flood Risk due to Levee See Notes. *Zone X*

OTHER AREAS
- NO SCREEN — Areas of Minimal Flood Hazard *Zone X*
- Area of Undetermined Flood Hazard *Zone D*

GENERAL STRUCTURES
- Channel, Culvert, or Storm Sewer
- Accredited or Provisionally Accredited Levee, Dike, or Floodwall
- Non-accredited Levee, Dike, or Floodwall

OTHER FEATURES
- E — 18.2 / 17.5 — Cross Sections with 1% Annual Chance Water Surface Elevation (BFE)
- 8 — Coastal Transect
- Coastal Transect Baseline
- Profile Baseline
- Hydrographic Feature
- 513 — Base Flood Elevation Line (BFE)
- Limit of Study
- Jurisdiction Boundary

NOTES TO USERS

For information and questions about this map, available products associated with this FIRM including historic versions of this FIRM, how to order products or the National Flood Insurance Program in general, please call the FEMA Map Information eXchange at 1-877-FEMA-MAP (1-877-336-2627) or visit the FEMA Map Service Center website at http://msc.fema.gov. Available products may include previously issued Letters of Map Change, a Flood Insurance Study Report, and/or digital versions of this map. Many of these products can be ordered or obtained directly from the website. Users may determine the current map date for each FIRM panel by visiting the FEMA Map Service Center website or by calling the FEMA Map Information eXchange.

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Base map information shown on this FIRM was provided by the Douglas County GIS Department and the Town of Castle Rock GIS Department. Additional input was provided by the City of Lone Tree and Town of Parker. These data are current as of 2003.

LOGO

SCALE

N

Map Projection:

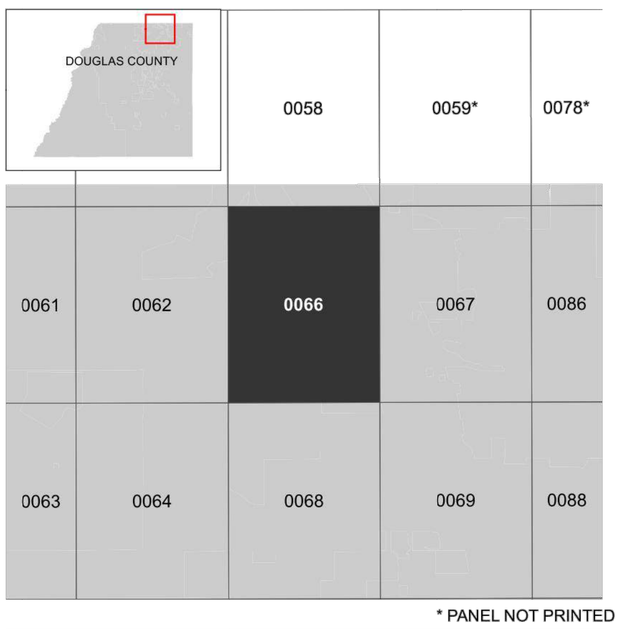
NAD83 UTM Zone 13N
Western Hemisphere; Vertical Datum:NAVD88

1 inch = 500 feet 1:6,000

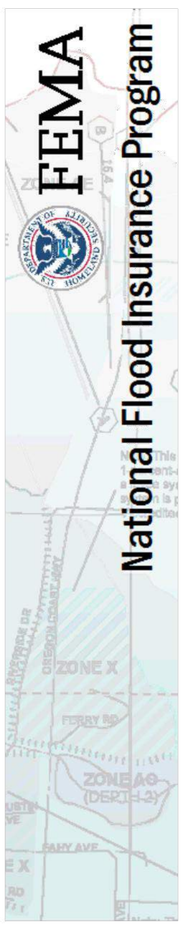
0 1,000 2,000 Feet

0 250 500 Meters

PANEL LOCATOR



* PANEL NOT PRINTED



NATIONAL FLOOD INSURANCE PROGRAM
FLOOD INSURANCE RATE MAP

DOUGLAS COUNTY, COLORADO
And Incorporated Areas

PANEL 66 OF 495

Panel Contains:

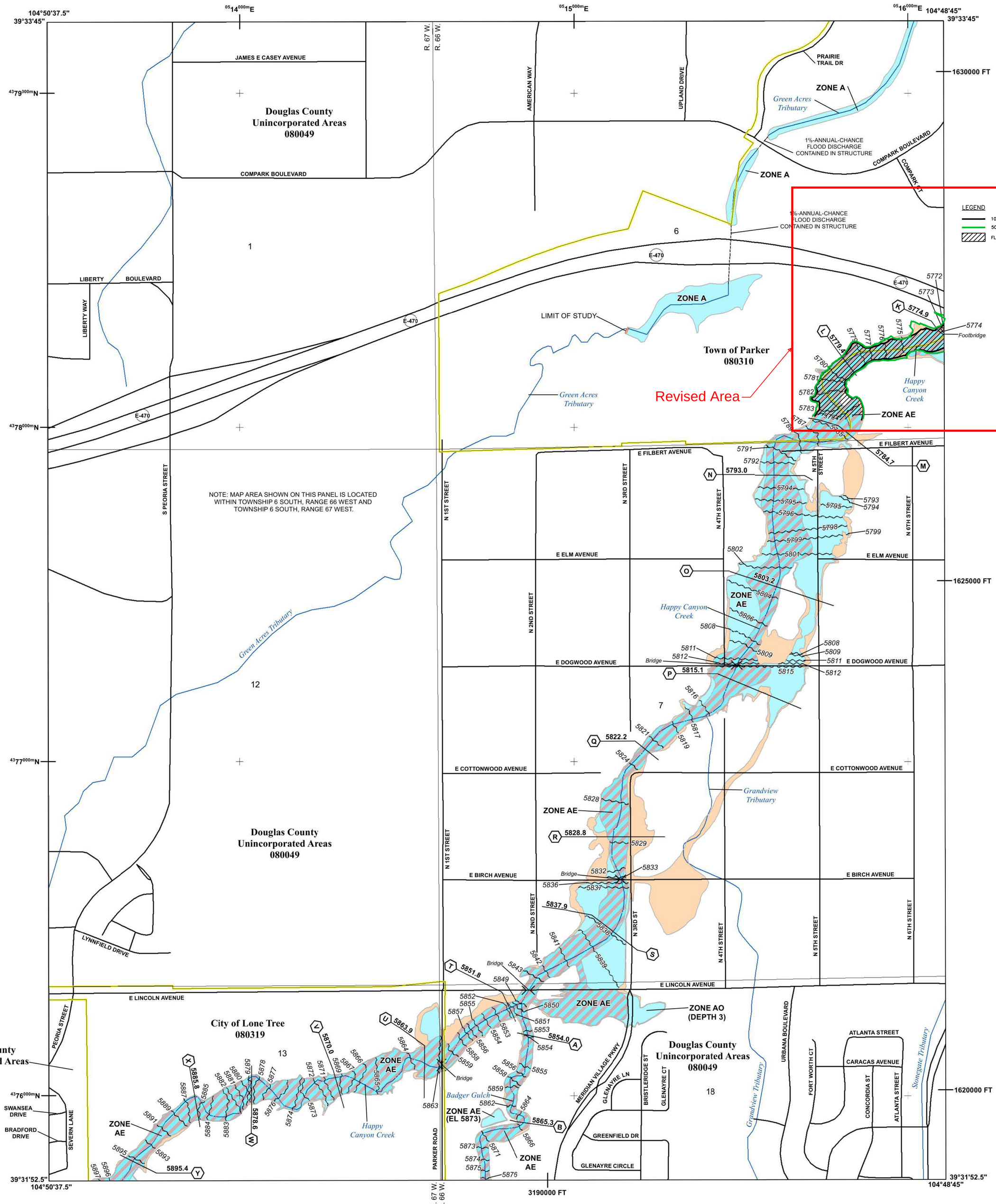
COMMUNITY	NUMBER	PANEL	SUFFIX
DOUGLAS COUNTY	080049	0066	H
PARKER, TOWN OF	080310	0066	H

PRELIMINARY
JUNE 30, 2016

VERSION NUMBER
2.3.3.2

MAP NUMBER
08035C0066H

MAP REVISED



FLOOD HAZARD INFORMATION

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

THE INFORMATION DEPICTED ON THIS MAP AND SUPPORTING DOCUMENTATION ARE ALSO AVAILABLE IN DIGITAL FORMAT AT

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SPECIAL FLOOD HAZARD AREAS

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- With BFE or Depth *Zone AE, AO, AH, VE, AR*
- Regulatory Floodway

OTHER AREAS OF FLOOD HAZARD

- 0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile *Zone X*
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OTHER AREAS

- NO SCREEN — Areas of Minimal Flood Hazard *Zone X*
- Area of Undetermined Flood Hazard *Zone D*

GENERAL STRUCTURES

- Channel, Culvert, or Storm Sewer
- Levee, Dike, or Floodwall

OTHER FEATURES

- 18.2 / 17.5 — Cross Sections with 1% Annual Chance Water Surface Elevation (BFE)
- 8 — Coastal Transect
- Coastal Transect Baseline
- Profile Baseline
- Hydrographic Feature
- 513 — Base Flood Elevation Line (BFE)
- Limit of Study
- Jurisdiction Boundary

NOTES TO USERS

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Base map information shown on this FIRM was provided by the Douglas County GIS Department and the Town of Castle Rock GIS Department. Additional input was provided by the City of Lone Tree and Town of Parker. These data are current as of 2003.

LOGO

SCALE

Map Projection:

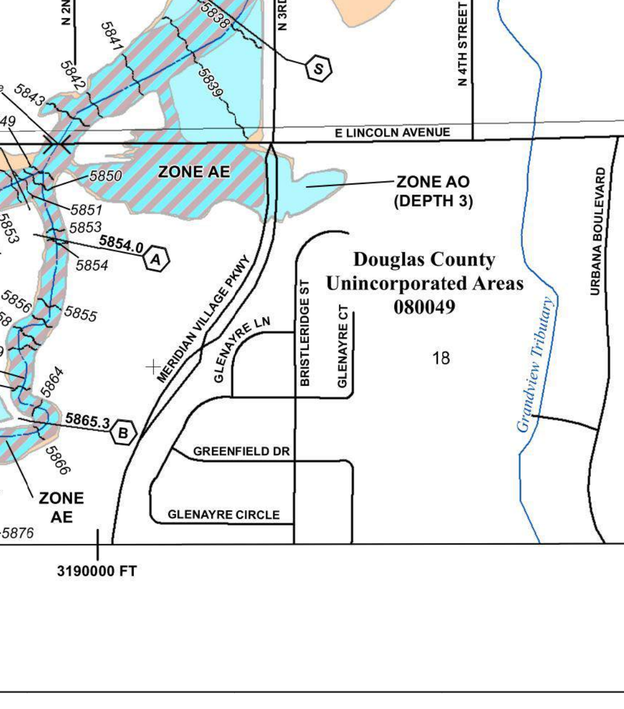
NAD83 UTM Zone 13N
Western Hemisphere; Vertical Datum: NAVD88

1 inch = 500 feet 1:6,000

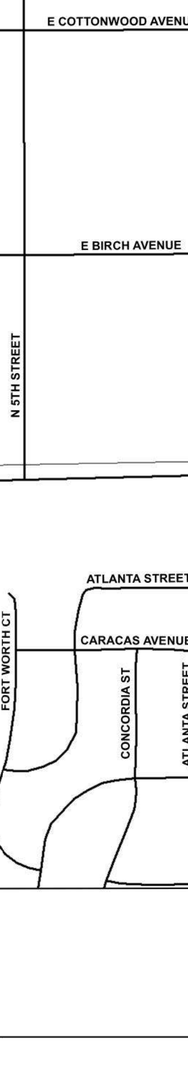
0 1,000 2,000 Feet

0 250 500 Meters

PANEL LOCATOR



* PANEL NOT PRINTED



NATIONAL FLOOD INSURANCE PROGRAM

FLOOD INSURANCE RATE MAP

DOUGLAS COUNTY, COLORADO
and Incorporated Areas

PANEL 62 OF 495

Panel Contains:

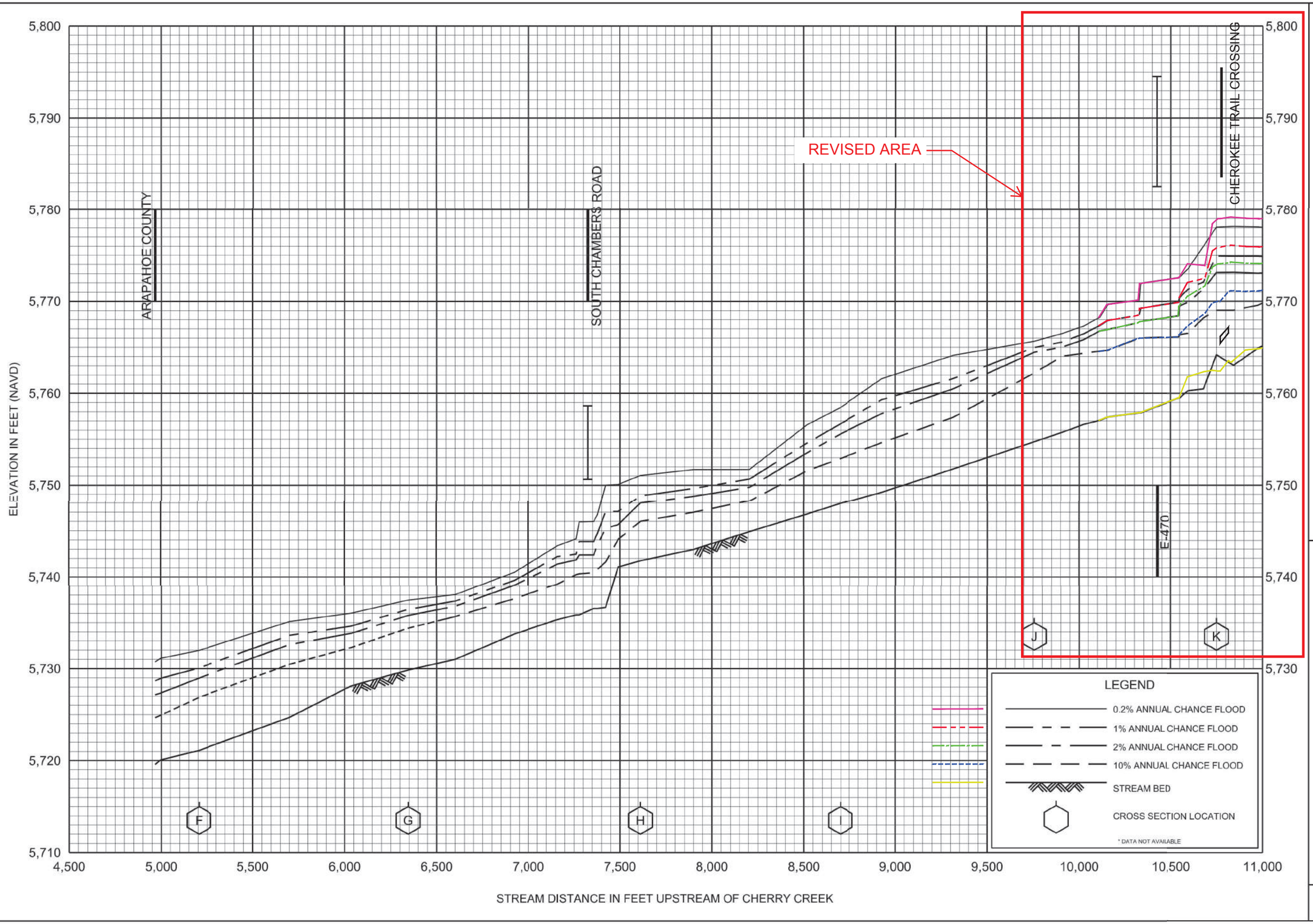
COMMUNITY	NUMBER	PANEL	SUFFIX
DOUGLAS COUNTY	080049	0062	H
LONE TREE, CITY OF	080319	0062	H
PARKER, TOWN OF	080310	0062	H

REVISED
PRELIMINARY
12/13/2018

VERSION NUMBER
2.3.3.2

MAP NUMBER
08035C0062H

MAP REVISED



FLOOD PROFILES

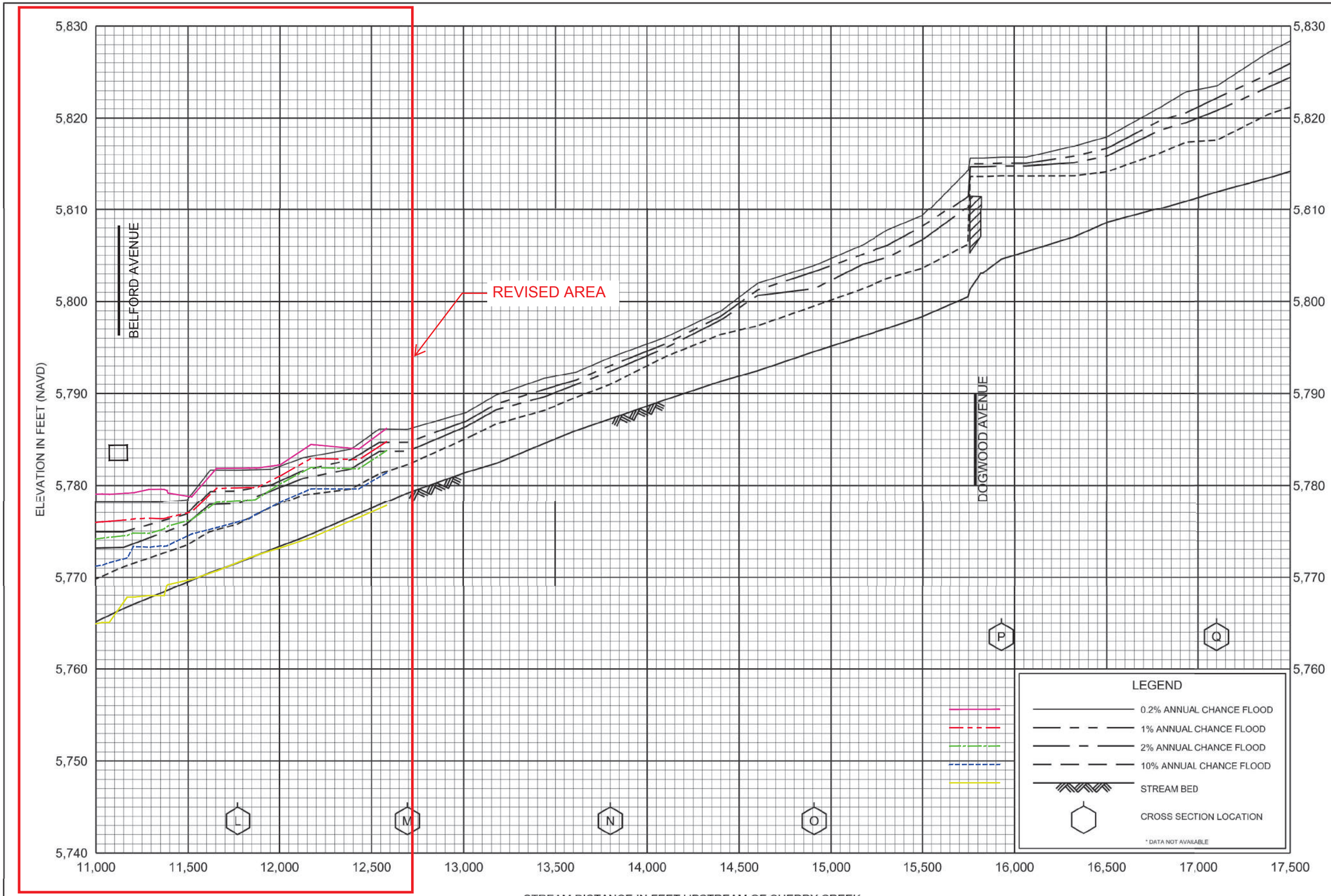
HAPPY CANYON CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

DOUGLAS COUNTY, CO

AND INCORPORATED AREAS

113P



FLOOD PROFILES

HAPPY CANYON CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

DOUGLAS COUNTY, CO

AND INCORPORATED AREAS

114P

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Happy Canyon Creek								
F	5,206	245	859	14.2	5,730.1	5,730.1	5,730.1	0.0
G	6,345	418	1,378	7.5	5,736.4	5,736.4	5,736.4	0.0
H	7,611	327	1,467	8.5	5,748.8	5,748.8	5,748.8	0.0
I	8,700	114	706	14.7	5,756.7	5,756.7	5,756.7	0.0
J	9,756	378	1,459	6.6	5,765.0	5,765.0	5,765.0	0.0
K	10,750	219	1,813	6.1	5,775.9	5,775.9	5,775.9	0.0
L	11,772	200	1,018	10.9	5,779.8	5,779.8	5,779.8	0.0
M	12,541	476	1,850	4.5	5,784.3	5,784.3	5,784.3	0.0
N	13,800	231	1,043	10.5	5,793.0	5,793.0	5,793.4	0.4
O	14,907	346	1,173	12.4	5,803.2	5,803.2	5,803.2	0.0
P	15,928	427	1,982	4.2	5,815.1	5,815.1	5,815.6	0.5
Q	17,100	90	605	16.6	5,822.2	5,822.2	5,822.3	0.1
R	18,063	205	968	12.8	5,828.8	5,828.8	5,828.8	0.0
S	19,040	233	1,778	4.3	5,837.9	5,837.9	5,838.4	0.5
T	20,347	160	914	7.0	5,851.8	5,851.8	5,851.8	0.0
U	21,423	315	1,808	5.5	5,863.9	5,863.9	5,863.9	0.0
V	22,534	207	740	14.7	5,870.0	5,870.0	5,870.0	0.0
W	23,660	270	905	12.7	5,878.6	5,878.6	5,878.6	0.0
X	24,604	241	805	13.6	5,885.8	5,885.8	5,885.8	0.0
Y	25,498	202	1,010	11.0	5,895.4	5,895.4	5,895.4	0.0
Z	26,842	220	681	11.5	5,906.5	5,906.5	5,906.5	0.0
AA	27,900	165	732	8.5	5,918.4	5,918.4	5,918.4	0.0
AB	29,034	415	1,552	3.9	5,932.4	5,932.4	5,932.4	0.0
AC	29,970	103	503	11.4	5,940.5	5,940.5	5,940.5	0.0

Revised Area

[1] Feet above confluence with Cherry Creek

TABLE 7

FEDERAL EMERGENCY MANAGEMENT AGENCY

ARAPAHOE COUNTY, CO
AND INCORPORATED AREAS

FLOODWAY DATA

HAPPY CANYON CREEK

FELSBURG HOLT & ULLEVIG

Job Title Happy Canyon Creek By ZJG Date 6/13/17 Job No. 115360-01

Subject Bridge Scour Checked Sheet 1 of

Vratio

$V_{shear} / V_{fall} = V_* / w$

$V_{shear} = V_* = (g\ y_1\ S_1)^{1/2}$ — 32.16; upstream depth (ft); E.G.L. slope (ft/ft)

$V_{*100} = (32.16 * 8.49 * 0.002589)^{1/2} = 0.84$

$V_{*500} = (32.16 * 11.45 * 0.00166)^{1/2} = 0.78$

d_{50} size = 0.005 ft (1.5 mm)

$V_{fall} = w = 0.7$

$V_{ratio_{100}} = V_{*100} / w = 0.84 / 0.7 = 1.2$

$V_{ratio_{500}} = V_{*500} / w = 0.78 / 0.7 = 1.11$

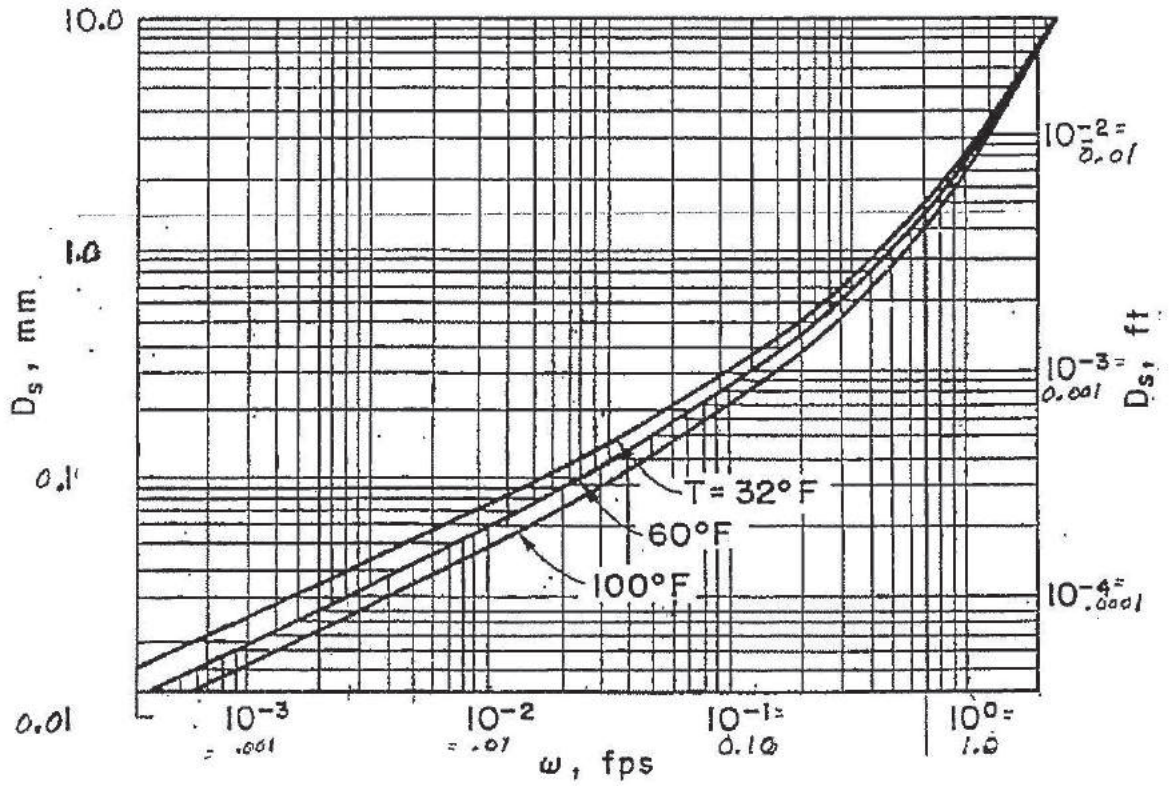


Figure 3. Fall Velocity of Sand-Sized Particles.

REV. 7-26-00

FELSBURG HOLT & ULLEVIG

Job Title | By | Date | Job No.

Subject Bridge Scour | Checked | Sheet 2 of

Determine if Contraction Scour is live bed or clear water

$V_c = 11.17\ y_1^{1/6} D_{50}^{1/3}$ (11.52 struck; Critical Velocity; Upstream flow depth)

$V_{c100} = 11.17 \times 8.49^{1/6} \times 0.005^{1/3} = 2.73$

V_{100} main channel $= 8.21$ ∴ Live Bed Scour

If $V_{c100} \leq V_{100\,mc}$ then Live Bed Scour
If $V_{c100} > V_{100mc}$ then Clear Water

$V_{c500} = 11.17 \times 11.45^{1/6} \times 0.005^{1/3} = 2.87$

$V_{500\,mc} = 8.24$ ∴ Live Bed Scour

REV 7-26-00

FELSBURG HOLT & ULLEVIG

Job Title | By | Date | Job No.

Subject *Bridge Scour* | Checked | Sheet 3 of

CLEAR WATER SCOUR

$$Ys = \left[\frac{Q^2}{120\, D_m^{2/3} W^2} \right]^{3/7} - Y_1$$

Ys: Avg. Scour Depth

Q: Q bridge

Y_1: depth of flow in channel

D_m: bo Horn width of bridge less piers (low chord)

$1.25\, D_{50} = 1.25 * ____ = ____$

DOES NOT APPLY

$$Ys_{100} = \left[\frac{____^2}{120 * __^{2/3} * __^2} \right]^{3/7} - ____ = ____ \text{ ft}$$

$$Ys_{500} = \left[\frac{____^2}{120 * __^{2/3} * __^2} \right]^{3/7} - ____ = ____ \text{ ft.}$$

LIVE BED SCOUR

$$y_2 = \left(\frac{Q_2}{Q_1} \right)^{6/7} * \left(\frac{W_1}{W_2} \right)^{K_1} * (Y_1)$$

Q_2: Flow in cont. main channel which is often Q Total

Q_1: Flow in approach main channel that transports sediment

W_1: Avg. bo Horn width of the main channel at approach cross section

W_2: Avg. bo Horn width of the contracted section.

Y_1: Avg. depth in upstream main channel

V* / w	K_1
< 0.5	0.59
0.5 - 2.0	0.64
> 2.0	0.69

$$y_{2(100)} = \left(\frac{8303}{8027} \right)^{0.857} * \left(\frac{160}{145} \right)^{0.64} * 8.49 = 9.31 \qquad Ys = y_2 - y_1 = 9.31 - 8.49 = 0.82'$$

$$y_{2(500)} = \left(\frac{12024}{10913} \right)^{0.857} * \left(\frac{160}{145} \right)^{0.64} * 11.45 = 13.25 \qquad Ys = y_2 - y_1 = 13.25 - 11.45 = 1.8'$$

Contraction Scour

100 YR = 0.82'

500 YR = 1.8'

REV 7-26-00

FELSBURG HOLT & ULLEVIG

Job Title | By | Date | Job No.

Subject *Bridge Scour* | Checked | Sheet 4 of

Clear Water OR Live-Bed Scour at Abutments

$$y_s = y_a\left[2.27\,K_1\,K_2\left(\frac{a'}{y_a}\right)^{0.43} Fr^{0.61} + 1\right]$$

- y_a: Avg Depth in floodplain
- a': (To ineffective flow boundary) Length of Abutment projected normal to flow
- Fr: Approach Froude No.
- K_1: Abutment coefficient — Vert. wall abut. $K = 1.00$; " " with wingwalls $K = 0.82$; Spill through abut. $K = 0.55$
- K_2: Coefficient of abutment angle, $K_2 = (\theta/90)^{0.13}$; $K_2 = (90/90)^{0.13} = 1.0$

LEFT ABUTMENT

$$y_{s_{100}} = \frac{4.91}{}\left[2.27 * \frac{1.0}{} * \frac{1.0}{} * \left(\frac{14}{4.91}\right)^{0.43} * \frac{0.7}{}^{0.61} + 1\right]$$

$= 18.98$

$$y_{s_{500}} = \frac{6.79}{}\left[2.27 * \frac{1.0}{} * \frac{1.0}{} * \left(\frac{14}{6.79}\right)^{0.43} * \frac{0.49}{}^{0.61} + 1\right]$$

$= 20.41$

RIGHT ABUTMENT

$$y_{s_{100}} = \frac{4.91}{}\left[2.27 * \frac{1.0}{} * \frac{1.0}{} * \left(\frac{12}{4.91}\right)^{0.43} * \frac{0.7}{}^{0.61} + 1\right]$$

$= 18.08$

$$y_{s_{500}} = \frac{6.79}{}\left[2.27 * \frac{1.0}{} * \frac{1.0}{} * \left(\frac{12}{6.79}\right)^{0.43} * \frac{0.49}{}^{0.61} + 1\right]$$

$= 19.53$

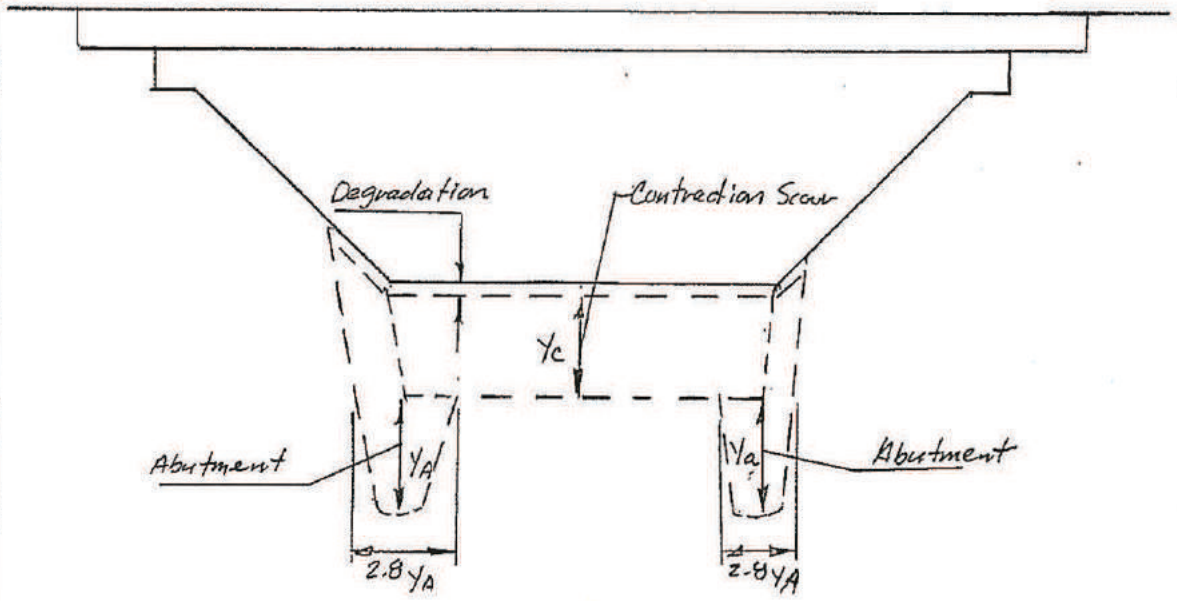
Note:

Per HEC-18, Section 3.3.3, since abutment scour lacks field verification, riprap protection at the abutments makes it unnecessary to design abutments to resist the computed abutment scour depth. Also per HEC-18 Section 4.5.9 "Discussion of Abutment Scour Computations", it is stated that if properly vegetated in the overbanks, channel banks and areas adjacent to the abutment, scour depths as predicted with the Froehlich equation will probably not occur.

FELSBURG HOLT & ULLEVIG

Job Title | By | Date | Job No.

Subject *Bridge Scour* | Checked | Sheet 5 of



	100-YEAR			500-YEAR		
	LEFT	CHAN.	RT.	LEFT	CH.	RT.
Degradation	0	2.0	0	0	2.0	0
Contraction	0.82	0.82	0.82	1.8	1.8	1.8
Abutment	19.98	—	19.08	20.41	—	19.53
Total	19.8	2.82	18.9	22.21	3.8	21.33
Pier						

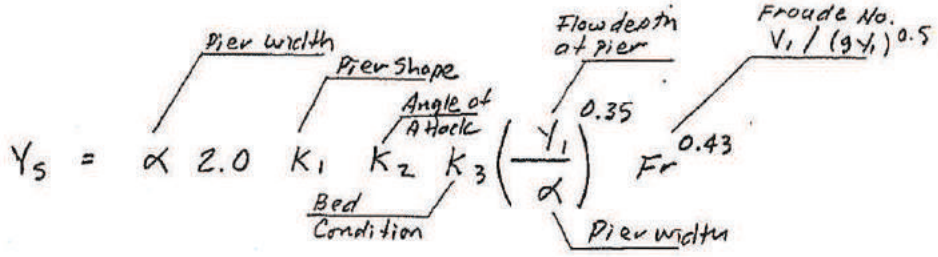
REV. 7-26-00

Local Scour at Pier

	100 YR	500-yr	
V =	10.3 fps	10.1 fps	= Velocity upstream of the pier
Y_1 =	8.1 ft	11.25 ft.	= Depth of flow upstream of pier

0	= Angle of attack of the flow
3.5 ft	= Pier width
21 ft	= Pier Length (3.5 x 6)
1.0	= k_1 Circular
1.0	= k_2
1.1	= k_3

F_{100} = 0.63 F_{500} = 0.53 = Froude

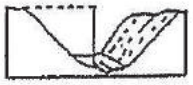
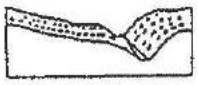
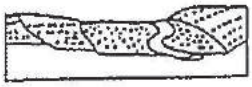
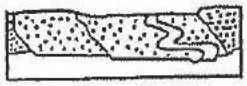
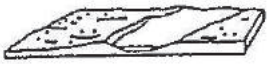
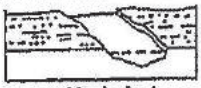
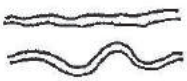
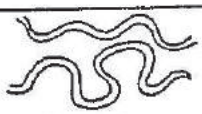
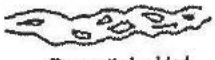
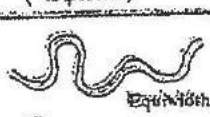
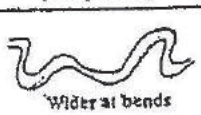
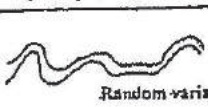


$$Ys_{100} = 3.5 * 2.0 * 1.0 * 1.0 * 1.1 * \left(\frac{8.1}{3.5}\right)^{0.35} * 0.63^{0.43}$$

$$= 8.471 \text{ ft.}$$

$$Ys_{500} = 3.5 * 2.0 * 1.0 * 1.0 * 1.1 * \left(\frac{11.25}{3.5}\right)^{0.35} * 0.53^{0.43}$$

$$= 8.82 \text{ ft.}$$

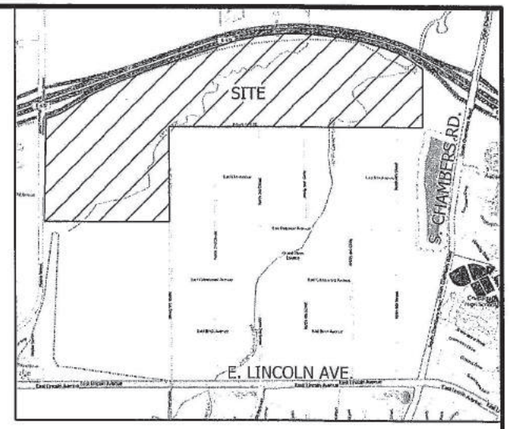
STREAM SIZE (SECT. 2.2.1)	Small (<100 ft. or 30 m wide)		Medium (100-500 ft. or 30 - 150 m)		Wide (>500 ft. or 150 m)
FLOW HABIT (SECT. 2.2.2)	Ephemeral	(Intermittent)	Perennial but flashy		Perennial
BED MATERIAL (SECT. 2.2.3)	Silt-clay	Silt	Sand	Gravel	Cobble or boulder
VALLEY SETTING (SECT. 2.2.4)	No valley; alluvial fan		Low relief valley (<100 ft. or 30 m deep)	Moderate relief (100-1000 ft. or 30-300 m)	 High relief (>1000 ft. or 300 m)
FLOOD PLAINS (SECT. 2.2.5)	 Little or none (<2X channel width)		 Narrow (2-10 channel width)		 Wide (>10X channel width)
NATURAL LEVEES (SECT. 2.2.6)	Little or None		 Mainly on Concave		Well Developed on Both Banks
APPARENT INCISION (SECT. 2.2.7)	 Not Incised			Probably Incised	
CHANNEL BOUNDARIES (SECT.. 2.2.8)	Alluvial		Semi-alluvial		Non-alluvial
TREE COVER ON BANKS (SECT. 2.2.8)	<50 percent of bankline		50-90 percent		>90 percent
SINUOSITY (SECT. 2.2.9)	Straight Sinuosity 1-1.05)	 Sinuous (1.06-1.25)	 Meandering (1.25-2.0)		Highly meandering (>2)
BRAIDED STREAMS (SECT. 2.2.10)	Not braided (<5 percent)		Locally braided (5-35 percent)		 Generally braided (>35 percent)
ANABRANCHED STREAMS (SECT. 2.2.11)	Not anabranched (<5 percent)		Locally anabranched (5-35 percent)		Generally anabranched (>35 percent)
VARIABILITY OF WIDTH AND DEVELOPMENT OF BARS (SECT. 2.2.12)	 Equal width		 Wider at bends		 Random variation
	Narrow point bars		Wide point bars		Irregular point and lateral bars

GEOMORPHIC FACTORS THAT AFFECT STREAM STABILITY

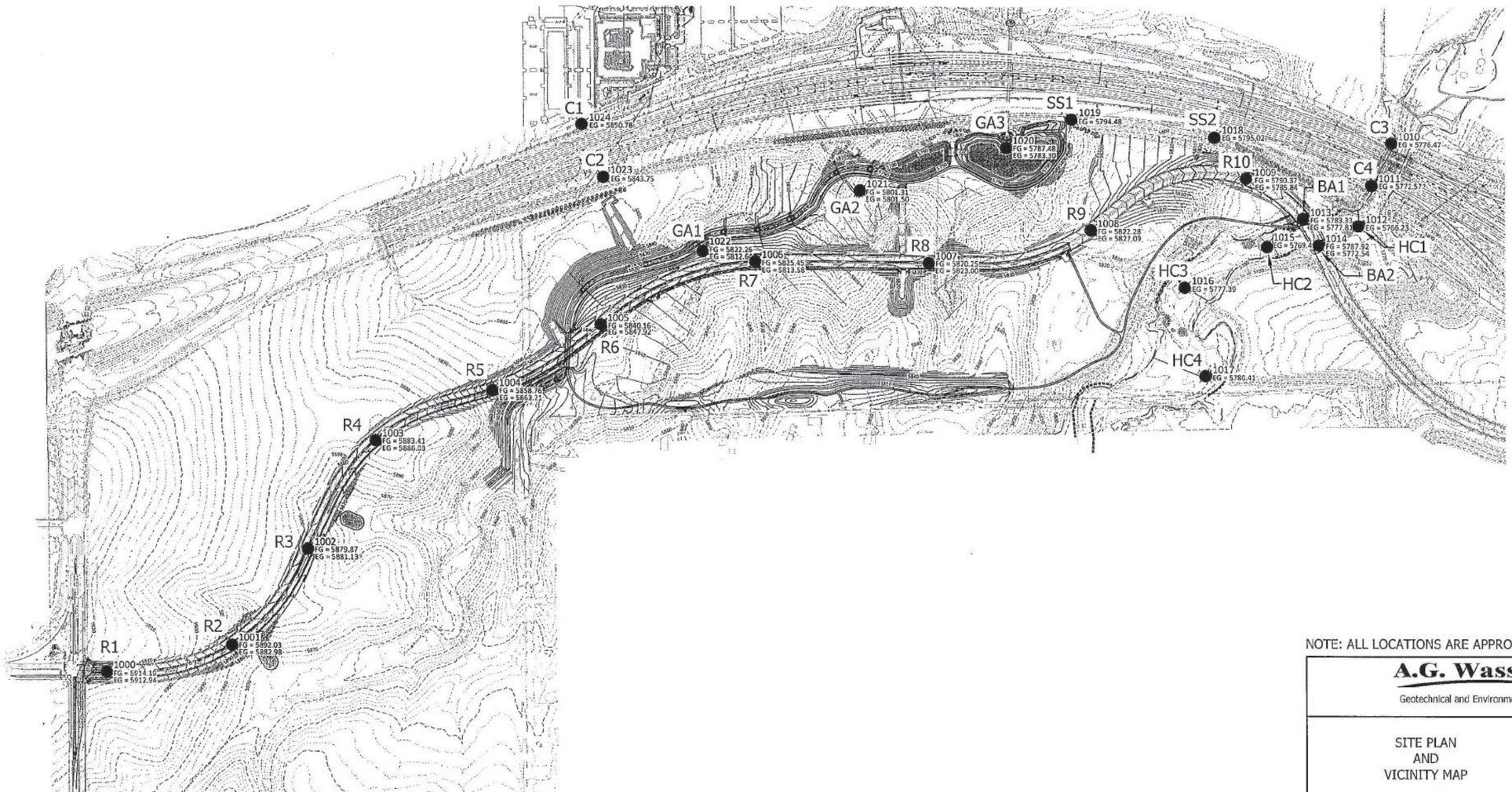
N

0 1000 2000

Scale In Feet



VICINITY MAP
NOT TO SCALE



NOTE: ALL LOCATIONS ARE APPROXIMATE

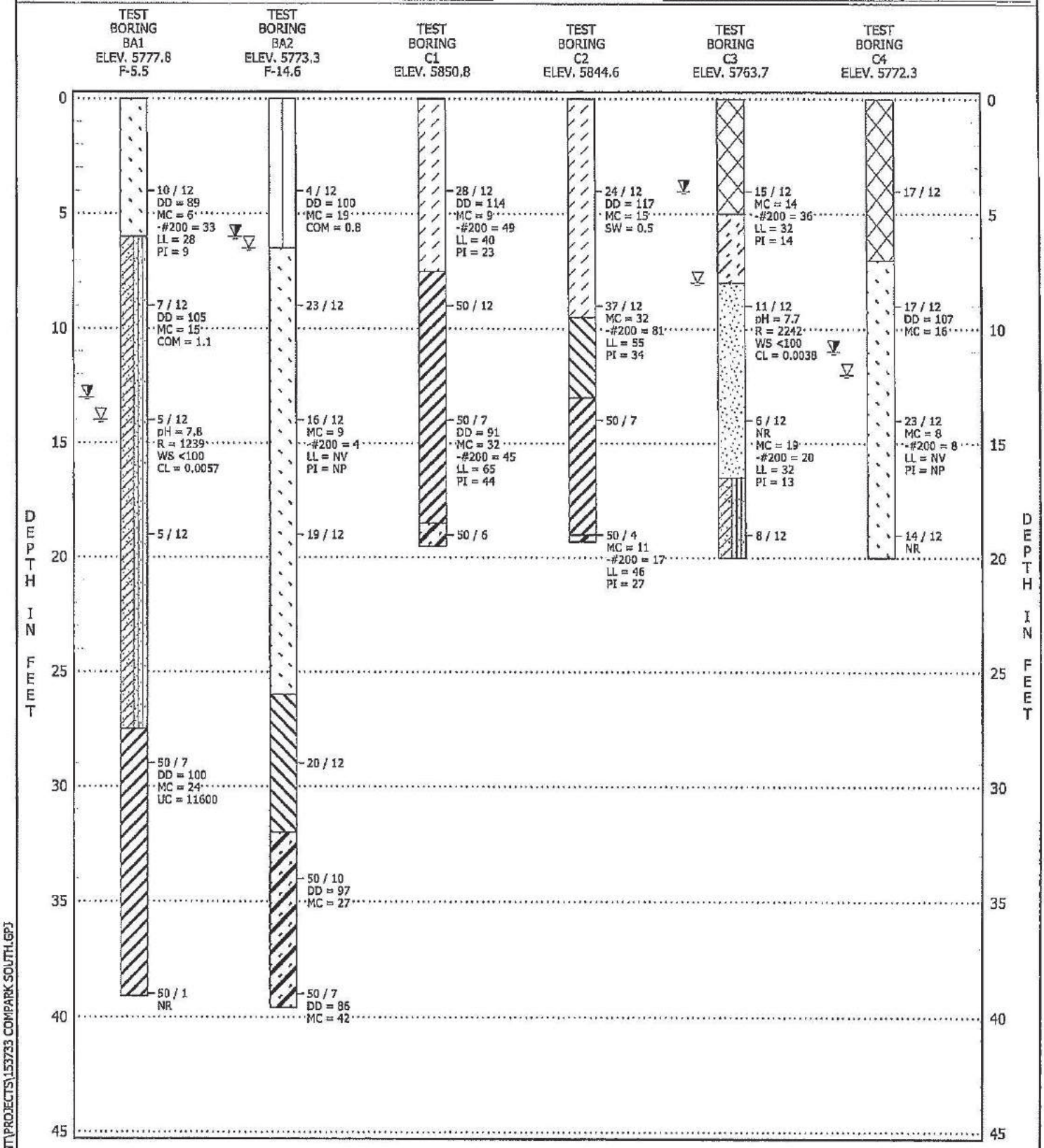
A.G. Wassenaar Inc.
Geotechnical and Environmental Consultants

SITE PLAN AND VICINITY MAP	PROJECT NO. 153733 FIGURE 1

A.G. Wassenaar, Inc.
Geotechnical and Environmental Consultants

CLIENT 470 Compark, LLC c/o MPV Compark Management, LLC **PROJECT NAME** Compark Village South

PROJECT NUMBER 153733 **PROJECT LOCATION** Parker, Douglas County, Colorado



SEE FIGURE 7 FOR LEGEND AND NOTES TO TEST BORINGS

TEST BORING LOGS

FIGURE 2

3/16/16 - U:\GINT\PROJECTS\153733 COMPARK SOUTH.GPJ

FELSBURG HOLT & ULLEVIG

Job Title	Compark South	By	CDT	Date	24-Jul-17	Job No.	115360-01
	Belford Ave. @ Happy Canyon Creek						
Subject	GSB Calculations	Checked		Sheet	1	of	2

1. Estimate Mannings n For Flows over GSB

When upper **1/2** (+/- 1") of the rock depth (height) is left ungrouted: *UDFCD Volume 2 Equation 9-1*

$$n_{18"\text{-}42"(1/2)} = \frac{0.097 * (y/D)^{0.16}}{ln(2.55\ Y/D)}$$

Upper limit: n <= 0.15 for above equation

$$n_{18"\text{-}42"(1/2)} = \frac{0.097 * \quad ^{0.16}}{ln(2.55\ \quad)} = \frac{0.000}{\#NUM!} = \#NUM!$$

When upper **1/3** (+/- 1") of the rock depth (height) is left ungrouted: *UDFCD Volume 2 Equation 9-2*

$$n_{18"\text{-}42"(2/3)} = \frac{0.086 * (y/D)^{0.16}}{ln(2.55\ y/D)}$$

Low-flow n

y= 3
d= 1.5
2

$$n_{18"\text{-}42"(2/3)} = \frac{0.086 * 2.0^{0.16}}{ln(2.55 * \frac{3.0}{1.5})} = \frac{0.096}{1.629} = 0.059$$

High-flow n

y= 7.76
d= 1.5
5.1733

$$n_{18"\text{-}42"(2/3)} = \frac{0.086 * 5.2^{0.16}}{ln(2.55 * \frac{7.8}{1.5})} = \frac{0.114}{2.985} = 0.038$$

Upper limit: n <= 0.12 for above equation

y = depth of flow above top of rock, in feet

D = diameter of the boulder, in feet

Outside the low-flow section

UDFCD Volume 2 Equation 9-7

$$R_p = \frac{V_c * S^{0.17}}{(S_s - 1)^{0.66}}$$

$$R_p = \frac{14.00 * 0.0075^{0.17}}{(2.55 - 1)^{0.66}} = \frac{6.09}{1.34} = 4.56$$

See Table 9-4 below
Use 18" (B18) grouted boulders for protection outside of the low-flow section.

Within the low-flow section

UDFCD Volume 2 Equation 9-7

$$R_p = \frac{V_c * S^{0.17}}{(S_s - 1)^{0.66}}$$

$$R_p = \frac{9.03 * 0.100^{0.17}}{(2.55 - 1)^{0.66}} = \frac{6.11}{1.34} = 4.57$$

See Table 9-4 below
Use 18" (B18) grouted boulders for protection within the low-flow section.

V_c = *Critical Velocity*
S = longitudinal slope along direction of flow in ft/ft
S_s = *Specific gravity of rock - assume 2.55*

(For drops of 6-feet or less in height, use UD-Channels Spreadsheet to find the 100-year critical velocities in the low-flow and the main channels to size boulders for each section)

Note: This project will use B24 boulders grouted 2/3 of the height. UDFCD recommends a minimum of B24 size due to maintenance concerns.

Table 9-4. Boulder sizes for various rock sizing parameters

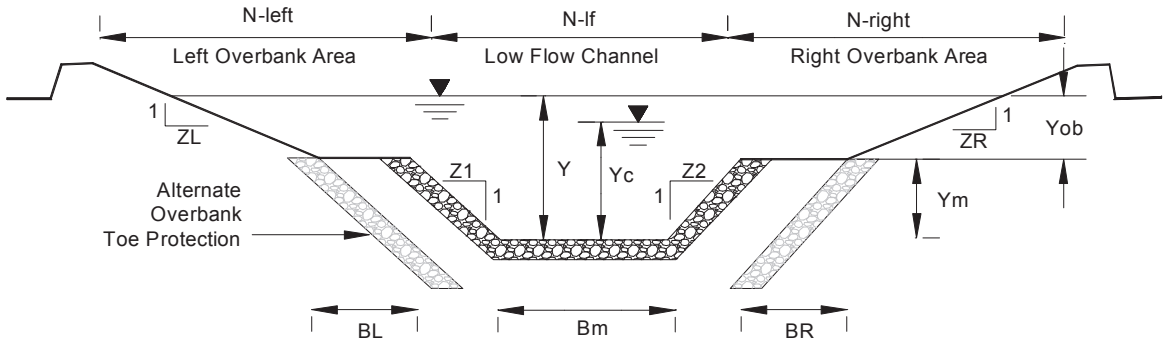
Rock Sizing Parameter, R_p	Grouted Boulders [1]
	Boulder Classification [2]
Less than 4.50	B18
4.50 to 4.99	B18
5.00 to 5.59	B24
5.60 to 6.99	B36
7.00 to 8.00	B48

[1] Grouted to no less than 1/3 the height (+1"/- 0"), no more than 1/2 (+0"/- 1") of boulder height.
[2] See *Open Channels* chapter.

Capacity Analysis of Composite Channel

Project: Happy Canyon Creek @ Belford Avenue - Drops

Channel ID: High & Low-Flow at 0.75% Slope



Design Information (Input)

Channel Invert Slope	So =	0.00750 ft/ft	Left Overbank Bottom Width	BL =	75.00 ft
			Left Overbank Side Slope	ZL =	0.03 ft/ft
Low Flow Channel Bottom Width	Bm =	15.00 ft	Left Overbank Manning's n	n-left =	0.0350
Low Flow Channel Left Side Slope	Z1 =	4.00 ft/ft	Right Overbank Bottom Width	BR =	20.00 ft
Low Flow Channel Right Side Slope	Z2 =	4.00 ft/ft	Right Overbank Side Slope	ZR =	2.50 ft/ft
Low Flow Channel Manning's Nn for Qd	n-lf =	0.0590	Right Overbank Manning's n	n-right =	0.0350
Low Flow Channel Manning's Nn for Q100	n-m-Q100 =	0.0380			
(See USDCM Vol. II, n vs. Depth Graph)					
Low Flow Channel Bank-full depth	**Ym =**	**3.00 ft**	**Overbank Flow Depth Yob (Y - Ym)**	**Yob =**	**4.85 ft**

Low Flow Channel Condition for Qd			**Low Flow Channel Flow Condition for Q100**		
Top width	Tlf =	39.0 ft	Top width	Tm =	39.0 ft
Flow area	Alf =	81.0 sq ft	Flow area	Am =	270.2 sq ft
Wetted perimeter	Plf =	39.7 ft	Wetted perimeter	Pm =	39.7 ft
Discharge (Calculated)	**Qlf =**	**284.8 cfs**	**Discharge**	**Qm =**	**3,292.1 cfs**
Velocity	**Vlf=**	**3.5 fps**	**Velocity**	**Vm =**	**12.2 fps**
Froude number	**Fr-lf =**	**0.43**	**Froude number**	**Frm =**	**0.82**
Qd Critical Velocity	Vlfc =	6.74 fps	100-Yr. Critical Velocity	Vmc =	14.0 fps
Qd Critical Depth	Ylfc =	1.88 ft	100-Yr. Critical Depth	Ymc =	7.0 ft

Left Overbank Flow Condition for Q100			**Right Overbank Flow Condition for Q100**		
Top width	TL =	75.1 ft	Top width	TR =	32.1 ft
Flow area	AL =	364.0600 sq ft	Flow area	AR =	126.4000 sq ft
Wetted perimeter	PL =	79.8500 ft	Wetted perimeter	PR =	33.0600 ft
Discharge	**QL =**	**3,690.5 cfs**	**Discharge**	**QR =**	**1,139.5 cfs**
Velocity	**VL =**	**10.1 fps**	**Velocity**	**VR =**	**9.0 fps**
Froude number	**FrL =**	**0.81**	**Froude number**	**FrR =**	**0.80**
100-Yr. Critical Velocity	VLc =	11.7 fps	100-Yr. Critical Velocity	VRc =	10.6 fps
100-Yr. Critical Depth in Overbanks	YLc =	4.2 ft	100-Yr. Critical Depth in Overbanks	YRc =	4.2 ft

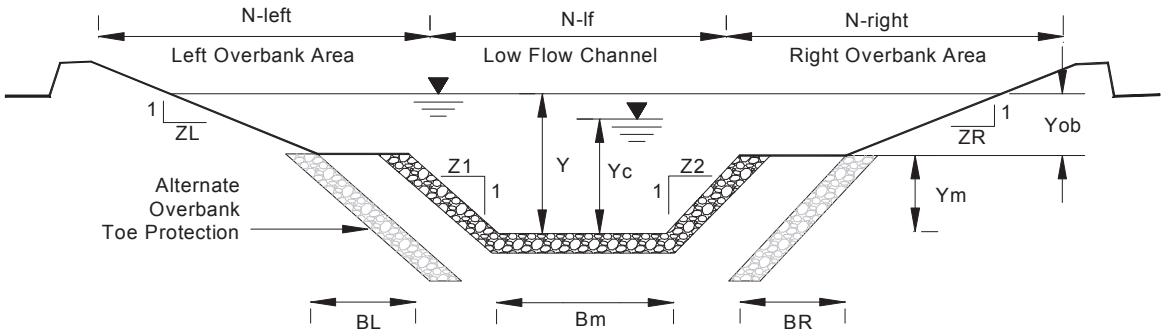
Composite Cross-Section Flow Condition for Q100

Top width	**T =**	**146.3 ft**	**Discharge**	**Q =**	**8,122.1 cfs**
Channel Depth Y	**Y =**	**7.85 ft**	**Velocity**	**V =**	**10.7 fps**
Flow area	A =	760.6 sq ft	**Froude number**	**Fr =**	**0.83**
Wetted perimeter	P =	152.7 ft	100-Yr. Critical Velocity	Vc =	12.2 fps
Cross-Sectional Manning's n (Calculated)	n =	0.0353	100-Yr. Critical Depth in Overbanks	Yc =	4.20 ft

Capacity Analysis of Composite Channel

Project: Happy Canyon Creek @ Belford Avenue Drops

Channel ID: Low-Flow at 10:1



Design Information (Input)

Channel Invert Slope	So =	0.10000 ft/ft	Left Overbank Bottom Width	BL =	75.00 ft
			Left Overbank Side Slope	ZL =	0.03 ft/ft
Low Flow Channel Bottom Width	Bm =	15.00 ft	Left Overbank Manning's n	n-left =	0.0350
Low Flow Channel Left Side Slope	Z1 =	4.00 ft/ft	Right Overbank Bottom Width	BR =	20.00 ft
Low Flow Channel Right Side Slope	Z2 =	4.00 ft/ft	Right Overbank Side Slope	ZR =	2.50 ft/ft
Low Flow Channel Manning's Nn for Qd	n-lf =	0.0590	Right Overbank Manning's n	n-right =	0.0350
Low Flow Channel Manning's Nn for Q100	n-m-Q100 =	0.0380			
(See USDCM Vol. II, n vs. Depth Graph)					
Low Flow Channel Bank-full depth	**Ym =**	**3.00 ft**	**Overbank Flow Depth Yob (Y - Ym)**	**Yob =**	**4.85 ft**

Low Flow Channel Condition for Qd			**Low Flow Channel Flow Condition for Q100**		
Top width	Tlf =	39.0 ft	Top width	Tm =	39.0 ft
Flow area	Alf =	81.0 sq ft	Flow area	Am =	270.2 sq ft
Wetted perimeter	Plf =	39.7 ft	Wetted perimeter	Pm =	39.7 ft
Discharge (Calculated)	**Qlf =**	**1,039.9 cfs**	**Discharge**	**Qm =**	**12,020.9 cfs**
Velocity	**Vlf=**	**12.8 fps**	**Velocity**	**Vm =**	**44.5 fps**
Froude number	**Fr-lf =**	**1.57**	**Froude number**	**Frm =**	**2.98**
Qd Critical Velocity	Vlfc =	9.03 fps	100-Yr. Critical Velocity	Vmc =	16.2 fps
Qd Critical Depth	Ylfc =	3.81 ft	100-Yr. Critical Depth	Ymc =	7.9 ft
Left Overbank Flow Condition for Q100			**Right Overbank Flow Condition for Q100**		
Top width	TL =	75.2 ft	Top width	TR =	32.1 ft
Flow area	AL =	364.1000 sq ft	Flow area	AR =	126.4000 sq ft
Wetted perimeter	PL =	79.8500 ft	Wetted perimeter	PR =	33.0600 ft
Discharge	**QL =**	**13,478.3 cfs**	**Discharge**	**QR =**	**4,160.9 cfs**
Velocity	**VL =**	**37.0 fps**	**Velocity**	**VR =**	**32.9 fps**
Froude number	**FrL =**	**2.96**	**Froude number**	**FrR =**	**2.92**
100-Yr. Critical Velocity	VLc =	17.9 fps	100-Yr. Critical Velocity	VRc =	14.6 fps
100-Yr. Critical Depth in Overbanks	YLc =	10.0 ft	100-Yr. Critical Depth in Overbanks	YRc =	9.1 ft

Composite Cross-Section Flow Condition for Q100

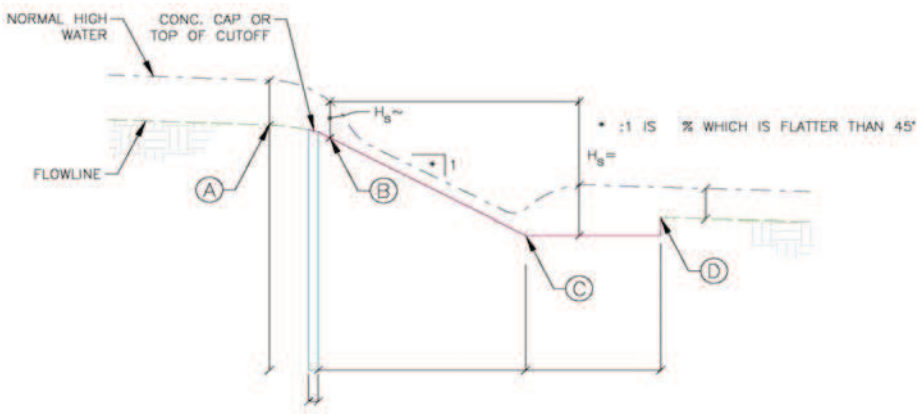
Top width	**T =**	**146.3 ft**	**Discharge**	**Q =**	**29,660.0 cfs**
Channel Depth Y	**Y =**	**7.85 ft**	**Velocity**	**V =**	**39.0 fps**
Flow area	A =	760.7 sq ft	**Froude number**	**Fr =**	**3.01**
Wetted perimeter	P =	152.7 ft	100-Yr. Critical Velocity	Vc =	18.4 fps
Cross-Sectional Manning's n (Calculated)	n =	0.0353	100-Yr. Critical Depth in Overbanks	Yc =	8.07 ft

Job Title	Compark South	By	CDT	Date	24-Jul-17	Job No.	115360-01
	Belford Ave. @ Happy Canyon Creek						
Subject	Seepage Control		Checked		Sheet 1	of	1

1. Lane's Weighed Creep Method

$$Cw = \frac{\left(\frac{L_H}{3} + L_v\right)}{Hs}$$

UDFCD Volume 2 Equation 9-5



From (A) to (B) L_H = 8.0 L_v = 0 + 0.25 = 0.25 '

Hs ~ 0.25 (Change in water surface elevation between A & B)

$$Cw = \frac{\left(\frac{8.0}{3} + 0.3\right)}{0.3} = 11.7 \qquad 11.7 > 6.0 \quad \text{OK}$$

From (A) to (C) L_H = 38.0 L_v = 3 + 0.25 = 3.25 '

Hs = 1.06 (Change in water surface elevation between A & C)

$$Cw = \frac{\left(\frac{38.0}{3} + 3.3\right)}{1.1} = 15.0 \qquad 15.0 > 6.0 \quad \text{OK}$$

L_H = *Horizontal creep distance*
Lv = Vertical creep distance
C_w = *Creep ratio*
H_s = *Differential head between analysis points (ft)*

Table 9-3. Lane's weighted creep: Recommended minimum ratios

Material	Ratio
Very fine sand or silt	8.5
Fine sand	7.0
Medium sand	6.0
Coarse sand	5.0
Fine gravel	4.0
Medium gravel	3.0
Coarse gravel including cobbles	3.0
Boulders with some cobbles and gravel	3.0
Soft clay	3.0
Medium clay	2.0
Hard clay	1.8
Very hard clay or hardpan	1.6

Notes: Soil samples at the site located along Happy Canyon Creek provided by A.G. Wassenaar Inc. indicates coarse to mediam lenses of clay/sand interbedded poorly graded sand with gravel, well-graded sand with silt and gravel material. Free groundwater was encountered at the time of drilling (March 2016) ranging in depths of 2 feet near the proposed ped. box culvert and 4 feet to 8 feet along the channel.

Average LWC Ratio per UDFCD Table 9-3 to the right is: 6.0

REVETMENT RIPRAP DESIGN
SIZING

Project: Belford @ HCC | By: CDT | I:\115360-01 - Compark at Belford\CADD\Hydraulics\Calculations\
Project No. 115360-01 | Date: 7/24/2017 | Happy Canyon Creek\Bridge Hydraulics

$d_{30} = y(s_f*C_s*C_v*C_t)[(V_{des}/(K_1(S_g-1)*g*y]^{2.5}$

d_{30}=Riprap particle size for which 30% is finer by weight , ft (adapted from USACE Engineering Manual No. 1110-2-1601, 1991)

y=	8.4	Local depth of flow above particle, ft
S_f=	1.2	Safety factor
C_s=	0.3	Stability coefficient (for blanket thickness=d100 or 1.5d50 whichever is greater, and uniformity ratio
		Stability coefficient (for blanket thickness=d100 or 1.5d50 whichever is greater, and uniformity ratio d85/d15 = 1.7 to 5.2) Use 0.30 for angular rock and 0.375 for rounded rock
C_v=	1.35	Velocity distribution coefficient
		use 1.0 for straight channels or the inside of bends
		use 1.283-0.2log(Rc/W) for the outside of bends (1 for Rc/W>26)= 1.35
		Rc= 130 Centerline radius of curvature of Channel bend, ft
		W= 294 Width of water surface at upstream end of channel bend, ft
		Rc/W= 0.442177
		use 1.25 downstream from concrete channels
		use 1.25 at the end of dikes
C_t=	1	Blanket thickness coefficient given as a function of the uniformity ratio d85/d15
		use 1.0 recommended because it is based on very limited data
V_{des}=	10.26	Characteristic velocity for design, defined as the depth-averaged velocity at a point
		20% upslope from the toe of the revetment, ft/s
	V_{des}= 10.26	For natural channels use $V_{des}=V_{avg}(1.74-0.52 \log(Rc/W)$
	V_{des}= 10.59	For trapezoidal channels use $V_{des}=V_{avg}(1.71-0.78 \log(Rc/W)$
V_{avg}=	5.33	Channel cross sectional average velocity, ft/s
K_1=	1.00	Side slope correctional factor — H:1= 4
		$k_1=(1-((\sin 14°)$ — θ= 14.0 0.24 = radians
		K_1= 1.00
S_g=	2.65	Specific gravity of riprap (usually taken at 2.65)
g=	32.2	Acceleration of gravity, 32.2 ft/s

d_{30}=	**0.67**	**Particle size for which 30% is finer by weight , ft**
d_{50}=	**0.81**	**$d_{50}=1.2d_{30}$, ft**
RIPRAP d_{50} SIZE=	**9.7**	**inches**
$t=1.5d_{50}$=	**14.5**	**Riprap Thickness, inches**

Use Soil Riprap (12 inch) (2'-0" thick)
@ 120+25 to 122+25 RT.

Reference: Lagasse, et. al., NCHRP Report 568, Riprap Design Criteria, Recommended Specifications, and Quality Control, 2006

REVETMENT RIPRAP DESIGN
SIZING

Project: Belford @ HCC | By: CDT | I:\115360-01 - Compark at Belford\CADD\Hydraulics\Calculations\
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$d_{30} = y(s_f*C_s*C_v*C_t)[(V_{des}/(K_1(S_g-1)*g*y]^{2.5}$

d_{30}=Riprap particle size for which 30% is finer by weight , ft (adapted from USACE Engineering Manual No. 1110-2-1601, 1991)

y=	7.35	Local depth of flow above particle, ft
S_f=	1.2	Safety factor
C_s=	0.3	Stability coefficient (for blanket thickness=d100 or 1.5d50 whichever is greater, and uniformity ratio
		Stability coefficient (for blanket thickness=d100 or 1.5d50 whichever is greater, and uniformity ratio d85/d15 = 1.7 to 5.2) Use 0.30 for angular rock and 0.375 for rounded rock
C_v=	1.24	Velocity distribution coefficient
		use 1.0 for straight channels or the inside of bends
		use 1.283-0.2log(Rc/W) for the outside of bends (1 for Rc/W>26)= 1.26
		Rc= 308 Centerline radius of curvature of Channel bend, ft
		W= 236 Width of water surface at upstream end of channel bend, ft
		Rc/W= 1.305085
		use 1.25 downstream from concrete channels
		use 1.25 at the end of dikes
C_t=	1	Blanket thickness coefficient given as a function of the uniformity ratio d85/d15
		use 1.0 recommended because it is based on very limited data
V_{des}=	10.80	Characteristic velocity for design, defined as the depth-averaged velocity at a point
		20% upslope from the toe of the revetment, ft/s
	V_{des}= 10.80	For natural channels use $V_{des}=V_{avg}(1.74-0.52 \log(Rc/W)$
	V_{des}= 10.42	For trapezoidal channels use $V_{des}=V_{avg}(1.71-0.78 \log(Rc/W)$
V_{avg}=	6.43	Channel cross sectional average velocity, ft/s
K_1=	1.00	Side slope correctional factor
		$k_1=(1-((\sin 14°)$ H:1= 4
		θ= 14.0 0.24 = radians
		K_1= 1.00
S_g=	2.65	Specific gravity of riprap (usually taken at 2.65)
g=	32.2	Acceleration of gravity, 32.2 ft/s

d_{30}=	**0.72**	**Particle size for which 30% is finer by weight , ft**
d_{50}=	**0.87**	**$d_{50}=1.2d_{30}$, ft**
RIPRAP d_{50} SIZE=	**10.4**	**inches**
$t=1.5d_{50}$=	**15.6**	**Riprap Thickness, inches**

Use Soil Riprap (12 inch) (2'-0" thick)
@ 116+25 to 118+75 RT.

Reference: Lagasse, et. al., NCHRP Report 568, Riprap Design Criteria, Recommended Specifications, and Quality Control, 2006

REVETMENT RIPRAP DESIGN
SIZING USING UDFCD CRITERIA

Project:	Belford @ HCC	By: CDT	I:\115360-01 - Compark at Belford\CADD\Hydraulics\Calculations\
Project No.	115360-01	Date: 7/24/2017	Happy Canyon Creek\Bridge Hydraulics

d_{50} >/= ((V*S^0.17)/(4.5)*(Gs-1)^0.66)^2

V=	14.58	Velocity, ft/s	*(Worst case velocity at Drop 2.)*
S=	0.0075	Longitudinal Slope, ft/ft	
G_s=	2.65	Specific gravity of riprap (usually taken at 2.65)	
d_{50}=	**1.03**	**ft**	
RIPRAP d_{50} SIZE=	**12.3**	**inches**	
t=1.75d50=	**21.6**	**Riprap Thickness, inches**	

Riprap for Approach to Drop Structres
Soil Riprap (12 Inch) (2'-0" thick)

Reference: UDFCD Manual, Volume 1, Section 8.1.1 Equation 8-11

RIPRAP AT BRIDGE ABUTMENTS AND GUIDE BANKS
SIZING

Project: Belford @ HCC By: CDT I:\115360-01 - Compark at Belford\CADD\Hydraulics\Calculations\
Project No. 115360-01 Date: 7/24/2017 Happy Canyon Creek\Bridge Hydraulics

$d_{50} = Y*K/(S_g-1)*(V^2/gy)$ for Froude numbers less than 0.80

$d_{50} = Y*K/(S_g-1)*(V^2/gy)^{0.14}$ for Froude numbers greater than 0.80

d_{50}=Median stone diamenter, ft (adapted from FHWA's HEC23, Legasse et al, 2001)

SBR= Set Back Ratio = Dist. From main channel/Flow depth in main channel

	Left Abutment	Right Abutment	
D=	114	37	Distance from main channel
Y_{ch}=	8.33	8.33	Flow depth in main channel
SBR=	13.7	4.4	Set Back Ratio
Q=	5317	1203	If SBR is >5, then $V=Q_{overbank}/A_{overbank}$ (Overbank flow only)
A=	762	198	If SBR is <5, then $V=Q_{total}/A_{total}$ (Entire bridge opening)
$V_{char.}$=	7.0	7.2	

Q_{total} =8303 cfs

A_{total} =1150 (sq ft)

V=	7.56	7.66	Characteristic average velocity in the contracted section, ft/s
S_g=	2.65	2.65	Specific gravity of riprap (usually taken at 2.65)
g=	32.2	32.2	Acceleration of gravity, 32.2 ft/s
y=	8.24	8.24	Depth of flow in the contracted bridge opening, ft
K=	1.02	1.02	For Froude <0.80 use K=0.89 for spill through and 1.02 for vertical wall abutments
			For Froude >0.80 use K=0.61 for spill through and 0.69 for vertical wall abutments
F=	0.46	0.47	Froude number, $(V/(gy)^{0.5}$

d_{50}=	1.10	1.13	Median stone diamenter, ft for Froude number less than 0.80
d_{50}=	4.11	4.12	Median stone diamenter, ft for Froude number greater than 0.80

	Left Abutment	Right Abutment	
d_{50}=	**1.10**	**1.13**	Median stone diamenter, ft
RIPRAP d_{50} SIZE=	**13.2**	**13.5**	**inches**
$t=1.5d_{50}$	**19.8**	**20.3**	**Riprap Thickness, inches**

Riprap for Bridge Abutments
Soil Riprap (18 Inch) (3'-0" thick)
& Riprap (18 Inch) (3'-0" thick)

Reference: Lagasse, et. al., NCHRP Report 568, Riprap Design Criteria, Recommended Specifications, and Quality Control, 2006

RIPRAP AT BRIDGE PIERS
SIZING

Project: Belford @ HCC By: CDT I:\115360-01 - Compark at Belford\CADD\Hydraulics\Calculations\
Project No. 115360-01 Date: 7/24/2017 Happy Canyon Creek\Bridge Hydraulics

$d_{50} = 0.692(V_{des})^2/(S_g-1)*2*g$

d_{50}=Riprap particle size for which 50% is finer by weight, ft (adapted from FHWA's HEC23, Legasse et al, 2001)

K_1=	1.5	Shape factor equal to 1.5 for round-nose pier, 1.7 for square-faced piers, ft/s
K_2=	0.9	Velocity adjustment factor or location in the channel
		0.9 for a pier near a bank in a straight reach
		1.7 for a pier located in the main current of flow around a sharp bend
S_g=	2.65	Specific gravity of riprap (usually taken as 2.65)
g=	32.2	Acceleration of gravity, 32.2 ft/s

If only the average channel velocity is known, then $V_{des}=K_1*K_2*V_{avg}$:

V_{avg}=	8.21	Channel average velocity, fps	From bridge hyd. sheet
V_{des}=	11.0835	Design velocity for local conditions at the pier, ft/s	$V_{des}=K_1*K_2*V_{avg}$

If the local velocity at the pier is known (a 2-D model stream tube), then $Vdes=K_1*V_{local}$:

V_{local}=	9.79	Local velocity in the vicinity of the pier, ft/s	From bridge hyd. sheet
V_{des}=	14.685	Design velocity for local conditions at the pier, ft/s	$V_{des}=K_1*V_{local}$

V_{des}= 14.685 Design velocity in the vicinity of the pier to be used, ft/s

d_{50}=	1.40	Particle size for which 50% is finer by weight , ft			
d_{50} =	16.9	Riprap size in inches	Use standard size d_{50}= (6", 9", 12" 18", 24")=	18	inches
$t=3d_{50}$=	50.6	Minimum riprap thickness, inches	$t=3d_{50}$=	54.0	

Conclusion

Use 4.50 ft thick layer of
Riprap d50= 18 inches

Reference: Lagasse, et. al., NCHRP Report 568, Riprap Design Criteria, Recommended Specifications, and Quality Control, 2006

RIPRAP FOR OVERTOPPING FLOW
FOR SLOPES 4:1 AND FLATTER

Project: Belford @ HCC | By: CDT | I:\115360-01 - Compark at Belford\CADD\Hydraulics\Calculations\
Proj. No. 115360-01 | Date: 7/24/2017 | Happy Canyon Creek\Bridge Hydraulics

Weir formula H=(Q/C*L)^.67

Q=	2691	Discharge, cfs (FHAD Future 10yr c.f.s)
C=	2.6	Weir coefficient
L=	310	Length of broad crested weir, ft
H=	2.24	Overtopping depth, ft

Median Rock Size d50=ku*qf^0.52/Cu^0.25*S^0.75*(sin a/Sg cos a-1)(cos a tan p-sin a))^1.11

Ku=	0.525	Constant for English units				
qf=	8.7	Unit discharge at failure, ft/s/ft				
Cu=	4.5	Coefficient of uniformity of the riprap, d60/d10				
S=	0.25	Slope of the embankment. ft/ft				
Sg	2.65	Specific gravity of the riprap				
ά=	4	Slope of the embankment, H:1	H:1=	4.0	θ= 14.0	0.24 = radians
φ=	1	Angle of repose for riprap, H:1	H:1=	1.0	θ= 45.0	0.79 = radians
d50=	0.56	Smallest possible median rock size, d50, ft				
d50=	6.7	Smallest possible median rock size, d50, in				
Use a d50 of	18	inches (from Table C8.1)				

Interstitial Velocity Vi=(2.48(g*d50)^0.5)*(S^0.58/Cu^2.22)

g=	32.2	Acceleration due to gravity, ft/sec
d50=	1.5	Particle size for which 50% is finer by weight, ft
S=	0.25	Slope, ft/ft
Cu=	4.5	Coefficient of uniformity of the riprap, d60/d10
Vi=	0.27	ft/sec
ŋ=	0.45	porosity
Vavg=	0.12	ft/sec

Thickness of riprap as if all of the flow were through the riprap t=qf/Vavg, ft

t=	70.5	thickness of riprap layer, ft	
2*d50=	3.0	ft	**FALSE If "t" is < than 2*d50, then design is complete and a 2d50 thickness is ok**
Use a d50 of	18	in.	**0 If "t" is > than 2*d50, then continue**

Allowable flow depth over riprap h=(0.06(Sg-1)d50tanφ)/(0.97S)

h=	0.61	ft depth

Calculate Manning roughness coefficient, n n=.034(d50)^.1667

n=	0.04	

Calculate Unit Discharge, q q=1.489/n*y^1.67*S^0.5

q1=	9.02	ft3/s/ft

Calculate the Required Interstitial Flow through the riprap and the flow provided by a riprap thickness of 2d50

q2=	-0.34	ft3/s/ft	q2=qf-q1
q=	0.37	ft3/s/ft	q=2d50*Vavg

t=2d50=	36	in	**If q is > than or equal to q2, then the design is complete with a 2d50**
t=	18	in	**If not, then increase riprap size to next higher gradation (C8.1)**

Reference: Lagasse, et. al., NCHRP Report 568, Riprap Design Criteria, Recommended Specifications, and Quality Control, 2006

Table C8.1. Minimum and maximum allowable particle size in inches.

Nominal Riprap Class by Median Particle Diameter		d_{15}		d_{50}		d_{85}		d_{100}	Cu, Coef. Of Uniform. (d60/d10)
Class	Size	Min	Max	Min	Max	Min	Max	Max	
I	6 in	3.7	5.2	5.7	6.9	7.8	9.2	12.0	4.5
II	9 in	5.5	7.8	8.5	10.5	11.5	14.0	18.0	4
III	12 in	7.3	10.5	11.5	14.0	15.5	18.5	24.0	4.5
IV	15 in	9.2	13.0	14.5	17.5	19.5	23.0	30.0	
V	18 in	11.0	15.5	17.0	20.5	23.5	27.5	36.0	4
VI	21 in	13.0	18.5	20.0	24.0	27.5	32.5	42.0	
VII	24 in	14.5	21.0	23.0	27.5	31.0	37.0	48.0	3.7
VIII	30 in	18.5	26.0	28.5	34.5	39.0	46.0	60.0	
IX	36 in	22.0	31.5	34.0	41.5	47.0	55.5	72.0	
X	42 in	25.5	36.5	40.0	48.5	54.5	64.5	84.0	

(CDOT)

Note: Particle size d corresponds to the intermediate (B) axis of the particle.

FELSBURG HOLT & ULLEVIG

Job Title: Compark at Belford **By:** ZJG **Date:** 03/05/18 **Job No.:** 115360-01

Subject: Riprap Apron Sizing For Single Circular Conduit **Checked:** **Sheet** 1 of 1

1. Given Information

Structure Name and Location:

Q	51.00	c.f.s	(design flow)
D	4.00	ft.	(pipe diameter)
n	0.013		(Manning's n)
S_o	0.03500	ft./ft.	(pipe slope)
Assume flow is	Supercritical	Supercritical/Subcritical	

Tailwater Depth (Y_t) = unknown, assume = 0.4*D: 1.6 ft.

D / 3 = 4.00 ft / 3 = 1.333 ft.

Allowable Velocity = 5 fps (Max.=7.0 fps if Clay, and 5.0 fps if Sandy)

2. Manning Formula - Input CulvertMaster Results

V	16.50	f.p.s.	(velocity)
y_n	5.40	ft.	(normal depth of supercritical flow)
y_n/D	1.35		
D_a	4.70	ft	$D_a=(D+y_n)/2$, for supercritical flow

3. Required Rock Size

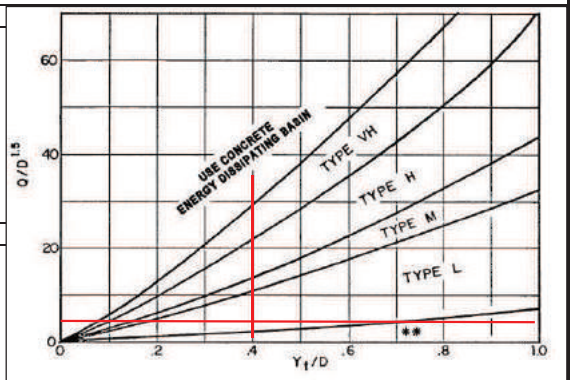
$Q/D^{1.5}$ = Q / $D_?^{1.5}$ | D if subcritical or D_a if supercritical

$Q/D^{1.5}$ = 51.00 / (4.70 $)^{1.5}$

$Q/D^{1.5}$ = **5.01**

y_t/D = 1.6 / 4.00

y_t/D = **0.40**



Use D_d instead of D whenever flow is supercritical in the barrel.
** Use Type L for a distance of 3D downstream.

Figure 9-38. Riprap erosion protection at circular conduit outlet (valid for $Q/D_{1.5} \leq 6.0$)

Per Fig 9-38, use Type **L** riprap d_{50} = **9** in.

d_{50} = = 0.42 ft check from putting eq. 9-18 into eq. 9-16 for supercritical

Minimum Thickness of d_{50}

$T_{MIN} = 2 * d_{50}$ = 2 * 9 = 18 in. = **1.5 ft.**

Riprap Designation	d_{50} (inches)
L	9
M	12
H	18
VH	24

4. Extent of Protection

Froude Parameter

$\frac{Q}{D^{2.5}} = \frac{51.00}{4.00^{2.5}}$ = **1.6** > 6.0 by ~ **0** so increase L_{pmax} by 1/4D for every 1

Use Figure 9-35 to the right to find 1/(2TanΘ)

$\frac{1}{2\text{TanΘ}}$ = **6.1** = Expansion Factor

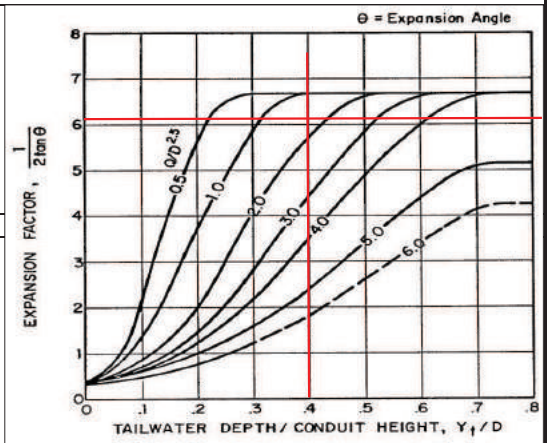


Figure 9-35. Expansion factor for circular conduits

5. Lp, Length of Protection

where V is max. allow velocity

L_p = 1/2 Tan Θ *(Q/V / y_t - D)

L_p = 6.1 *(10.20 / 1.6 - 4.00)

L_p = 14.49 ft

L_p CHECK

$L_{p\,Min} = 3*D$ = 12 ft

$L_{p\,Max}=10*D+1/4D($ 0) = 40 ft

USE = **14 ft**

7. T, Width of Protection

T = 2 (L_p * TanΘ) + Diameter of conduit = 2 * (14 * 1/(2*Expansion Factor)) + 4.00 = 6.3 ft. USE **7 ft.**

8. Summary

Riprap Min. d_{50} (in.)	T_{MIN}, Min. Thickness (ft.)	L_p, Min. Length (ft.)	T, Min. Width (ft.)	Riprap Quantity (C.Y.)	Filter Material (Class A) Quantity (C.Y.)
9	1.5	14	7		

FELSBURG HOLT & ULLEVIG

Job Title: Compark at Belford **By:** ZJG **Date:** 03/05/18 **Job No.:** 115360-01

Subject: Riprap Apron Sizing For Multiple Box Culverts **Checked:** **Sheet** 1 of 1

1. Given Information

Structure Name and Location:

Quantity	Width (ft)		Height (ft)		
2	- 10	x	3		
Q	625.00		c.f.s	(design flow)	
n	0.013			(Manning's n)	
S_o	0.0210		ft./ft.	(pipe slope)	
Assume flow is	Supercritical		(Supercritical or Subcritical)		

Tailwater Depth (Y_t) = if unknown or hydraulic jump downstream = 0.4*H: 1.2 ft.

H / 3 = 1.0 ft.

Allowable Velocity = 5 fps

(Max.=7.0 fps if Clay, and 5.0 fps if Sandy)

2. Manning Formula - Input CulvertMaster Results

V	2.74	f.p.s.	(velocity)
y_n	2.11	ft.	(normal depth of supercritical flow)
y_n/D	#REF!		
H_a	1.18	ft	$H_a=(H+y_n)/2$, for supercritical flow

3. Required Rock Size

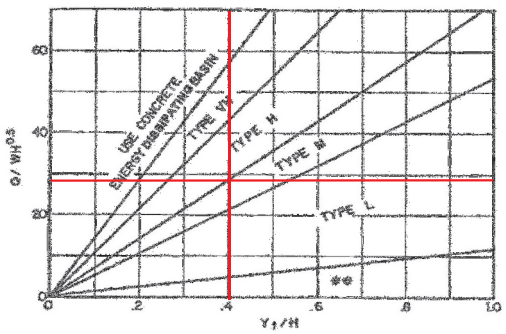
$Q_i/W_iH_i^{0.5}$ = Q / $W_iH_?^{0.5}$ (H if subcritical or H_a if supercritical)

= 312.50 / 10.86

= **28.8**

y_t/H = 1.2 / 3.00

y_t/H = **0.40**



Use H_a instead of H whenever culvert has supercritical flow in the barrel.
**Use Type L for a distance of 3H downstream.

Figure MD-23—Riprap Erosion Protection at Rectangular Conduit Outlet Valid for $Q/WH^{1.5} \leq 8.0$

Per Fig 9-38, use Type **M** riprap d_{50} = **12** **in.**

d_{50} = = 10.99 ft check from putting eq. 9-18 into eq. 9-16 for supercritical

Minimum Thickness of d_{50}

$T_{MIN} = 2 * d_{50}$ = **2.0** **ft.**

Riprap Designation	d_{50} (inches)
L	9
M	12
H	18
VH	24

4. Extent of Protection

Find equivalent rectangular conduit, where i stands for individual conduit, and H_{eq} = box culvert height

$W_{eq} = Q/W_iH_{eq}^{1.5}$ = 625.00 / 10 3 ^1.5

W_{eq} = 12.0 ft

Froude Parameter $\frac{Q}{W_{eq} H_{eq}^{3/2}}$ where subscript i stands for individual conduit = $\frac{625.00}{62.50}$ = **10.0** > 8.0 by **2** (insert whole number)

Use Figure 9-35 to the right to find Expansion Factor 1/(2TanΘ) (y-axis intercept)

$\frac{1}{2\text{Tan}\Theta}$ = **1** = Expansion Factor

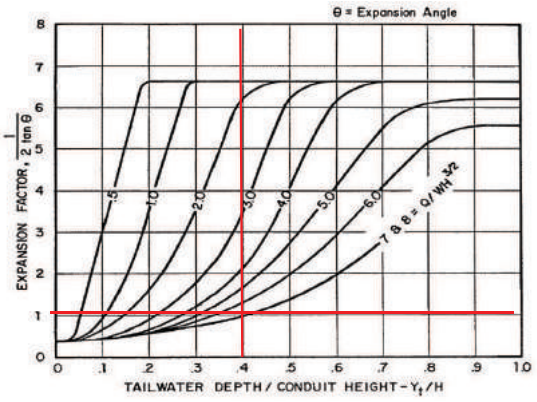


Figure 9-36. Expansion factor for rectangular conduits

5. Lp, Length of Protection

where V is max. allow velocity

L_p = 1/2 Tan Θ *(Q/V / y_t - W)

L_p = 1.0 *(125.00 / 1.2 - 10.0)

L_p = 94.17 ft

L_p CHECK

$L_{p\,Min}$ = 3*H = 0.75 ft

$L_{p\,Max}$=10*D+1/4D(2) = 4.0 ft

USE L_p = **4.0** **ft**

7. T, Width of Protection

T = 2 (L_p * TanΘ) + W_{eq} = 2 * (4 * 1/(2*Expansion Factor)) + 12.0 = **16** **ft.**

8. Summary

Riprap Min. d_{50} (in.)	T_{MIN}, Min. Thickness (ft.)	L_p, Min. Length (ft.)	T, Min. Width (ft.)	Riprap Quantity (C.Y.)	Filter Material (Class A) Quantity (C.Y.)
12	2.0	4	16		

FREEBOARD REQUIREMENTS

Project: Belford Avenue @ Happy Canyon Creek File Name: Freeboard.xlsx
Date: 24-Jul-17 FHU Project #: 115360-01

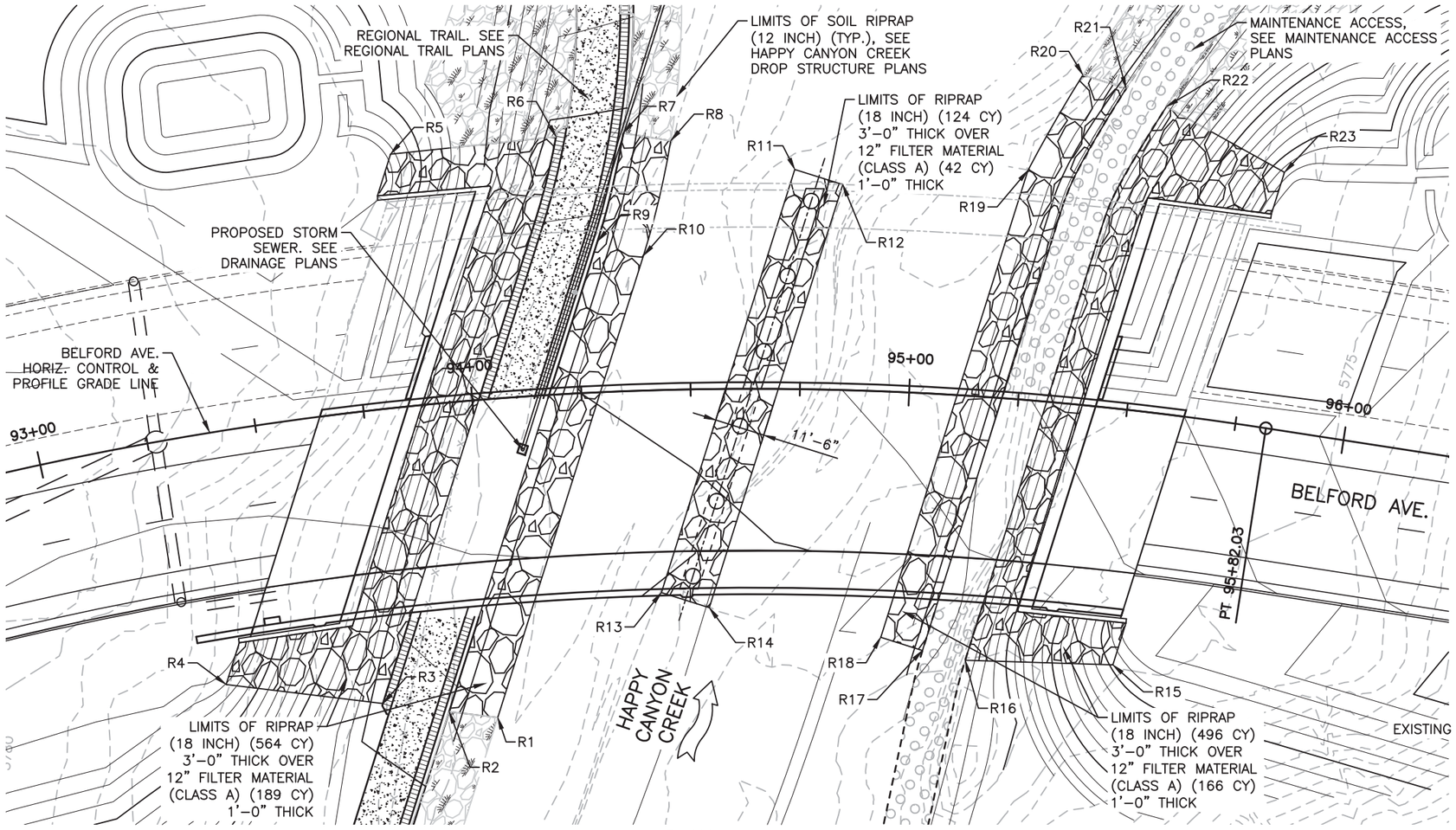
Fb = 0.1 * Q^0.3 + 0.008 * V^2 (English Units)
RE: UDFCD defers to CDOT Roadway Design Manual

REQUIRED FREEBOARD

Q_{100} =	8303	cfs	(Design Q)
V_{100} =	8.21	fps	(Average Velocity)
Fb=	2.04	ft.	(Required Freeboard)

AVAILABLE FREEBOARD

Low chord elevation =	5780.07	
Design W.S. elevation =	5776.33	
Available freeboard =	3.74	ft.



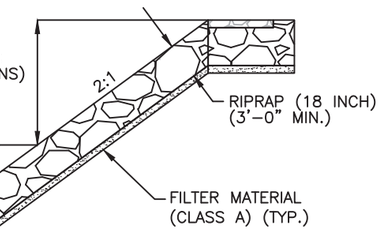
PLAN

HORIZONTAL SCALE: 1"=30'

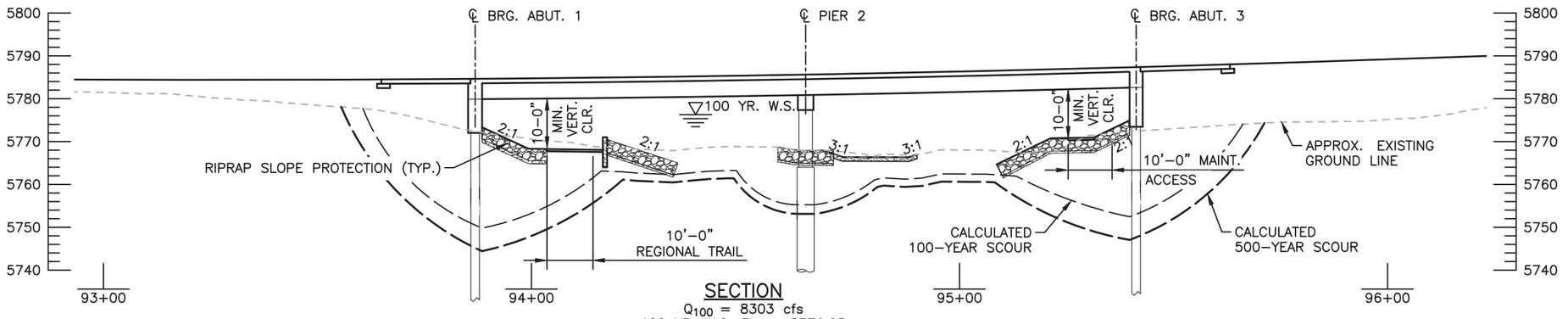
0' 15' 30' 60'

RIPRAP (18 INCH) POINT DATA

POINT	NORTHING	EASTING	ELEVATION	DESCRIPTION
R1	27831.26	94408.21	5769.24	FINISHED GRADE
R2	27841.26	94403.19	5769.22	FINISHED GRADE
R3	27854.90	94396.36	5769.55	FINISHED GRADE
R4	27887.20	94380.16	5782.92	FINISHED GRADE
R5	27922.95	94502.06	5781.50	FINISHED GRADE
R6	27893.61	94526.31	5769.80	FINISHED GRADE
R7	27881.26	94535.51	5769.73	FINISHED GRADE
R8	27871.26	94540.03	5768.10	FINISHED GRADE
R9	27872.48	94511.60	5768.79	FINISHED GRADE
R10	27861.91	94514.64	5768.02	FINISHED GRADE
R11	27843.96	94550.26	5768.19	FINISHED GRADE
R12	27832.91	94553.44	5767.38	FINISHED GRADE
R13	27815.87	94452.72	5767.63	FINISHED GRADE
R14	27804.82	94455.90	5768.01	FINISHED GRADE
R15	27720.69	94496.05	5785.18	FINISHED GRADE
R16	27749.41	94478.25	5771.13	FINISHED GRADE
R17	27758.80	94474.71	5770.94	FINISHED GRADE
R18	27768.40	94471.94	5768.80	FINISHED GRADE
R19	27799.40	94579.55	5768.14	FINISHED GRADE
R20	27801.00	94604.71	5766.27	FINISHED GRADE
R21	27791.05	94607.58	5771.26	FINISHED GRADE
R22	27781.07	94609.21	5771.45	FINISHED GRADE
R23	27750.27	94611.63	5786.40	FINISHED GRADE



RIPRAP (18 INCH)
TYPICAL SLOPE SECTION @ BRIDGE
N.T.S.



SECTION
Q_{100} = 8303 cfs
100 YR. W.S. EL. = 5776.25

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BELFORD–HAPPY CANYON CREEK BRIDGE
BRIDGE HYDRAULIC INFORMATION
(1 OF 2)

Designer:	C. TWISS	Structure Numbers	
Detailer:	R. DILLON		
Subset:	BRIDGE	Sheets:	B6 of 37

Project No./Code

Sheet Number 33

100–YEAR RECURRENCE INTERVAL

FLOW UPSTREAM OF BRIDGE = 8303 CFS (FHAD)

DRAINAGE AREA = 17.5± SQ. MI.

CHANNEL DESCRIPTION

BOTTOM MATERIAL: COHESIVE ☐ NONCOHESIVE ☒

BOTTOM MAT. SIZE: CLAY ☐ SILT ☐ SAND ☒ GRAVEL ☐ COBBLES ☐ OTHERS ____

STREAM FORM: STRAIGHT ☐ MEANDERING ☒ BRAIDED ☐

MANNING'S "n" FOR DESIGN: CHANNEL 0.030 OVERBANK 0.035

DEBRIS -- BRUSH ☒ TREES/LOGS ☒ ICE ☐ OTHER ____

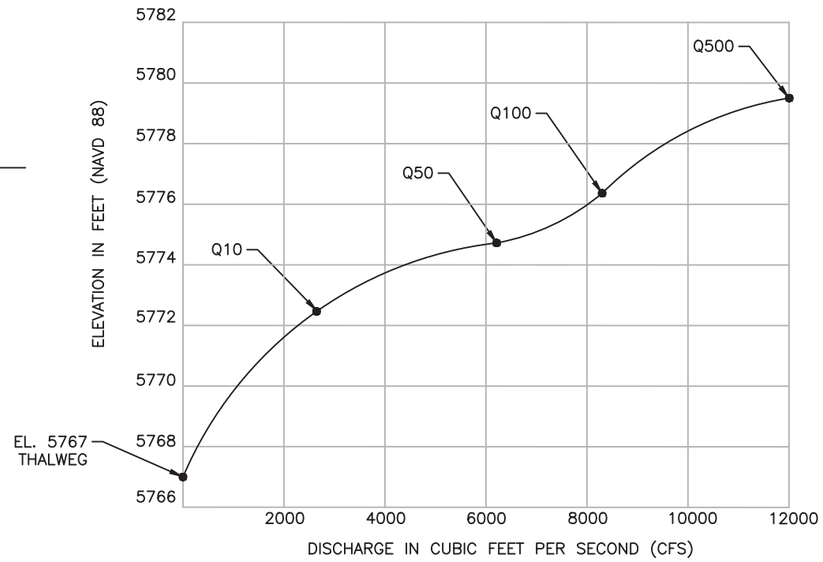
COMPARISON HYDRAULICS (100 YEAR EVENT)

(AT SECTION LOCATED 32 FEET UPSTREAM OF BRIDGE)

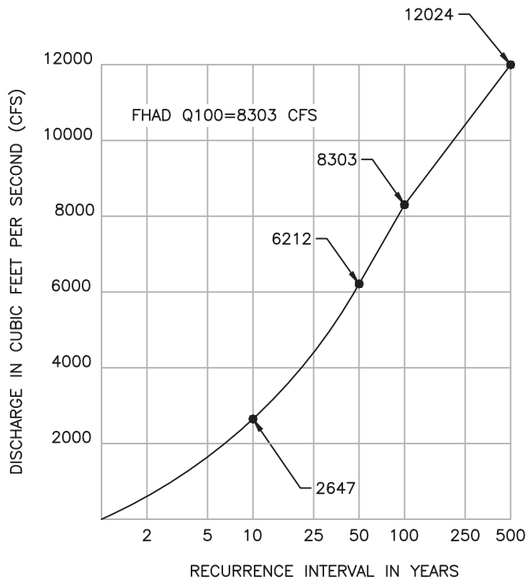
	VELOCITY (FT./SEC)		WS EL. (FT.)	MAX. BACKWATER (FT.)	FROUDE NO.
	AVERAGE	CHANNEL			
EXISTING CONDITIONS	9.90	13.70	5775.53	–	0.90
PROPOSED CONDITIONS	8.19	10.21	5776.35	–	0.63

HYDRAULIC DATA

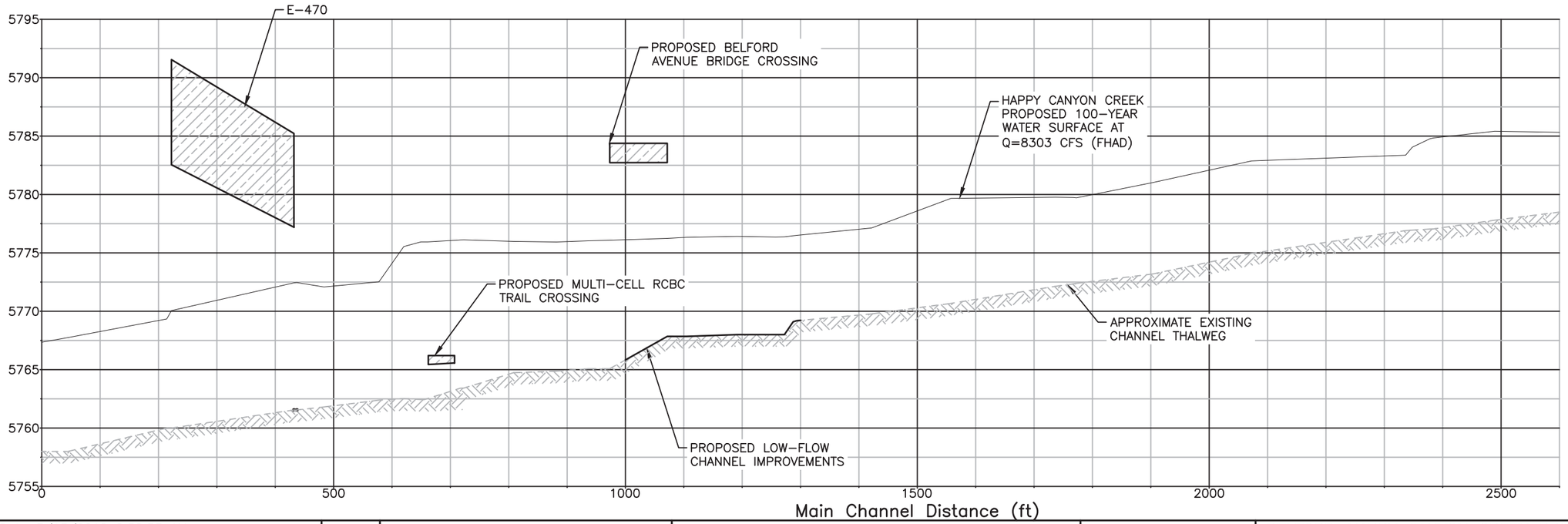
LOCATION	LOW CHORD ELEVATION AT ABUT. FRONT FACE		100–YEAR WATER SURFACE ELEVATION
	ABUT. 1	ABUT. 2	
S. SIDE (UPSTREAM)	5780.07	5782.73	5776.25
N. SIDE (DOWNSTREAM)	5780.07	5782.73	5776.10



STAGE–DISCHARGE CURVE AT UPSTREAM FACE OF BELFORD AVENUE



DISCHARGE–FREQUENCY CURVE



HORIZ. SCALE: 1"=200'
VERT. SCALE: 1"=10'

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BELFORD–HAPPY CANYON CREEK BRIDGE
BRIDGE HYDRAULIC INFORMATION
(2 OF 2)

Designer:	C. TWISS	Structure Numbers	
Detailer:	K. TURNER		
Subset:	BRIDGE	Sheets:	B7 of 37

Project No./Code

Sheet Number 34

STORM DRAINAGE INFRASTRUCTURE NOTES

1. ALL STORM DRAINAGE IMPROVEMENTS ARE SUBJECT TO COMPLIANCE WITH THE COLORADO DEPARTMENT OF TRANSPORTATION (CDOT) CURRENT EDITION OF THE STANDARD SPECIFICATIONS FOR ROAD AND BRIDGE CONSTRUCTION, M & S STANDARDS, AND ALL STANDARD SPECIAL PROVISIONS CURRENTLY USED BY CDOT, WITH THE MODIFICATIONS SET FORTH IN THE TOWN OF PARKER'S STORM DRAINAGE AND ENVIRONMENTAL CRITERIA MANUAL (SDECM), AS AMENDED.

2. THE CONTRACTOR SHALL COMPLY WITH THE "COLORADO WATER QUALITY CONTROL ACT" (TITLE 25, ARTICLE 8 CRS), THE "PROTECTION OF FISHING STREAMS" TITLE 33, ARTICLE 5, CRS), THE "CLEAN WATER ACT" (33 USC 1344), "CHERRY CREEK RESERVOIR CONTROL REGULATION NO. 72" (5 CCR 1002-72), THE REGULATION PROMULGATED, CERTIFICATION OR PERMITS ISSUES, AND THE REQUIREMENTS PRESENTED IN THE SDECM REVISION TO SECTION 107 AND THE CONSTRUCTION BMP PLAN. IN THE EVENT OF CONFLICTS BETWEEN THESE REQUIREMENTS AND WATER QUALITY CONTROL LAWS, RULES, OR REGULATIONS OF OTHER FEDERAL, OR STATE AGENCIES, THE MORE RESTRICTIVE LAWS, RULES, OR REGULATIONS SHALL APPLY.

3. INSPECTIONS: CONSTRUCTION SHALL NOT BEGIN UNTIL A GRADING PERMIT HAS BEEN ISSUED FOR THE PROJECT. THE CONTRACTOR SHALL NOTIFY THE TOWN OF PARKER ENGINEERING DEPARTMENT (PUBLIC WORKS) TO SCHEDULE INSPECTIONS A MINIMUM OF 48 HOURS PRIOR THE CONSTRUCTION OF ALL DRAINAGE INFRASTRUCTURE (STORM SEWERS, INLETS, MANHOLES, ENERGY DISSIPATERS, RIPRAP, GROUTED BOULDERS, DETENTION POND OUTLET STRUCTURES, FOREBAYS, TRICKLE CHANNELS, ETC). FAILURE TO NOTIFY THE ENGINEERING DEPARTMENT FOR INSPECTIONS MAY RESULT IN NON-ACCEPTANCE OF THE INFRASTRUCTURE BY THE TOWN. URBAN DRAINAGE AND FLOOD CONTROL DISTRICT MUST ALSO BE NOTIFIED IN A SIMILAR MANNER FOR ALL MAINTENANCE ELIGIBLE DRAINAGE INFRASTRUCTURES (CONSULT WITH STORMWATER ENGINEERING DIVISION).

4. STRUCTURAL BACKFILL (CDOT CLASS 1) SHALL BE COMPACTED TO CONFORM TO CDOT STANDARD SPECIFICATION 203.03. STRUCTURAL BACKFILL (CDOT CLASS 2) SHALL CONFORM TO CDOT STANDARD SPECIFICATION 203.07. AT THE CONTRACTOR'S OPTION, STRUCTURAL BACKFILL (SQUEEGEE) MEETING THE GRADATION REQUIREMENTS CONTAINED IN REVISION OF SECTION 206 OF THE CDOT STANDARD SPECIFICATIONS AS PRESENTED IN THE SDECM, MAY BE SUBSTITUTED FOR STRUCTURE BACKFILL (CLASS 1) OR CLASS 2) FOR BACKFILLING OF CULVERT PIPES, STORM SEWER PIPES, MANHOLES AND INLET STRUCTURES; HOWEVER, THE TOP 2 FEET BELOW SUBGRADE ELEVATION SHALL BE THE REQUIRED EMBANKMENT MATERIAL.

5. ALL EXCAVATIONS SHALL MEET OSHA REQUIREMENTS.

6. TESTING: PROBATIONARY ACCEPTANCE OF STORM DRAINAGE IMPROVEMENTS WILL BE CONTINGENT UPON SATISFACTORY TESTING RESULTS. IN ALL CASES WHERE TESTS INDICATE COMPACTION LESS THAN THAT REQUIRED BY TOWN SPECIFICATIONS, ADDITIONAL COMPACTION AND TESTS WILL BE REQUIRED UNTIL THE SPECIFICATIONS ARE MET. FREQUENCY OF TESTING WILL BE AS FOLLOWS:
1 TEST FOR SUBGRADE AND 1 TEST FOR BACKFILL AT EVERY ABOVE GROUND APPURTENANCE (MANHOLES, INLETS, ETC)
1 TEST EVERY 200 LF OF MAINLINE TRENCH EVERY 1 FOOT OF BACKFILL LIFT AND WITHIN 1 FOOT FROM ALL STRUCTURES.

7. ALLOWABLE STORM SEWER CONDUIT MATERIAL WITHIN THE TOWN OF PARKER SHALL BE LIMITED TO REINFORCED CONCRETE PIPE (RCP) CONFORMING TO CDOT STANDARD SPECIFICATION 706.02.

8. ALL RCP JOINTS SHALL BE MANUFACTURED IN ACCORDANCE WITH ASTM C443. RUBBER GASKETS SHALL BE USED ON ALL PIPE JOINTS CONFORMING TO ASTM C443. ALL RCP SECTIONS SHALL BE JOINED IN SUCH A MANNER THAT THE ENDS ARE FULLY ENTERED AND THE INNER SURFACES ARE REASONABLE FLUSH. AVERAGE JOINT GAP THAT EXCEEDS ½ INCH SHALL BE FILLED WITH AN APPROVED FLEXIBLE PLASTIC SEALANT.

9. JOINT RESTRAINTS AND TOE-WALLS, CONFORMING TO CDOT M&S STANDARD PLAN NO. M-601-11 SHALL BE USED ON ALL RCP FLARED END SECTION OUTFALLS.

10. EPOXY COATED REBAR SHALL BE USED AS REINFORCING STEEL ON ALL STORM INLETS AND STRUCTURES. REFERENCE CDOT M&S STANDARD PLAN NO. M-604-10, 11, 12, AND 13.

11. CDOT CLASS D CONCRETE SHALL BE USED FOR ALL CONCRETE DRAINAGE STRUCTURES.

12. PRE-CAST INLETS AND MANHOLE BASES SHALL NOT BE USED WITHIN THE TOWN OF PARKER RIGHT-OF-WAY, WITH THE EXCEPTION OF CDOT TYPE C AND D INLETS.

13. TWO- (2) MANHOLE ACCESS POINTS ARE REQUIRED ON ALL TYPE "R" CURB INLETS GREATER THAN OR EQUAL TO TEN (10) FEET IN LENGTH AS PRESENTED IN CDOT M&S STANDARD PLAN NO. M-604-12.

14. ALL GROUTING (BOULDERS, RIPRAP) SHALL BE IN ACCORDANCE WITH THE REVISION OF SECTION 506 OF THE CDOT STANDARD SPECIFICATIONS AS PRESENTED IN THE SDECM.

15. ALL BOULDERS AND RIPRAP SHALL BE SELECTED AND PLACED IN ACCORDANCE WITH THE REVISION OF SECTION 506 OF THE CDOT STANDARD SPECIFICATIONS AS PRESENTED IN THE SDECM.

16. CONTRACTOR SHALL REFER TO THE TOWN OF PARKER'S CONSTRUCTION BEST MANAGEMENT PRACTICES DETAILS AND NOTES FOR ALL REQUIREMENTS RELATING TO RE-VEGETATION, SEDIMENT AND EROSION CONTROL REQUIREMENTS FOR CONSTRUCTION ACTIVITIES.

17. PIPE BELLS SHALL NOT BE CAST INTO MANHOLE BASES OR INLETS.

DROP STRUCTURE TABULATION

INDEX			ITEM NO.	CONTRACT ITEM	UNIT	GSB	
BOOK	PAGE	SHEET				PLAN	AS CONST.
			206	FILTER MATERIAL (CLASS A)	CY	1690	
			206	FILTER MATERIAL (CLASS C)	CY	61	
			206	STRUCTURE EXCAVATION	CY	130	
			206	STRUCTURE BACKFILL (CLASS 1)	CY	118	
			207	TOPSOIL	CY	832	
			501	STEEL SHEET PILING (TYPE II)	SF	11710	
			506	RIPRAP (12 INCH)	CY	76	
			506	SOIL RIPRAP (12 INCH)	CY	2884	
			506	SOIL RIPRAP (18 INCH)	CY	977	
			506	24 INCH GROUTED BOULDER	CY	602	
			601	CONCRETE CLASS D (BOX CULVERT)	CY	47	
			602	REINFORCING STEEL	LB	2352	
			602	REINFORCING STEEL (EPOXY COATED)	LB	740	
			603	48 INCH REINFORCED CONCRETE PIPE (CIP)	LF	187	
			603	48 INCH REINFORCED CONCRETE END SECTION	EA	1	
			603	10X3 FOOT CONCRETE BOX CULVERT (PRECAST)	LF	90	
			604	INLET TYPE D (10 FOOT)	EA	1	
			604	INLET SPECIAL	EA	1	
			619	8 INCH PLASTIC PIPE	LF	268	

NOTES:

1. 24 INCH GROUTED RIPRAP SHALL BE PAID FOR AS 24 INCH GROUTED BOULDERS.
2. SEE CBMP PLANS FOR TABULATION OF EROSION CONTROL ITEMS.
3. FOR UNCLASSIFIED EXCAVATION SEE EARTHWORK SUMMARY. COST OF EXCAVATION FOR ALL GROUTED BOULDERS AND SOIL RIPRAP IS INCLUDED IN THE COST OF THE BID ITEM.
4. DROP STRUCTURE TABULATION QUANTITIES HAVE BEEN CARRIED FORWARD TO THE SUMMARY OF APPROXIMATE QUANTITIES SHEETS.
5. 10X3 FOOT CONCRETE BOX CULVERT (PRECAST) QUANTITY SHOWN IS FOR THE DUAL BOX CULVERT AT CHEROKEE TRAIL.
6. THE PRESENCE OF GROUNDWATER IS ANTICIPATED AND THE CONTRACTOR SHALL BE RESPONSIBLE FOR DEWATERING DURING CONSTRUCTION FOR ALL STORM SEWER AND DROP STRUCTURE INFRASTRUCTURE. DEWATERING SHALL BE INCLUDED IN THE COST OF THE WORK AND NOT PAID FOR SEPARATELY.
7. THE SUGGESTED SEQUENCING FOR DEWATERING WHEN CONSTRUCTING THE DROP STRUCTURES INCLUDES CONSTRUCTING THE SHEET PILE CUTOFF WALLS FIRST, THEN INSTALLING DEWATERING WELLS OR TRENCHES TO DEWATER BELOW THE PROPOSED LOWEST EXCAVATION LIMITS.
8. THE CONTRACTOR SHALL BE RESPONSIBLE FOR ALL APPLICABLE DEWATERING PERMITS AND TREATMENT (AS REQUIRED) OF DISCHARGE FROM DEWATERING OPERATIONS.

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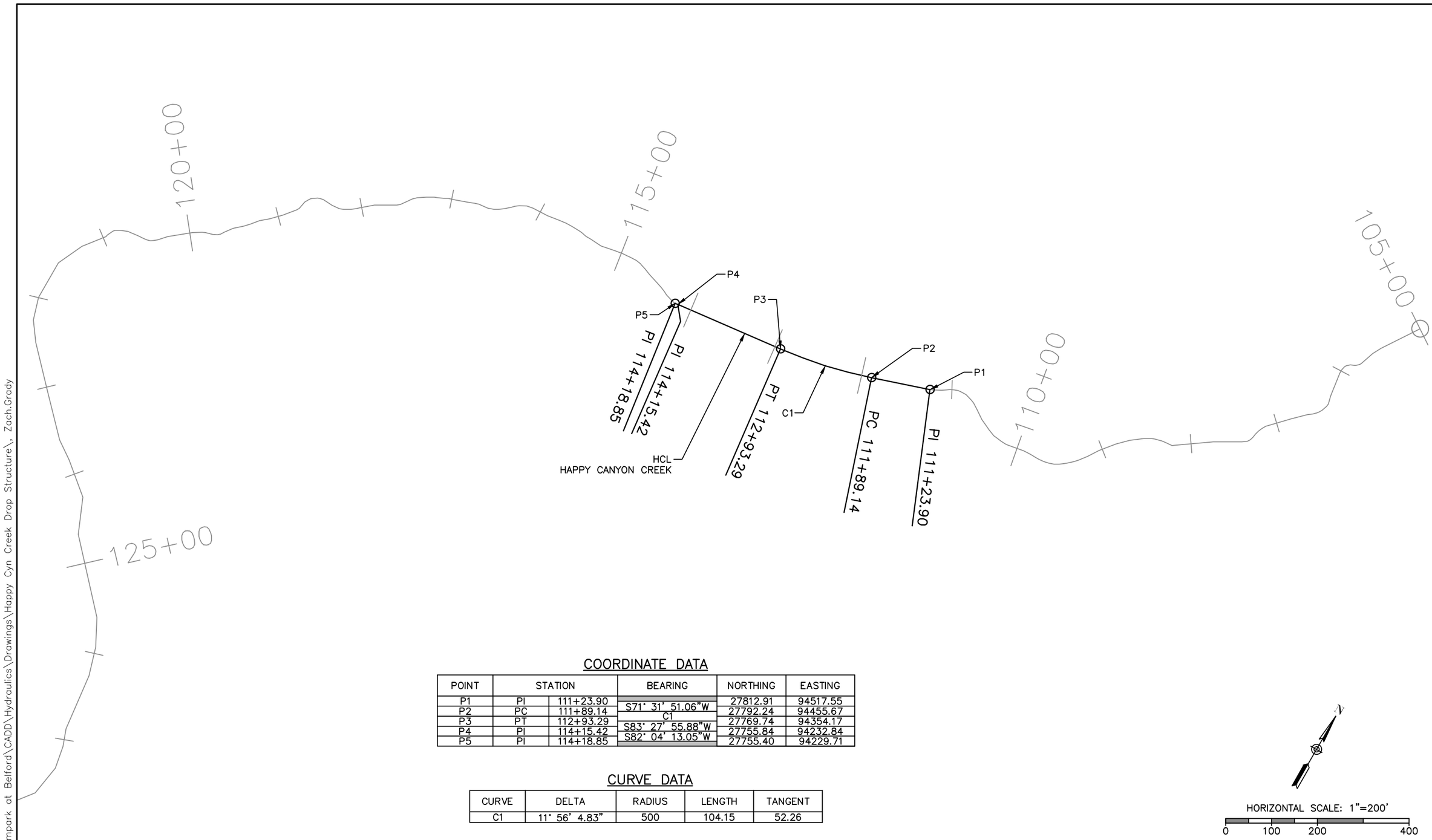
BELFORD-HAPPY CANYON CREEK
HAPPY CANYON CREEK DROP STRUCTURE TABULATION

Designer: CDT
Detailer: KLT
Subset: Drainage
Structure Numbers:
Sheets: DD-01 of 22

Project No./Code

Sheet Number



COORDINATE DATA

POINT	STATION		BEARING	NORTHING	EASTING
P1	PI	111+23.90		27812.91	94517.55
P2	PC	111+89.14	S71° 31' 51.06"W	27792.24	94455.67
P3	PT	112+93.29	C1	27769.74	94354.17
P4	PI	114+15.42	S83° 27' 55.88"W	27755.84	94232.84
P5	PI	114+18.85	S82° 04' 13.05"W	27755.40	94229.71

CURVE DATA

CURVE	DELTA	RADIUS	LENGTH	TANGENT
C1	11° 56' 4.83"	500	104.15	52.26

N

HORIZONTAL SCALE: 1"=200'

0 100 200 400

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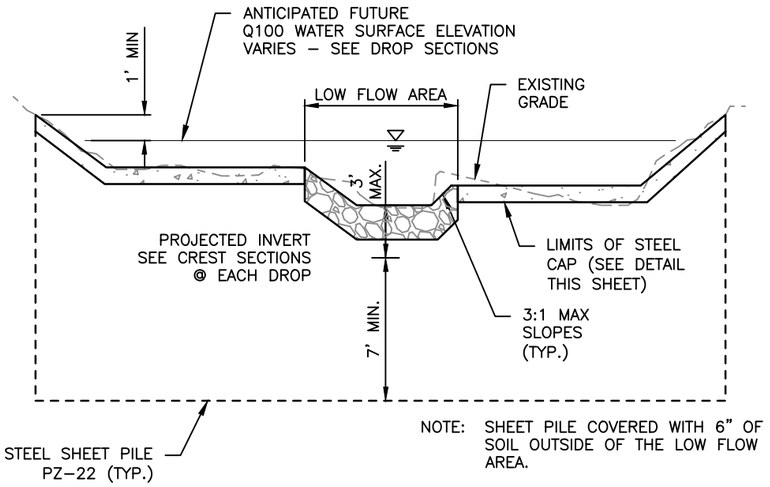
BELFORD-HAPPY CANYON CREEK
HAPPY CANYON CREEK DROP STRUCTURE
HCL GEOMETRY LAYOUT

Designer: CDT
Detailer: KLT
Subset: Drainage
Structure Numbers:
Sheets: DD-02 of 22

Project No./Code

Sheet Number

Know what's below.
Call before you dig.



SHEET PILE TYPICAL SECTION

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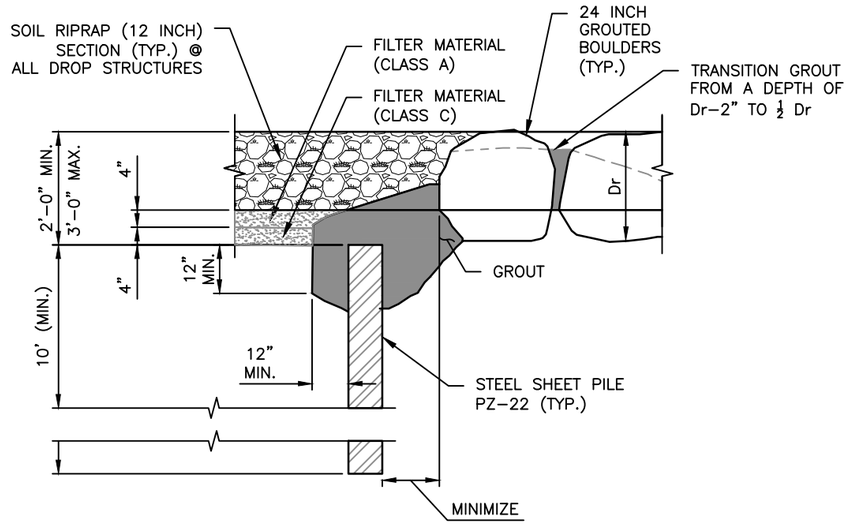

SHEET PILE CUTOFF CONNECTION (GROUTED BOULDER)

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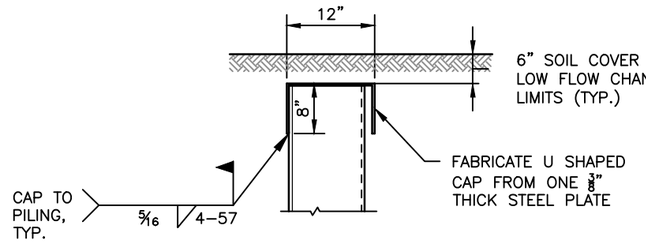

NOTE: STEEL CAP REQUIRED OUTSIDE OF GROUTED BOULDER SECTION ONLY. ALL INCIDENTAL ITEMS REQUIRED FOR THE STEEL SHEET PILE CAP SHALL BE INCLUDED IN THE COST OF STEEL SHEET PILING (TYPE II).

STEEL SHEET PILE CAP DETAIL

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BELFORD–HAPPY CANYON CREEK
HAPPY CANYON CREEK DROP STRUCTURE
SHEET PILE DETAILS

Designer: CDT
Detailer: KLT
Subset: Drainage
Structure Numbers:
Sheets: DD–03 of 22

Project No./Code

Sheet Number

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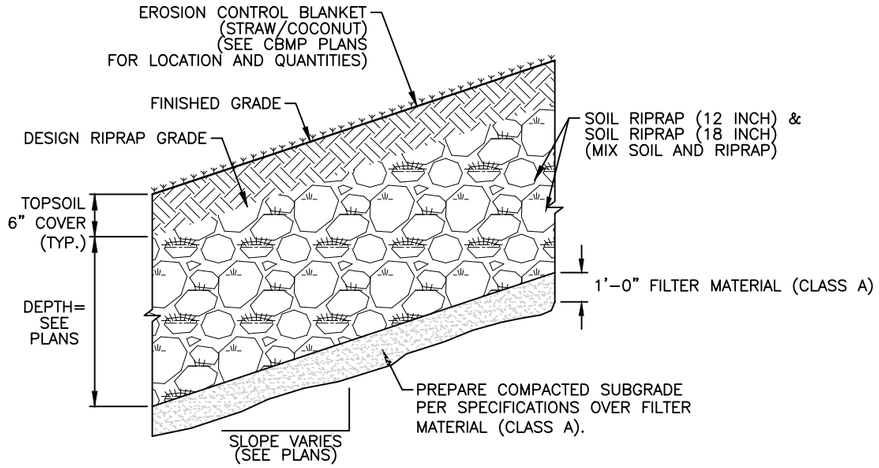
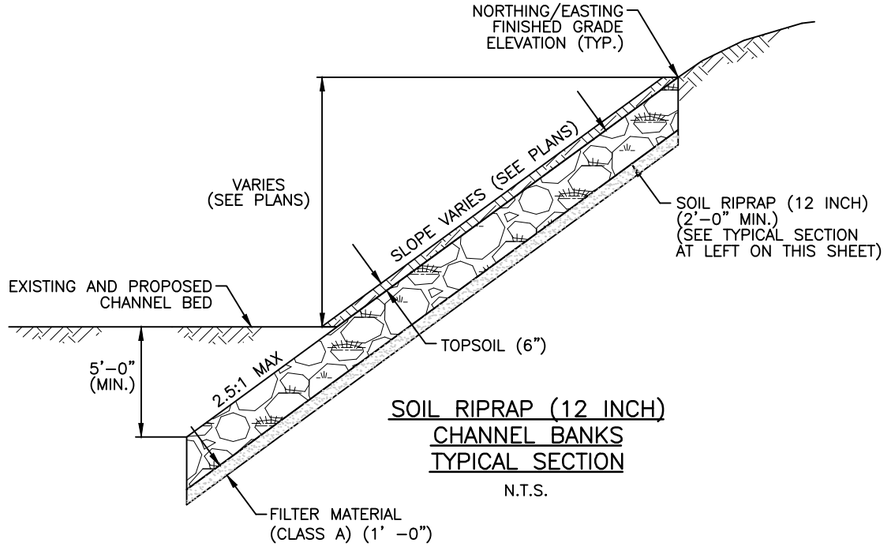


SOIL RIPRAP (12 INCH) & SOIL RIPRAP (18 INCH)
TYPICAL SECTION
N.T.S.

RIPRAP AND SOIL RIPRAP GRADATION				
UDFCD RIPRAP DESIGNATION	% SMALLER THAN GIVEN SIZE BY WEIGHT	INTERMEDIATE ROCK DIMENSION (INCHES)	D_{50}* (INCHES)	BID ITEM DESCRIPTION
TYPE M	70 – 100	21	12	RIPRAP (12 INCH)
	50 – 70	18		
	35 – 50	12		SOIL RIPRAP (12 INCH)
	2 – 10	4		
TYPE H	70 – 100	30	18	RIPRAP (18 INCH)
	50 – 70	24		
	35 – 50	18		SOIL RIPRAP (18 INCH)
	2 – 10	6		
TYPE VH	70 – 100	42	24	24 INCH GROUTED BOULDER
	50 – 70	33		
	35 – 50	24		
	2 – 10	9		



SOIL RIPRAP (12 INCH)
CHANNEL BANKS
TYPICAL SECTION
N.T.S.

SOIL RIPRAP (12 INCH) & SOIL RIPRAP (18 INCH) NOTES:

1. ELEVATION TOLERANCES FOR THE SOIL RIPRAP SHALL BE 0.10 FEET. THICKNESS OF SOIL RIPRAP SHALL BE NO LESS THAN THICKNESS SHOWN AND NO MORE THAN 2-INCHES GREATER THAN THE THICKNESS SHOWN.
2. WHERE "SOIL RIPRAP" IS DESIGNATED ON THE CONTRACT DRAWINGS, RIPRAP VOIDS ARE TO BE FILLED WITH NATIVE SOIL. THE RIPRAP SHALL BE PRE-MIXED WITH THE NATIVE SOIL AT THE FOLLOWING PROPORTIONS BY VOLUME: 65% RIPRAP AND 35% SOIL. THE SOIL USED FOR MIXING SHALL BE NATIVE TOPSOIL AND BE INSTALLED IN A MANNER THAT RESULTS IN A DENSE, INTERLOCKED LAYER OF RIPRAP WITH RIPRAP VOIDS FILLED COMPLETELY WITH SOIL. SEGREGATION OF MATERIALS SHALL BE AVOIDED AND IN NO CASE SHALL THE COMBINED MATERKAL CONSIST PRIMARILY OF SOIL; THE DENSITY AND INTERLOCKING NATURE OF RIPRAP IN THE MIXED MATERIAL SHALL ESSENTIALLY BE THE SAME AS IF THE RIPRAP WAS PLACED WITHOUT SOIL.
3. WHERE SPECIFIED (TYPICALLY AS "BURIED SOIL RIPRAP"), A SURFACE LAYER OF TOPSOIL SHALL BE PLACED OVER THE SOIL RIPRAP ACCORDING TO THE THICKNESS SPECIFIED ON THE CONTRACT DRAWINGS. THE TOPSOIL SURFACE LAYER SHALL BE COMPACTED TO APPROXIMATELY 85% OF THE MAXIMUM DENSITY AND WITHIN TWO PERCENTAGE POINTS OF OPTIMUM MOISTURE IN ACCORDANCE WITH ASTM D698. TOPSOIL SHALL BE ADDED TO ANY AREAS THAT SETTLE.
4. ALL SOIL RIPRAP THAT IS BURIED WITH THE TOPSOIL SHALL BE REVIEWED AND APPROVED BY THE ENGINEER PRIOR TO ANY TOPSOIL PLACEMENT.
2. CRIMP MULCH AS CALLED FOR IN THE CBMP PLANS AND SPECIFICATIONS.
3. SEE DD-03 FOR SOIL RIPRAP AT DROP STRUCTURES.

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File Name: H115360-01DROP04Soil Riprap Det.dwg
Horizontal Scale: N.T.S Vertical Scale: N.T.S

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BELFORD-HAPPY CANYON CREEK
HAPPY CANYON CREEK DROP STRUCTURE
DETAILS

Designer: CDT
Detailer: KLT
Subset: Drainage
Structure Numbers:
Sheets: DD-04 of 22

Project No./Code

Sheet Number

Know what's below. Call before you dig.

GROUT NOTES

BOULDER PLACEMENT NOTES:

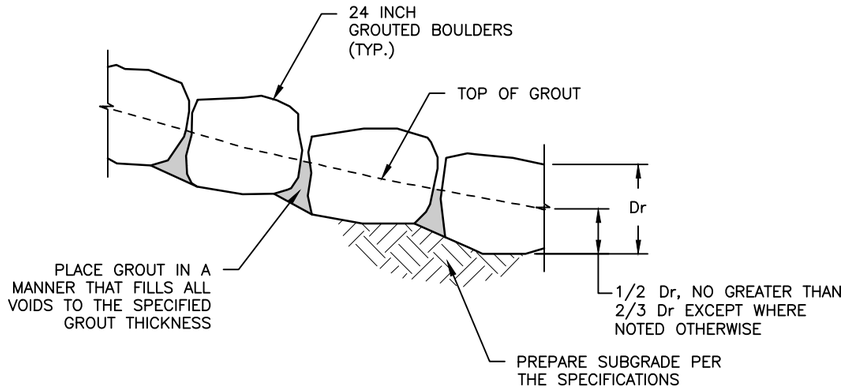
1. PLACE BOULDERS WITH THE REQUIRED BOULDER HEIGHT VERTICAL. PLACE BOULDERS AS TIGHTLY TOGETHER AS POSSIBLE (WITHOUT TOUCHING) WHILE PROVIDING ENOUGH ROOM BETWEEN THEM TO THOROUGHLY VIBRATE THE GROUT AND TO ENSURE NO GAPS IN THE GROUT. THE SMALL DIMENSION OF A 2X4 CAN BE USED AS A GUIDE TO CHECK MINIMUM SPACING.
2. BEFORE GROUTING, CLEAN ALL DIRT AND MATERIAL FROM ROCK THAT COULD PREVENT THE GROUT FROM BINDING TO THE ROCK. KEEP BOULDERS FROM TOUCHING. AVOID SLIDING BOULDERS AGAINST SUBGRADE TO PROPERLY POSITION.

MATERIAL SPECIFICATIONS:

1. ALL GROUT SHALL HAVE A MINIMUM 28–DAY COMPRESSIVE STRENGTH EQUAL TO 3200 PSI.
2. ONE CUBIC YARD OF GROUT SHALL HAVE A MINIMUM OF SIX (6) SACKS OF TYPE II PORTLAND CEMENT.
3. A MAXIMUM OF 25% TYPE F FLY ASH MAY BE SUBSTITUTED FOR THE PORTLAND CEMENT.
4. THE AGGREGATE SHALL BE COMPRISED OF 70% NATURAL SAND (FINES) AND 30% 3/8–INCH ROCK (COARSE).
5. THE GROUT SLUMP SHALL BE BETWEEN 4–INCHES TO 6–INCHES.
6. AIR ENTRAINMENT SHALL BE BETWEEN 5.5% AND 7.5%.
7. TO CONTROL SHRINKAGE AND CRACKING, 1.5 POUNDS OF FIBERMESH, OR EQUIVALENT, SHALL BE USED PER CUBIC YARD OF GROUT.
8. COLOR ADDITIVE IN REQUIRED AMOUNTS SHALL BE USED WHEN SO SPECIFIED BY CONTRACT.

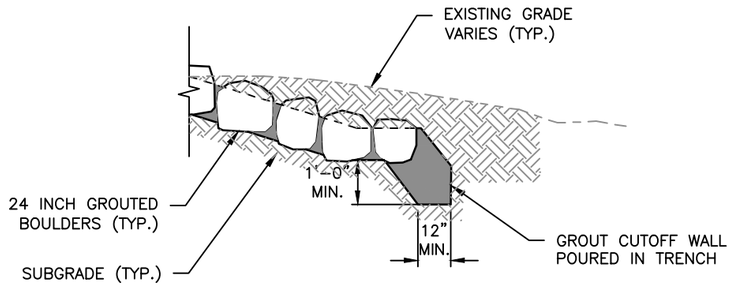
GROUT PLACEMENT SPECIFICATIONS:

1. SPECIAL PROCEDURES SHALL BE REQUIRED FOR GROUT PLACEMENT WHEN THE AIR TEMPERATURES ARE LESS THAN 40°F OR GREATER THAN 90°F. CONTRACTOR SHALL OBTAIN PRIOR APPROVAL FROM THE DESIGN ENGINEER OF THE PROCEDURES TO BE USED FOR PROTECTING THE GROUT.
2. GROUT SHALL BE DELIVERED BY MEANS OF A LOW PRESSURE (LESS THAN 10 PSI) GROUT PUMP USING A 2–INCH DIAMETER (MAXIMUM) NOZZLE.
3. FULL DEPTH PENETRATION OF THE GROUT INTO THE BOULDER VOIDS SHALL BE ACHIEVED BY INJECTING GROUT STARTING WITH THE NOZZLE NEAR THE BOTTOM AND RAISING IT AS THE GROUT FILLS, WHILE VIBRATING GROUT INTO PLACE USING A PENCIL VIBRATOR.
4. ALL GROUT BETWEEN BOULDERS SHALL BE TREATED WITH A BROOM FINISH.
5. AFTER GROUT PLACEMENT, EXPOSED BOULDER FACES SHALL BE CLEANED AND FREE OF GROUT.
6. ALL FINISHED GROUT SURFACES SHALL BE SPRAYED WITH A CLEAR LIQUID MEMBRANE CURING COMPOUND AS SPECIFIED IN ASTM C309.



GROUTED BOULDER PLACEMENT DETAIL

N.T.S.



STRUCTURE EDGE WALL DETAIL

N.T.S.

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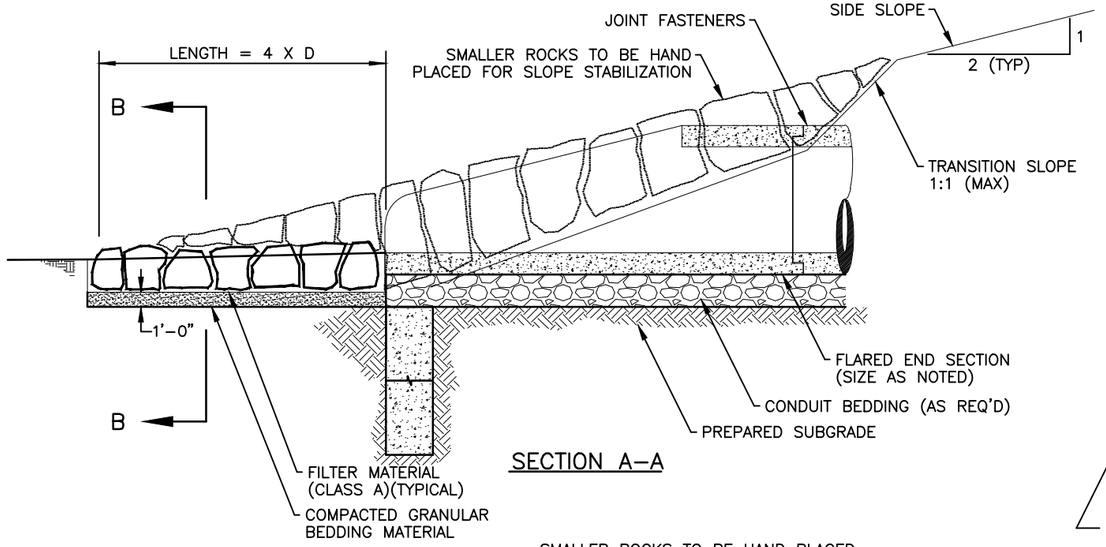
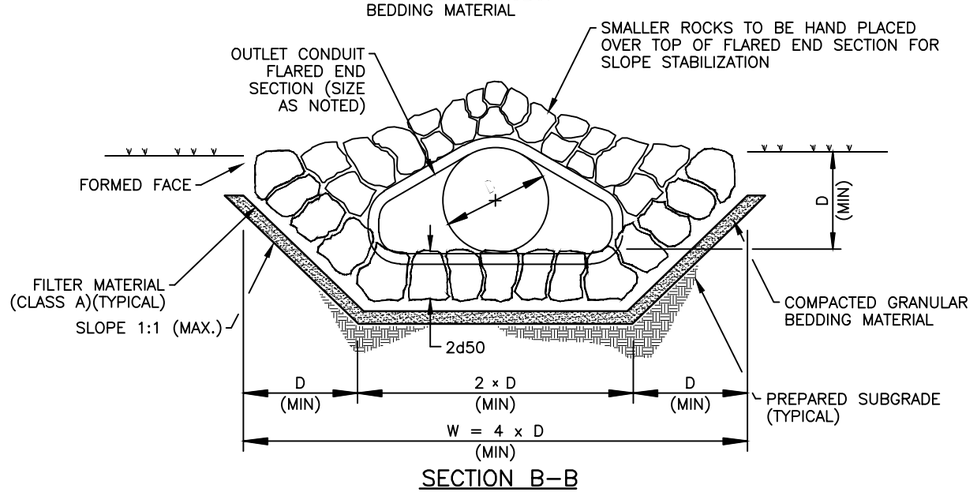
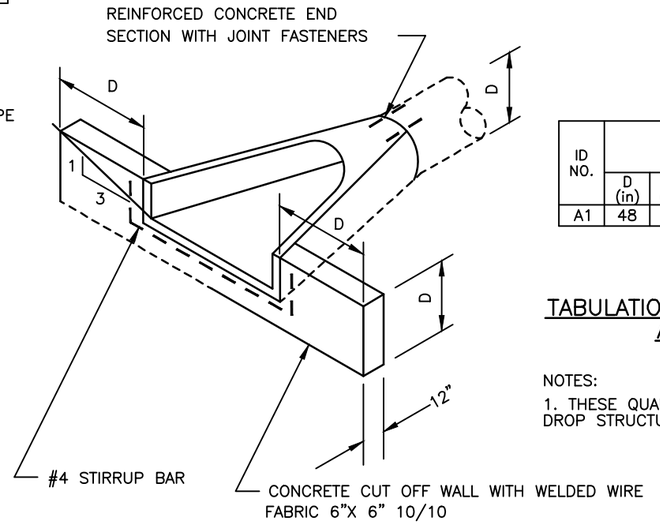
BELFORD–HAPPY CANYON CREEK HAPPY CANYON CREEK DROP STRUCTURE DETAIL				Project No./Code
Designer: CDT	Structure Numbers			
Detailer: KLT				
Subset: Drainage	Sheets: DD–05 of 22			Sheet Number



SECTION A–A



SECTION B–B



ID NO.	DIMENSIONS					QUANTITIES	
	D (in)	W (ft)	L (ft)	RIPRAP TYPE	d50 (in)	RIPRAP (12 INCH) (CY)	FILTER MATERIAL (CLASS A) (CY)
A1	48	16	16	M	12	19	9

TABULATION OF RIPRAP AND GEOTEXTILE MATERIAL AT CULVERT INLETS & OUTLETS

NOTES:

1. THESE QUANTITIES HAVE BEEN CARRIED FORWARD TO THE DROP STRUCTURE TABULATION.

CONCRETE TOEWALL AND END SECTION FOR REINFORCED CONCRETE PIPE

NOTES:

1. D= INSIDE DIAMETER OF REINFORCED CONCRETE PIPE.
2. CONCRETE FOR THE TOEWALL SHALL BE CONCRETE CLASS D (WALL)
3. EACH REINFORCED CONCRETE END SECTION SHALL BE CONNECTED TO THE REINFORCED CONCRETE PIPE WITH CONCRETE PIPE JOINT FASTENERS (2–EACH). CONCRETE PIPE JOINT FASTENERS SHALL BE INCLUDED IN THE COST OF THE REINFORCED CONCRETE END SECTION.
4. ALL CONCRETE, REINFORCING, CONNECTIONS, STRUCTURE EXCAVATION, AND EXTRA WORK REQUIRED TO CONSTRUCT THE CONCRETE TOEWALL SHALL BE INCLUDED IN THE COST OF 48 INCH RCES.
5. ALL REINFORCED CONCRETE PIPE EXTENSIONS SHALL HAVE A CONCRETE COLLAR AND SHALL BE INCLUDED IN THE COST OF THE REINFORCED CONCRETE PIPE.
6. REMOVED RIPRAP MAY BE UTILIZED FOR RIPRAP (12 INCH) UNLESS DIRECTED OTHERWISE BY THE ENGINEER.

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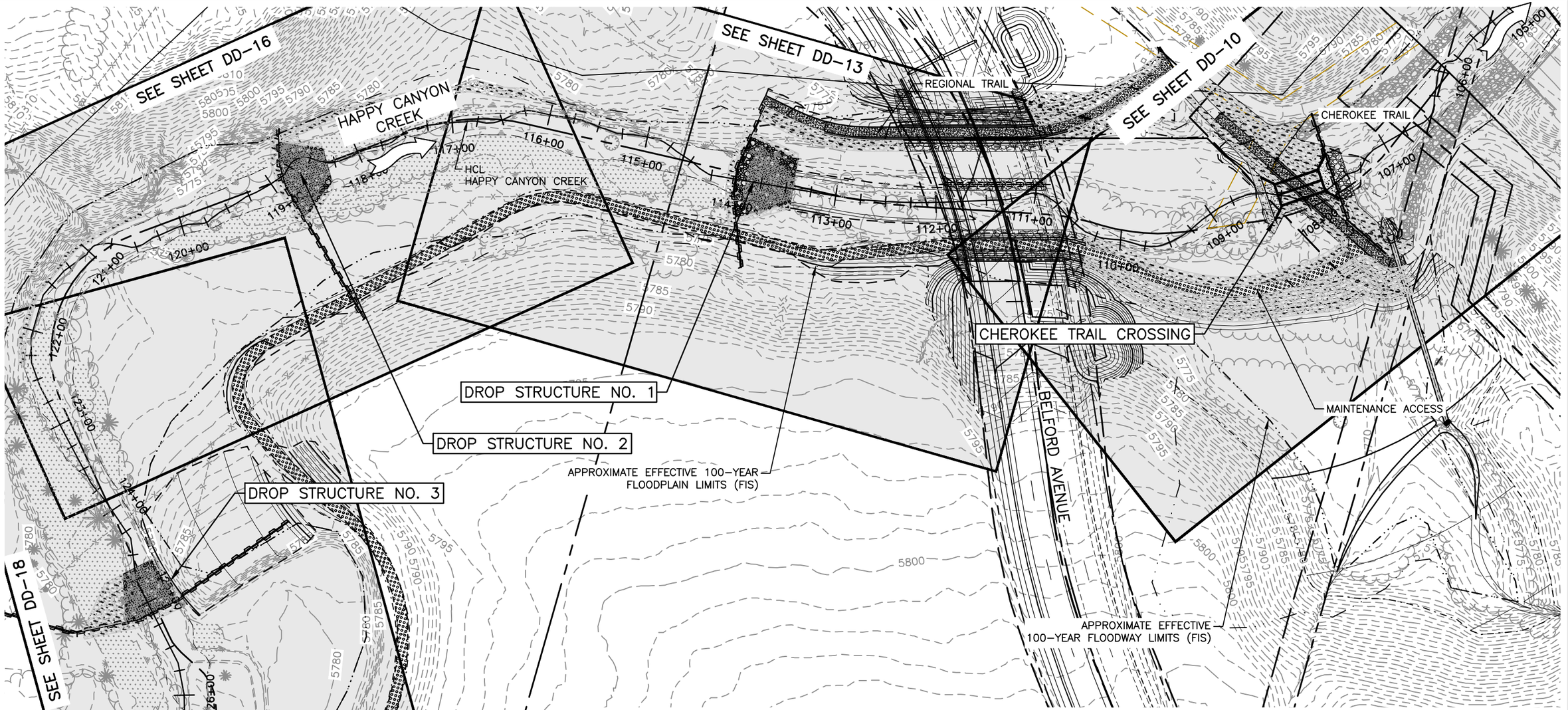
BELFORD–HAPPY CANYON CREEK DRAINAGE
OUTLET PROTECTION DETAILS

Designer: CDT
Detailer: KLT
Subset: Drainage
Structure Numbers:
Sheets: DD–06 of 22

Project No./Code

Sheet Number



NOTES:

1. SEE UTILITY PLANS FOR ADDITIONAL INFORMATION
2. UTILITY INFORMATION SHOWN IS PLOTTED FROM THE BEST AVAILABLE DATA. THE CONTRACTOR IS RESPONSIBLE FOR MAKING THEIR OWN DETERMINATION AS TO THE TYPE AND LOCATION OF UTILITIES AS MAY BE NECESSARY TO AVOID DAMAGE THERETO. CONTACT THE UTILITY NOTIFICATION CENTER OF COLORADO AT 811 FOR UTILITY LOCATIONS AT LEAST 48 HOURS PRIOR TO EXCAVATING. CONTRACTOR SHALL COORDINATE WITH UTILITY COMPANY FOR ANY UTILITIES THAT NEED RELOCATING.

LEGEND

- TOP OF CUT
- TOE OF FILL
- WETLANDS
- SOIL RIPRAP (12 INCH)
- RIPRAP (12 INCH)
- RIPRAP (18 INCH)
- 24" GROUTED BOULDERS

N

HORIZONTAL SCALE: 1"=100'

0 50 100 200

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BELFORD-HAPPY CANYON CREEK
HAPPY CANYON CREEK DROP STRUCTURE PLAN

Designer: CDT
Detailer: KLT
Subset: Drainage
Structure Numbers:
Sheets: DD-07 of 22

Project No./Code

Sheet Number

NOTES

1. UTILITY INFORMATION SHOWN IS PLOTTED FROM THE BEST AVAILABLE DATA. THE CONTRACTOR IS RESPONSIBLE FOR MAKING THEIR OWN DETERMINATION AS TO THE TYPE AND LOCATION OF UTILITIES AS MAY BE NECESSARY TO AVOID DAMAGE THERETO. CONTACT THE UTILITY NOTIFICATION CENTER OF COLORADO AT 811 FOR UTILITY LOCATIONS AT LEAST 48 HOURS PRIOR TO EXCAVATING. CONTRACTOR SHALL COORDINATE WITH UTILITY COMPANY FOR ANY UTILITIES THAT NEED RELOCATING.
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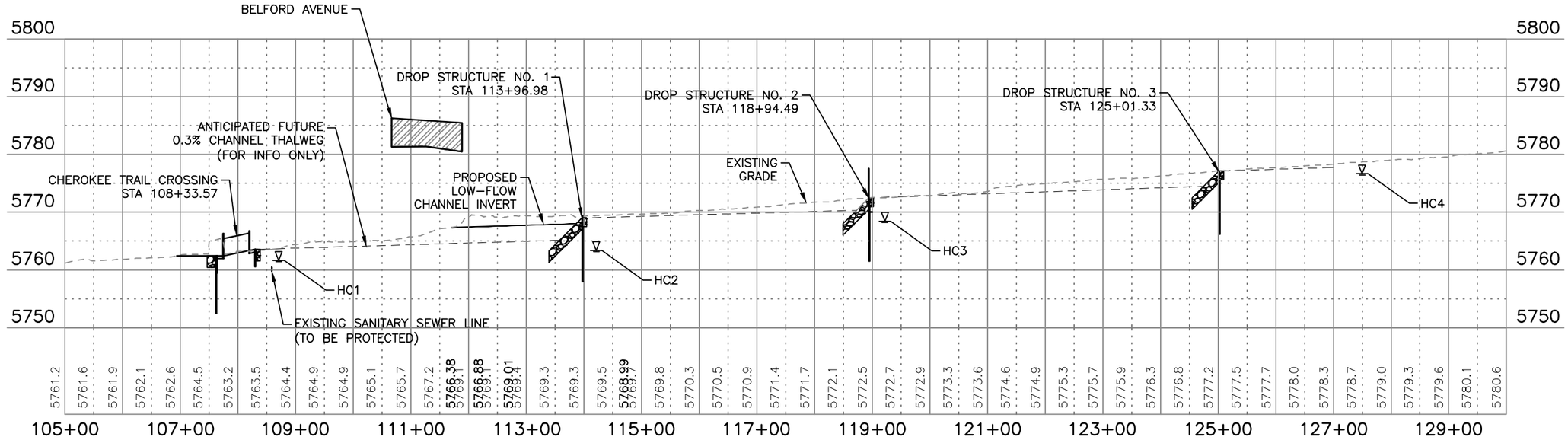

HAPPY CANYON CREEK PROFILE

HORIZONTAL SCALE: 1"=200'
VERTICAL SCALE: 1"=20'

0' 100' 200' 400'

0' 10' 20' 40'

▽ APPROX. GROUNDWATER ELEVATION

GROUNDWATER ELEVATIONS	
TEST BORING ID	APPROX. DEPTH BELOW SURFACE (FT.)
HC1	-2.0
HC2	-6.0
HC3	-4.0
HC4	-2.0

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BELFORD-HAPPY CANYON CREEK
HAPPY CANYON CREEK DROP STRUCTURE PROFILE

Designer:	CDT	Structure Numbers	
Detailer:	ZJG		
Subset:	Drainage	Sheets:	DD-08 of 22

Project No./Code

Sheet Number

NOTES:

1. SEE SHEET DD–11 FOR CHEROKEE TRAIL POINT DATA.
2. SEE SHEET DD–10 FOR SECTIONS A AND B.
3. SEE SHEET DD–04 FOR SOIL RIPRAP DETAILS.
4. SEE UTILITY PLANS FOR ADDITIONAL INFORMATION
5. UTILITY INFORMATION SHOWN IS PLOTTED FROM THE BEST AVAILABLE DATA. THE CONTRACTOR IS RESPONSIBLE FOR MAKING THEIR OWN DETERMINATION AS TO THE TYPE AND LOCATION OF UTILITIES AS MAY BE NECESSARY TO AVOID DAMAGE THERETO. CONTACT THE UTILITY NOTIFICATION CENTER OF COLORADO AT 811 FOR UTILITY LOCATIONS AT LEAST 48 HOURS PRIOR TO EXCAVATING. CONTRACTOR SHALL COORDINATE WITH UTILITY COMPANY FOR ANY UTILITIES THAT NEED RELOCATING.

BELFORD AVENUE

MAINTENANCE ACCESS

HAPPY CANYON CREEK

111+00

110+00

109+00

108+00

107+00

106+00

105+00

LIMITS OF RIPRAP (18 INCH) SEE BRIDGE HYDRAULIC SHEETS FOR INFORMATION.

STORM SEWER LINE "B". SEE SHEETS DD–12 AND DD–16 FOR INFORMATION

LIMITS OF SOIL RIPRAP (18 INCH) 3'–0" THICK (313 CY) OVER FILTER MATERIAL (CLASS A) 1'–0" THICK (105 CY). SEE DD–04.

CHEROKEE TRAIL SEE TRAIL PLANS FOR INFORMATION.

LIMITS OF SOIL RIPRAP (18 INCH) 3'–0" THICK (664 CY) OVER FILTER MATERIAL (CLASS A) 1'–0" THICK (222 CY). SEE DD–04.

STEEL SHEET PILING (TYP.) (2220 SF). SEE SHEET DD–03.

PROPOSED DUAL 10' X 3' RCBC. SEE DD–10.

LIMITS OF RIPRAP (12 INCH) (57 CY) OVER FILTER MATERIAL (CLASS A) (29 CY). SEE DD–10.

APPROXIMATE LIMITS OF EXISTING RIPRAP (TO REMAIN)

105+00 HAPPY CANYON CREEK HCL (TYP.)

LIMITS OF SOIL RIPRAP (12 INCH) 2'–0" THICK (685 CY) OVER FILTER MATERIAL (CLASS A) 1'–0" THICK (343 CY). SEE DD–04.

APPROXIMATE EFFECTIVE 100–YEAR FLOODPLAIN LIMITS (FIS)

EXISTING SANITARY SEWER LINE (TO BE PROTECTED)

LIMITS OF SOIL RIPRAP (12 INCH) 2'–0" THICK (435 CY) OVER FILTER MATERIAL (CLASS A) 1'–0" THICK (218 CY). SEE DD–04.

APPROXIMATE EFFECTIVE 100–YEAR FLOODWAY LIMITS (FIS)

MAINTENANCE ACCESS SEE MAINTENANCE ACCESS PLANS FOR INFORMATION.

STORM SEWER LINE "A". SEE SHEET DD–12.

LIMITS OF RIPRAP (12 INCH) (19 CY) OVER FILTER MATERIAL (CLASS A) (9 CY). SEE DD–06.

CHEROKEE TRAIL

EB E–470

LEGEND

- TOP OF CUT
- TOE OF FILL
- WETLANDS
- SOIL RIPRAP (12 INCH & 18 INCH)
- RIPRAP (12 INCH)
- RIPRAP (18 INCH)

HORIZONTAL SCALE: 1"=40'

0' 20' 40' 80'

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BELFORD–HAPPY CANYON CREEK
HAPPY CANYON CREEK DROP STRUCTURE
CHEROKEE TRAIL PLAN

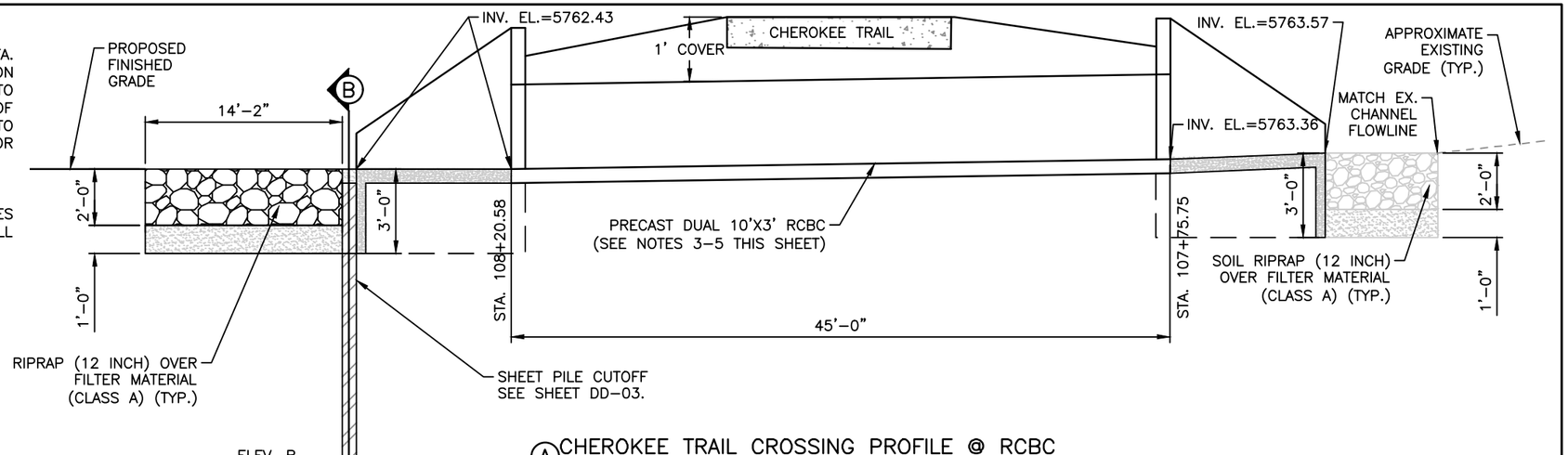
Designer: CDT
Detailer: ZJG
Subset: Drainage
Structure Numbers:
Sheets: DD–09 of 22

Project No./Code

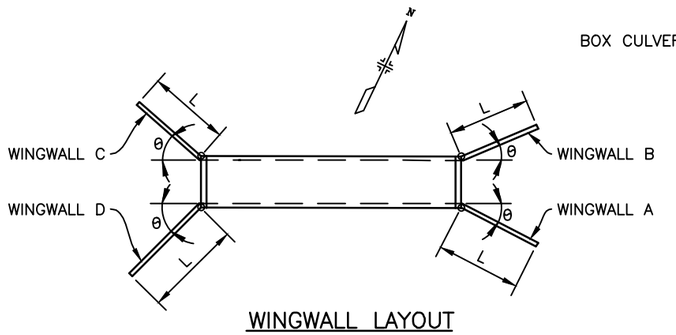
Sheet Number

NOTES:

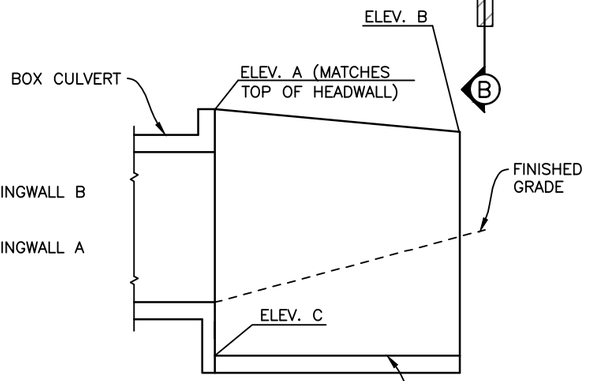
1. UTILITY INFORMATION SHOWN IS PLOTTED FROM THE BEST AVAILABLE DATA. THE CONTRACTOR IS RESPONSIBLE FOR MAKING THEIR OWN DETERMINATION AS TO THE TYPE AND LOCATION OF UTILITIES AS MAY BE NECESSARY TO AVOID DAMAGE THERETO. CONTACT THE UTILITY NOTIFICATION CENTER OF COLORADO AT 811 FOR UTILITY LOCATIONS AT LEAST 48 HOURS PRIOR TO EXCAVATING. CONTRACTOR SHALL COORDINATE WITH UTILITY COMPANY FOR ANY UTILITIES THAT NEED RELOCATING.
2. SEE UTILITY PLANS FOR ADDITIONAL INFORMATION.
3. PRECAST BOX CULVERT MUST CONFORM TO CDOT M-STANDARDS M-603-2.
4. FOR CAST-IN-PLACE END SECTIONS, USE M-601-2 FOR WALL THICKNESSES AND REINFORCEMENT SIZE AND SPACINGS WITH S=10 FT, R=6 FT, AND FILL HEIGHT = 0-5 FT.
5. FOR WINGWALLS AND CONCRETE APRON, USE M-601-20.



(A) CHEROKEE TRAIL CROSSING PROFILE @ RCBC
STA 107+48.70 TO 108+41.52
N.T.S.

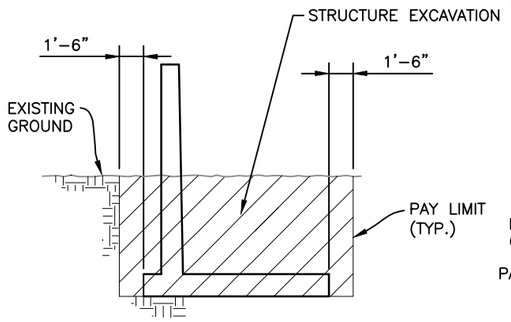


WINGWALL LAYOUT AT BOX CULVERT

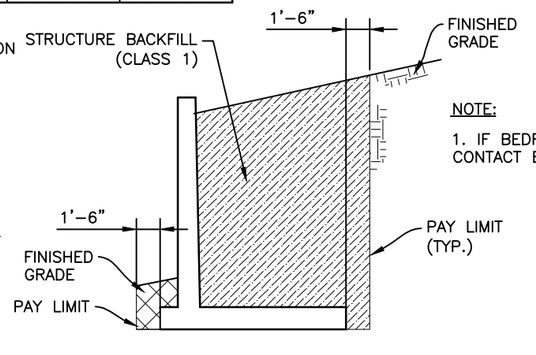


ELEVATION WINGWALLS

WINGWALL	θ	L	ELEV. A	ELEV. B	ELEV. C
A	45°0'0"	15'-6"	5767.18	5763.43	5760.43
B	45°0'0"	15'-6"	5767.18	5763.43	5760.43
C	45°0'0"	15'-6"	5768.11	5764.57	5761.36
D	45°0'0"	15'-6"	5768.11	5764.57	5761.36



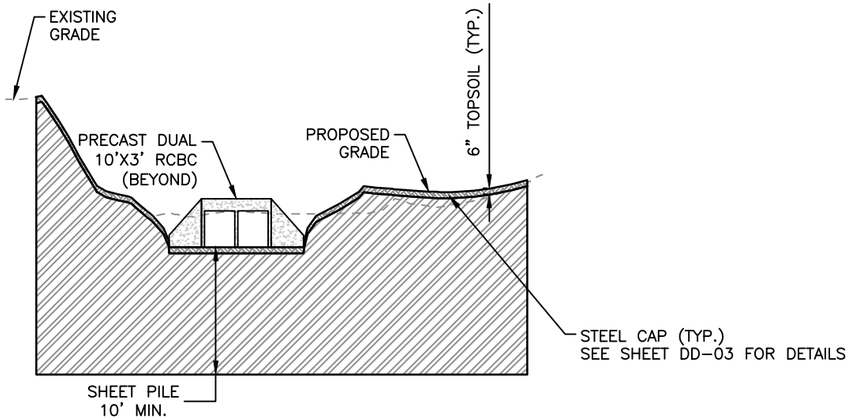
WINGWALLS EXCAVATION



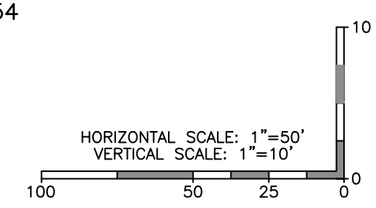
WINGWALLS BACKFILL

NOTE:

1. IF BEDROCK IS ENCOUNTERED, CONTACT ENGINEER PRIOR TO PROCEEDING.



(B) CREST SECTION
STA 107+63.54



HAPPY CANYON CREEK HYDRAULICS

Q100= 8,303 C.F.S
Q100 VELOCITY = 6.11 F.P.S
FROUDE No.=0.31
FOR INFO ONLY

CHEROKEE TRAIL CROSSING

I:\115360-01 - Compark at Belford\CADD\Hydraulics\Drawings\Happy Cyn Creek Drop Structure\, Zach.Grady

Print Date: 4/16/2019 8:56:51 AM
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Horizontal Scale: 1"=50' Vertical Scale: 1"=10'

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Sheet Revisions

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As Constructed
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BELFORD-HAPPY CANYON CREEK
HAPPY CANYON CREEK DROP STRUCTURE
CHEROKEE TRAIL PROFILE/DETAILS

Designer:	CDT	Structure Numbers	
Detailer:	ZJG		
Subset:	Drainage	Sheets:	DD-10 of 22

Project No./Code

Sheet Number

HAPPY CANYON CREEK CHEROKEE TRAIL STEEL SHEET PILE CUTOFF WALL POINT DATA

POINT	NORTHING	EASTING	ELEVATION	DESCRIPTION
W1	27865.91	94895.02	5767.95	STEEL SHEET PILE WALL – TOP OF STEEL CAP EL.
W2	27887.19	94849.78	5767.36	STEEL SHEET PILE WALL – TOP OF STEEL CAP EL.
W3	27979.15	94785.85	5774.82	STEEL SHEET PILE WALL – TOP OF STEEL CAP EL.

HAPPY CANYON CREEK CHEROKEE TRAIL GRADING POINT DATA

POINT	NORTHING	EASTING	ELEVATION	DESCRIPTION
G1	27872.10	94962.88	5779.00	FINISHED GRADE EL.
G2	27823.77	94932.12	5779.00	FINISHED GRADE EL.
G3	27808.04	94890.63	5779.00	FINISHED GRADE EL.
G4	27766.29	94809.24	5779.00	FINISHED GRADE EL.
G5	27745.18	94744.70	5779.00	FINISHED GRADE EL.

HAPPY CANYON CREEK CHEROKEE TRAIL SOIL RIPRAP POINT DATA

POINT	NORTHING	EASTING	ELEVATION	DESCRIPTION
SR1	27769.57	94610.15	5777.00	SOIL RIPRAP (12 INCH) – FINISHED GRADE EL.
SR2	27835.00	94932.41	5777.00	SOIL RIPRAP (12 INCH) – FINISHED GRADE EL.
SR3	27801.00	94604.71	5765.86	SOIL RIPRAP (12 INCH) – FINISHED GRADE EL.
SR4	27800.34	94633.29	5767.10	SOIL RIPRAP (12 INCH) – FINISHED GRADE EL.
SR5	27797.05	94661.68	5769.72	SOIL RIPRAP (12 INCH) – FINISHED GRADE EL.
SR6	27804.21	94763.47	5770.47	SOIL RIPRAP (12 INCH) – FINISHED GRADE EL.
SR7	27862.90	94848.01	5766.25	SOIL RIPRAP (18 INCH) – FINISHED GRADE EL.
SR8	27885.85	94800.95	5767.60	SOIL RIPRAP (18 INCH) – FINISHED GRADE EL.
SR9	27876.75	94787.62	5765.88	SOIL RIPRAP (18 INCH) – FINISHED GRADE EL.
SR10	27853.55	94783.45	5766.72	SOIL RIPRAP (18 INCH) – FINISHED GRADE EL.
SR11	27913.61	94738.94	5766.30	SOIL RIPRAP (18 INCH) – FINISHED GRADE EL.
SR12	27871.26	94540.03	5768.10	SOIL RIPRAP (12 INCH) – FINISHED GRADE EL.
SR13	27892.28	94575.67	5770.18	SOIL RIPRAP (12 INCH) – FINISHED GRADE EL.
SR14	27920.57	94605.87	5772.85	SOIL RIPRAP (12 INCH) – FINISHED GRADE EL.
SR15	27943.91	94626.32	5774.60	SOIL RIPRAP (12 INCH) – FINISHED GRADE EL.
SR16	27967.25	94646.78	5775.74	SOIL RIPRAP (18 INCH) – FINISHED GRADE EL.
SR17	27912.28	94510.88	5777.00	SOIL RIPRAP (12 INCH) – FINISHED GRADE EL.
SR18	27925.40	94519.82	5777.00	SOIL RIPRAP (12 INCH) – FINISHED GRADE EL.
SR19	27937.08	94566.65	5777.00	SOIL RIPRAP (12 INCH) – FINISHED GRADE EL.
SR20	27941.85	94573.12	5777.00	SOIL RIPRAP (12 INCH) – FINISHED GRADE EL.
SR21	27962.56	94597.66	5777.00	SOIL RIPRAP (12 INCH) – FINISHED GRADE EL.
SR22	27970.79	94607.21	5777.00	SOIL RIPRAP (12 INCH) – FINISHED GRADE EL.
SR23	27995.66	94624.88	5777.00	SOIL RIPRAP (12 INCH) – FINISHED GRADE EL.
SR24	27980.34	94661.67	5776.11	SOIL RIPRAP (18 INCH) – FINISHED GRADE EL.
SR25	27988.53	94666.66	5776.90	SOIL RIPRAP (18 INCH) – FINISHED GRADE EL.
SR26	27956.85	94747.12	5773.49	SOIL RIPRAP (18 INCH) – FINISHED GRADE EL.
SR27	27965.72	94770.00	5773.56	SOIL RIPRAP (18 INCH) – FINISHED GRADE EL.
SR28	27950.72	94782.27	5766.42	SOIL RIPRAP (18 INCH) – FINISHED GRADE EL.
SR29	27953.26	94821.86	5765.14	SOIL RIPRAP (18 INCH) – FINISHED GRADE EL.
SR30	27913.37	94849.59	5764.89	SOIL RIPRAP (18 INCH) – FINISHED GRADE EL.
SR31	27904.16	94855.99	5765.02	SOIL RIPRAP (18 INCH) – FINISHED GRADE EL.
SR32	27881.83	94903.47	5766.84	SOIL RIPRAP (18 INCH) – FINISHED GRADE EL.
SR33	27890.55	94916.56	5771.36	SOIL RIPRAP (18 INCH) – FINISHED GRADE EL.
SR34	27878.94	94919.88	5772.38	SOIL RIPRAP (18 INCH) – FINISHED GRADE EL.

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Horizontal Scale: N.T.S. Vertical Scale: N.T.S.

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BELFORD–HAPPY CANYON CREEK
HAPPY CANYON CREEK DROP STRUCTURE
CHEROKEE TRAIL POINT DATA DETAIL

Designer: CDT
Detailer: ZJG
Subset: Drainage
Structure Numbers:
Sheets: DD–11 of 22

Project No./Code

Sheet Number

I.D.	NORTHING & EASTING	ITEM	LENGTH	PAY DEPTH	INV. IN	INV. OUT	NOTES
A1	N: 27899.87, E: 94884.63	48" RCES, RIPRAP			5763.28	5763.00	SEE DD-06 FOR DETAIL
A2		48" RCP	187'				
A3	N: 27721.77, E: 95000.49	TYPE D INLET		10'	5770.36	5769.79	CONNECT TO EX. 42" RCP
B1	N: 27914.54, E: 94715.62					5765.00	
B2		8" PLASTIC PIPE	27'				
B3	N: 27926.90, E: 94693.26					5765.13	45 DEGREE ELBOW/CLEANOUT
B4		8" PLASTIC PIPE	241'				

NOTES:

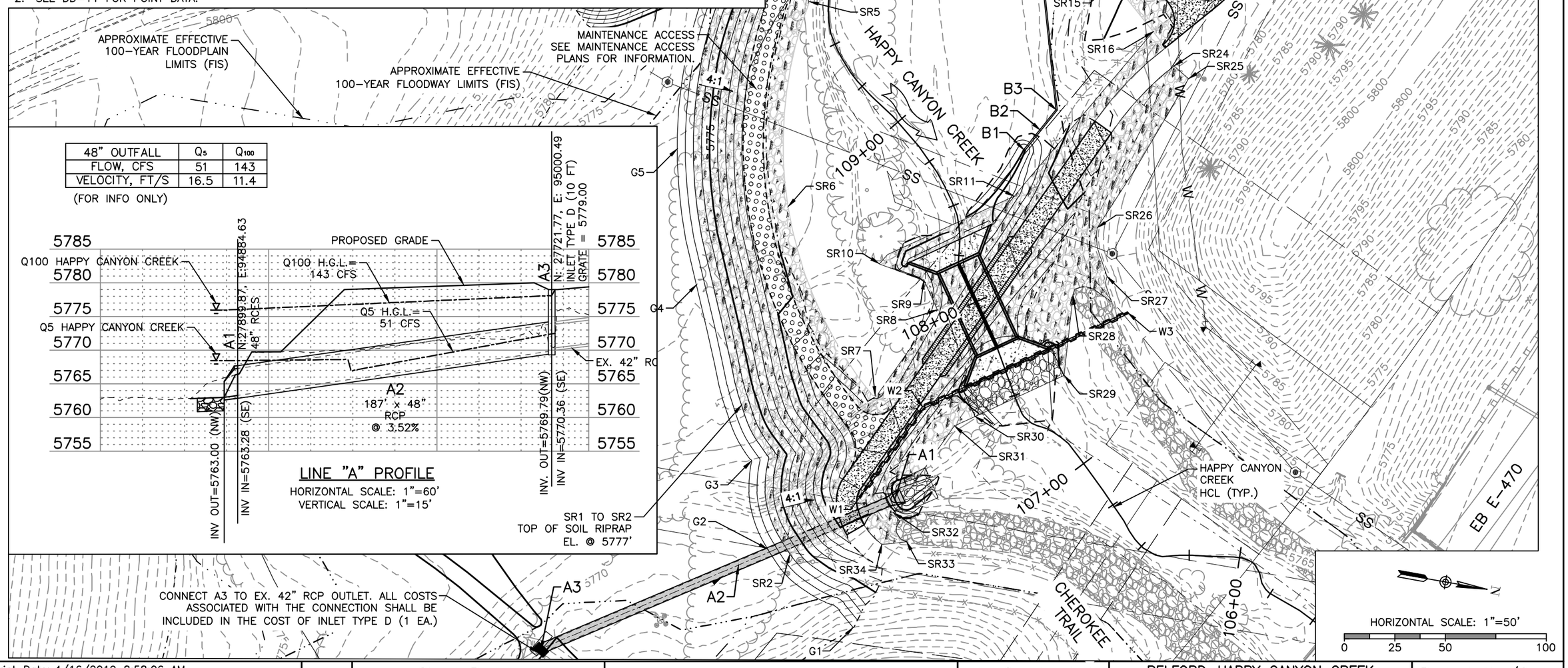
1. UTILITY INFORMATION SHOWN IS PLOTTED FROM THE BEST AVAILABLE DATA. THE CONTRACTOR IS RESPONSIBLE FOR MAKING THEIR OWN DETERMINATION AS TO THE TYPE AND LOCATION OF UTILITIES AS MAY BE NECESSARY TO AVOID DAMAGE THERETO. CONTACT THE UTILITY NOTIFICATION CENTER OF COLORADO AT 811 FOR UTILITY LOCATIONS AT LEAST 48 HOURS PRIOR TO EXCAVATING. CONTRACTOR SHALL COORDINATE WITH UTILITY COMPANY FOR ANY UTILITIES THAT NEED RELOCATING.
2. SEE DD-11 FOR POINT DATA.

48" OUTFALL	Q_5	Q_{100}
FLOW, CFS	51	143
VELOCITY, FT/S	16.5	11.4

(FOR INFO ONLY)

LINE "A" PROFILE

HORIZONTAL SCALE: 1"=60'
VERTICAL SCALE: 1"=15'



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File Name: ~~H115360-01DROP12Trading~~ CherokeeTrailCrossing.dwg		Date	Comments	Initials	No Revisions:
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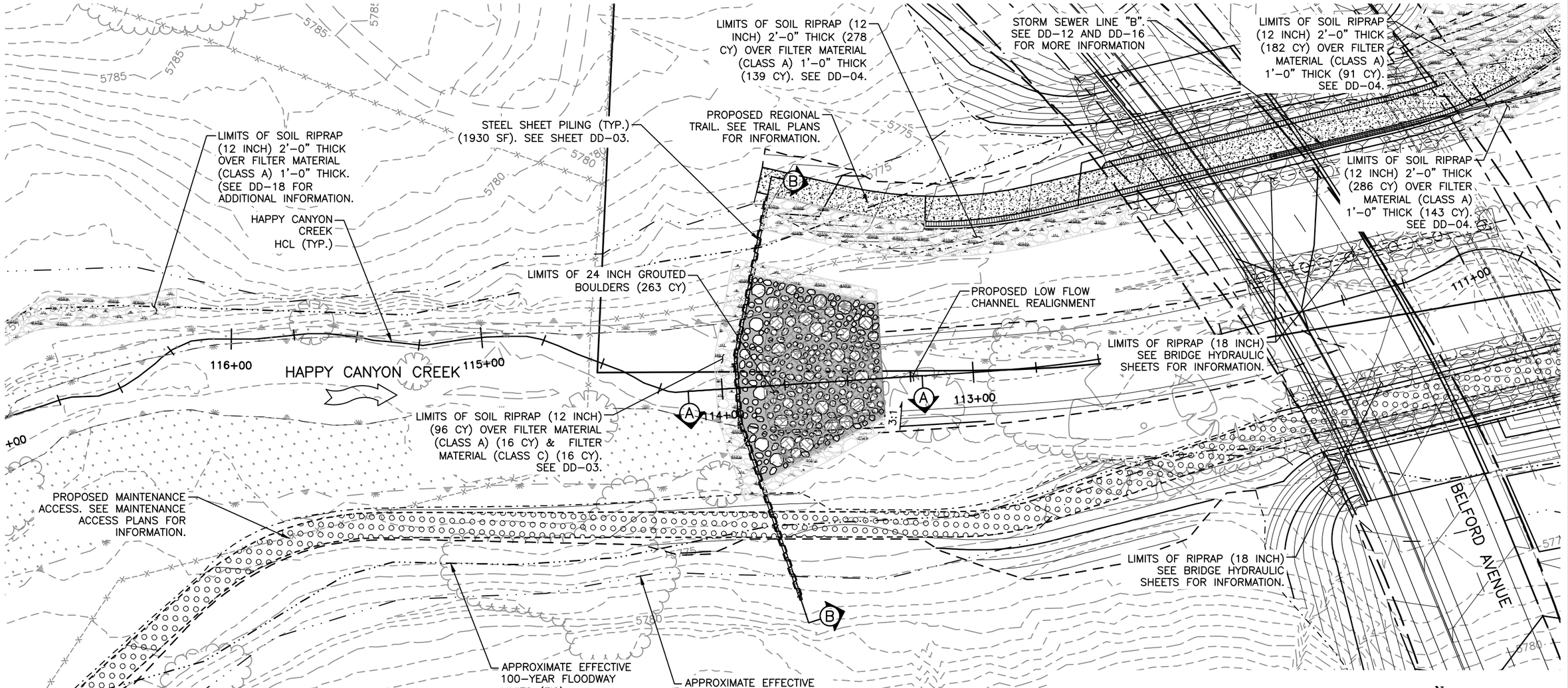
BELFORD-HAPPY CANYON CREEK
HAPPY CANYON CREEK DROP STRUCTURE
CHEROKEE TRAIL GRADING DETAIL

Designer:	CDT	Structure Numbers	
Detailer:	ZJG		
Subset:	Drainage	Sheets:	DD-12 of 22

Project No./Code

Sheet Number



NOTES:

1. SEE SHEET DD-15 FOR DROP NO. 1 POINT DATA.
2. SEE SHEET DD-14 FOR SECTIONS A AND B.
3. SEE SHEET DD-04 FOR SOIL RIPRAP DETAILS.
4. SEE SHEET DD-05 FOR GROUTED BOULDER DETAILS.
5. SEE UTILITY PLANS FOR ADDITIONAL INFORMATION
6. UTILITY INFORMATION SHOWN IS PLOTTED FROM THE BEST AVAILABLE DATA. THE CONTRACTOR IS RESPONSIBLE FOR MAKING THEIR OWN DETERMINATION AS TO THE TYPE AND LOCATION OF UTILITIES AS MAY BE NECESSARY TO AVOID DAMAGE THERETO. CONTACT THE UTILITY NOTIFICATION CENTER OF COLORADO AT 811 FOR UTILITY LOCATIONS AT LEAST 48 HOURS PRIOR TO EXCAVATING. CONTRACTOR SHALL COORDINATE WITH UTILITY COMPANY FOR ANY UTILITIES THAT NEED RELOCATING.

LEGEND

- TOP OF CUT
- TOE OF FILL
- WETLANDS
- SOIL RIPRAP (12 INCH)
- RIPRAP (18 INCH)
- 24" GROUTED BOULDERS
- 24" GROUTED BOULDERS (BURIED)

N

HORIZONTAL SCALE: 1"=40'

0' 20' 40' 80'

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BELFORD-HAPPY CANYON CREEK
HAPPY CANYON CREEK DROP STRUCTURE
DROP NO. 1 PLAN

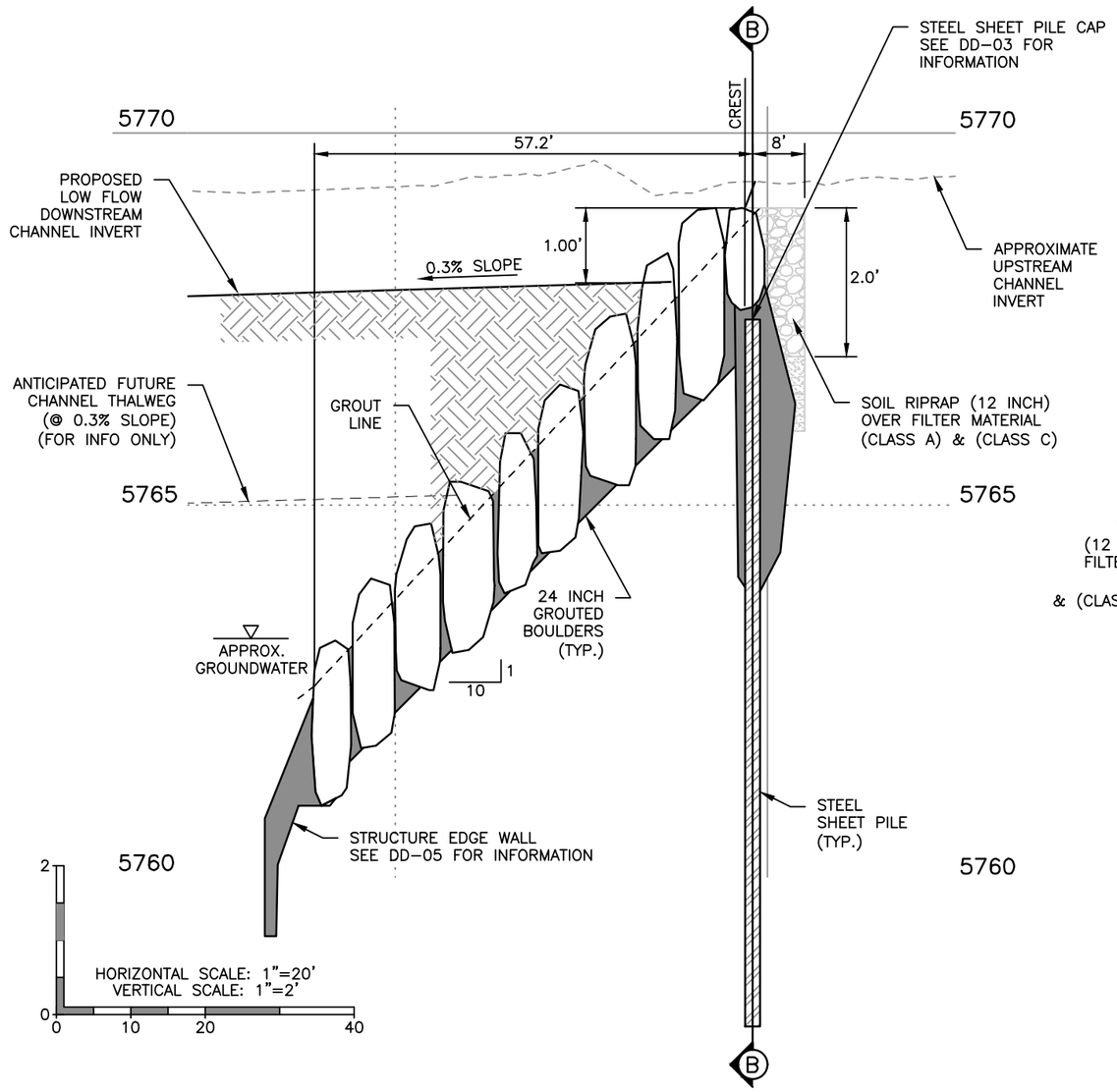
Designer: CDT
Detailer: ZJG
Subset: Drainage
Structure Numbers:
Sheets: DD-13 of 22

Project No./Code

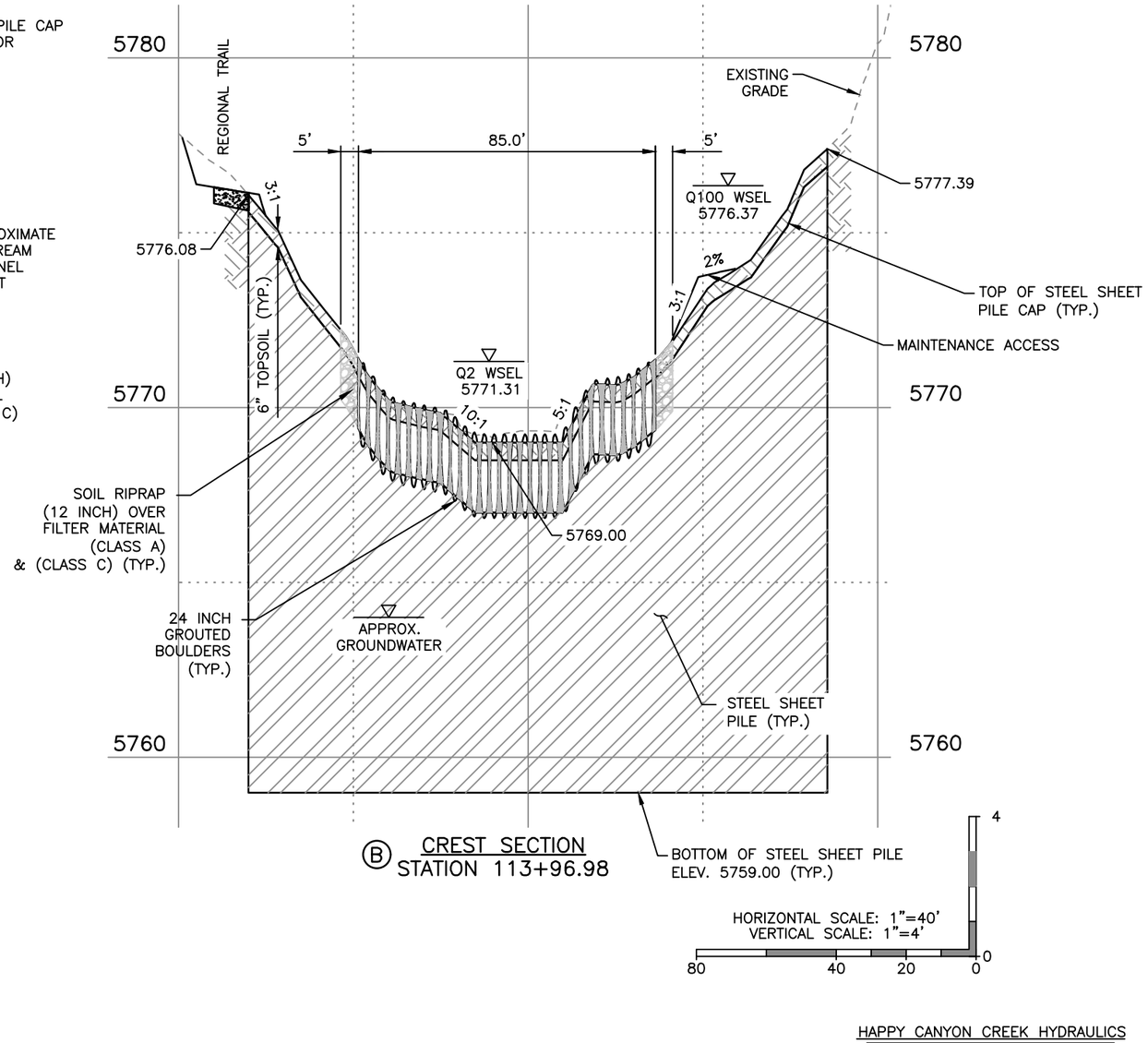
Sheet Number

NOTES

1. UTILITY INFORMATION SHOWN IS PLOTTED FROM THE BEST AVAILABLE DATA. THE CONTRACTOR IS RESPONSIBLE FOR MAKING THEIR OWN DETERMINATION AS TO THE TYPE AND LOCATION OF UTILITIES AS MAY BE NECESSARY TO AVOID DAMAGE THERETO. CONTACT THE UTILITY NOTIFICATION CENTER OF COLORADO AT 811 FOR UTILITY LOCATIONS AT LEAST 48 HOURS PRIOR TO EXCAVATING. CONTRACTOR SHALL COORDINATE WITH UTILITY COMPANY FOR ANY UTILITIES THAT NEED RELOCATING.
2. SEE UTILITY PLANS FOR ADDITIONAL INFORMATION.



Ⓐ GROUTED BOULDER DROP NO. 1 PROFILE
STA 113+39.80 TO 114+04.98



Ⓑ CREST SECTION
STATION 113+96.98

HAPPY CANYON CREEK HYDRAULICS

Q100= 8,303 C.F.S
Q100 VELOCITY = 14.17 F.P.S
FROUDE No.=0.93
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DROP STRUCTURE NO. 1

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File Name: H115360-01DROP14Δrop1 Prof Sect.dwg	(R-X)	Date	Comments	Initials	8008 S. Arapahoe Court, Suite 110, Centennial, CO 80112 ph:303.708.0500 fx:303.708.0400 manhard.com Civil Engineers • Surveyors • Water Resource Engineers • Water & Wastewater Engineers Construction Managers • Environmental Scientists • Landscape Architects • Planners	No Revisions:	Designer: CDT / Structure Numbers	
Horizontal Scale: As Noted Vertical Scale: As Noted						Revised:	Detailer: ZJG	
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HAPPY CANYON CREEK DROP STRUCTURE NO. 1 STEEL SHEET PILE CUTOFF WALL POINT DATA

POINT	NORTHING	EASTING	ELEVATION	DESCRIPTION
W1	27675.42	94283.50	5777.39	STEEL SHEET PILE WALL – TOP OF STEEL CAP EL.
W2	27745.87	94255.72	5767.00	STEEL SHEET PILE WALL – TOP OF STEEL CAP EL.
W3	27770.71	94252.88	5767.00	STEEL SHEET PILE WALL – TOP OF STEEL CAP EL.
W4	27834.84	94262.40	5776.14	STEEL SHEET PILE WALL – TOP OF STEEL CAP EL.

HAPPY CANYON CREEK DROP STRUCTURE NO. 1 GROUTED BOULDER POINT DATA

POINT	NORTHING	EASTING	ELEVATION	DESCRIPTION
GB1	27721.52	94265.85	5771.33	24 INCH GROUTED BOULDER – TOP OF BOULDER EL.
GB2	27745.93	94256.22	5769.00	24 INCH GROUTED BOULDER – TOP OF BOULDER EL.
GB3	27770.77	94253.37	5769.00	24 INCH GROUTED BOULDER – TOP OF BOULDER EL.
GB4	27803.26	94258.21	5771.31	24 INCH GROUTED BOULDER – TOP OF BOULDER EL.
GB5	27794.60	94308.20	5763.28	24 INCH GROUTED BOULDER – TOP OF BOULDER EL.
GB6	27749.89	94313.32	5763.28	24 INCH GROUTED BOULDER – TOP OF BOULDER EL.
GB7	27748.38	64266.00	5768.00	24 INCH GROUTED BOULDER – TOP OF BOULDER EL.
GB8	27770.60	94263.46	5768.00	24 INCH GROUTED BOULDER – TOP OF BOULDER EL.

HAPPY CANYON CREEK DROP STRUCTURE NO. 1 SOIL RIPRAP POINT DATA

POINT	NORTHING	EASTING	ELEVATION	DESCRIPTION
SR1	27821.75	94260.96	5774.00	SOIL RIPRAP (12 INCH) – FINISHED GRADE EL.
SR2	27816.88	94288.38	5772.05	SOIL RIPRAP (12 INCH) – FINISHED GRADE EL.
SR3	27814.14	94331.42	5770.00	SOIL RIPRAP (12 INCH) – FINISHED GRADE EL.
SR4	27821.34	94373.78	5769.37	SOIL RIPRAP (12 INCH) – FINISHED GRADE EL.
SR5	27831.26	94408.21	5769.24	SOIL RIPRAP (12 INCH) – FINISHED GRADE EL.
SR6	27713.51	94259.36	5772.32	SOIL RIPRAP (12 INCH) – FINISHED GRADE EL.
SR7	27744.91	94247.28	5770.17	SOIL RIPRAP (12 INCH) – FINISHED GRADE EL.
SR8	27769.75	94244.43	5769.27	SOIL RIPRAP (12 INCH) – FINISHED GRADE EL.
SR9	27809.53	94250.06	5772.74	SOIL RIPRAP (12 INCH) – FINISHED GRADE EL.
SR10	27808.21	94258.94	5772.14	SOIL RIPRAP (12 INCH) – FINISHED GRADE EL.
SR11	27799.78	94307.61	5770.41	SOIL RIPRAP (12 INCH) – FINISHED GRADE EL.
SR12	27794.60	94308.20	5770.01	SOIL RIPRAP (12 INCH) – FINISHED GRADE EL.
SR13	27749.89	94313.32	5770.02	SOIL RIPRAP (12 INCH) – FINISHED GRADE EL.
SR14	27744.44	94313.95	5770.34	SOIL RIPRAP (12 INCH) – FINISHED GRADE EL.
SR15	27716.81	94267.71	5771.86	SOIL RIPRAP (12 INCH) – FINISHED GRADE EL.

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Void:

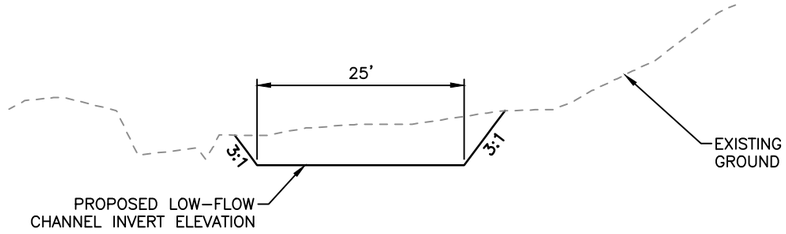
BELFORD–HAPPY CANYON CREEK
HAPPY CANYON CREEK DROP STRUCTURE
DROP NO. 1 POINT DATA DETAIL

Designer: CDT
Detailer: ZJG
Subset: Drainage
Structure Numbers:
Sheets: DD–15 of 22

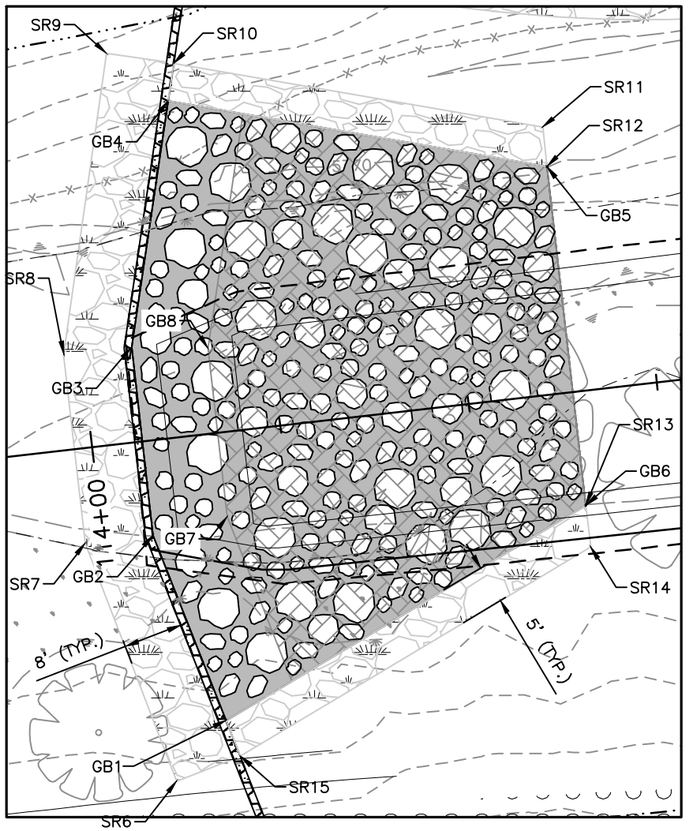
Project No./Code

Sheet Number

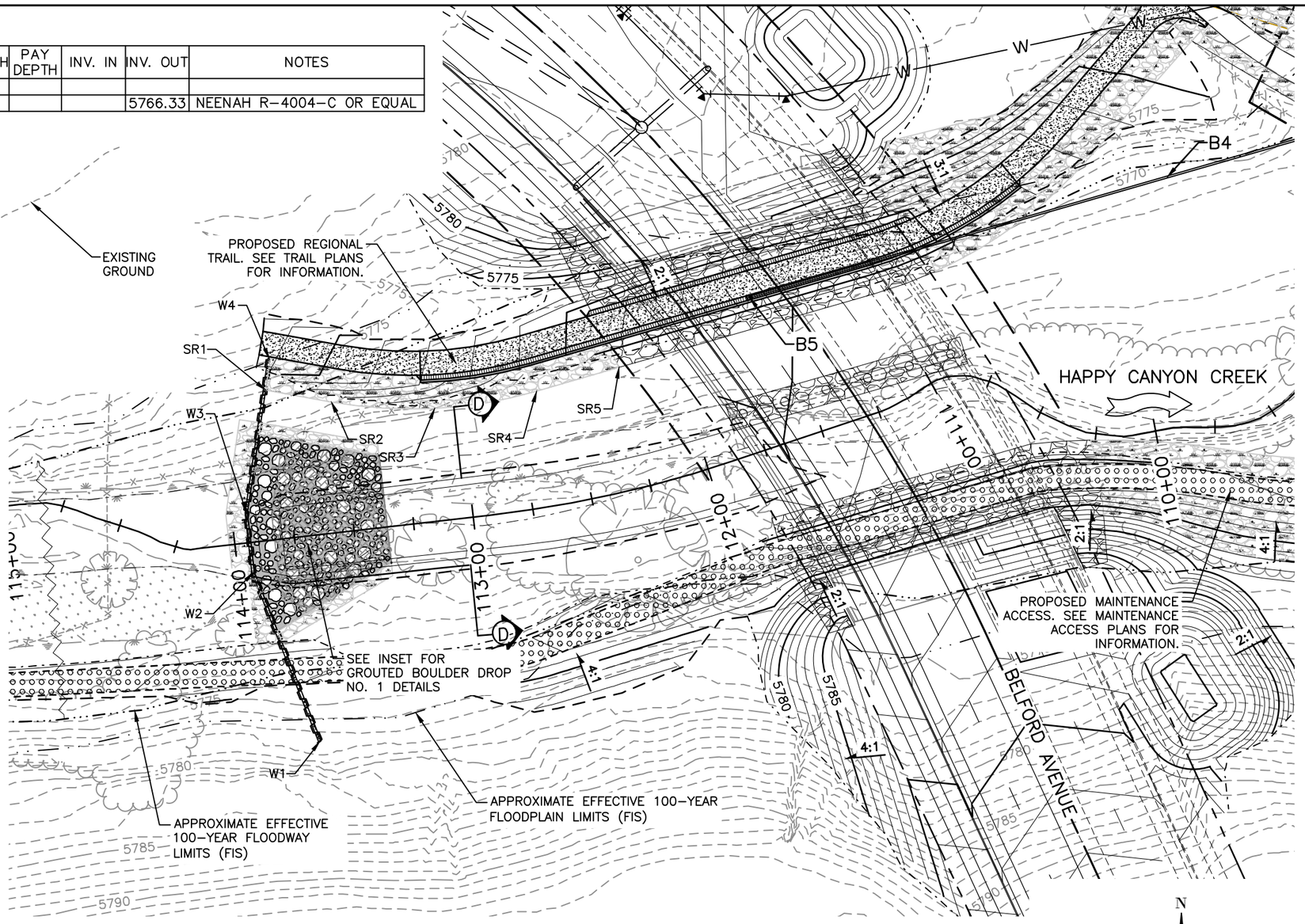
I.D.	NORTHING & EASTING	ITEM	LENGTH	PAY DEPTH	INV. IN	INV. OUT	NOTES
B4		8" PLASTIC PIPE	241'				
B5	N: 27860.43, E: 94462.48	INLET SPECIAL				5766.33	NEENAH R-4004-C OR EQUAL



Ⓓ TYPICAL CHANNEL SECTION
N.T.S.



DROP NO. 1 DETAILS
HORIZONTAL SCALE: 1"=20'



NOTES:

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2. SEE SHEET DD-15 FOR DROP NO. 1 POINT DATA.

HORIZONTAL SCALE: 1"=50'
0 25 50 100

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BELFORD-HAPPY CANYON CREEK
HAPPY CANYON CREEK DROP STRUCTURE
DROP NO. 1 GRADING DETAIL

Designer:	CDT	Structure Numbers	
Detailer:	ZJG		
Subset:	Drainage	Sheets:	DD-16 of 22

Project No./Code

Sheet Number

HAPPY CANYON CREEK DROP STRUCTURE NO. 2 STEEL SHEET PILE CUTOFF WALL POINT DATA

POINT	NORTHING	EASTING	ELEVATION	DESCRIPTION
W1	27522.92	93938.45	5780.50	STEEL SHEET PILE WALL – TOP OF STEEL CAP EL.
W2	27627.11	93827.62	5770.47	STEEL SHEET PILE WALL – TOP OF STEEL CAP EL.
W3	27648.48	93814.39	5770.47	STEEL SHEET PILE WALL – TOP OF STEEL CAP EL.
W4	27680.82	93804.64	5780.50	STEEL SHEET PILE WALL – TOP OF STEEL CAP EL.

HAPPY CANYON CREEK DROP STRUCTURE NO. 2 CHANNEL REVETMENT SOIL RIPRAP POINT DATA

POINT	NORTHING	EASTING	ELEVATION	DESCRIPTION
CR1	27384.46	93620.98	5776.96	SOIL RIPRAP (12 INCH) – FINISHED GRADE EL.
CR2	27409.72	93613.85	5776.89	SOIL RIPRAP (12 INCH) – FINISHED GRADE EL.
CR3	27455.43	93616.23	5776.93	SOIL RIPRAP (12 INCH) – FINISHED GRADE EL.
CR4	27504.52	93635.29	5777.00	SOIL RIPRAP (12 INCH) – FINISHED GRADE EL.
CR5	27521.43	93646.91	5777.11	SOIL RIPRAP (12 INCH) – FINISHED GRADE EL.
CR6	27547.94	93676.17	5776.07	SOIL RIPRAP (12 INCH) – FINISHED GRADE EL.
CR7	27561.71	93693.16	5776.00	SOIL RIPRAP (12 INCH) – FINISHED GRADE EL.
CR8	27566.68	93697.18	5776.04	SOIL RIPRAP (12 INCH) – FINISHED GRADE EL.
CR9	27681.39	93814.88	5776.99	SOIL RIPRAP (12 INCH) – FINISHED GRADE EL.
CR10	27699.52	93838.94	5776.86	SOIL RIPRAP (12 INCH) – FINISHED GRADE EL.
CR11	27713.46	93854.66	5777.09	SOIL RIPRAP (12 INCH) – FINISHED GRADE EL.
CR12	27724.95	93872.92	5776.90	SOIL RIPRAP (12 INCH) – FINISHED GRADE EL.
CR13	27732.94	93886.34	5777.00	SOIL RIPRAP (12 INCH) – FINISHED GRADE EL.
CR14	27743.41	93902.84	5777.05	SOIL RIPRAP (12 INCH) – FINISHED GRADE EL.
CR15	27754.96	93929.13	5776.62	SOIL RIPRAP (12 INCH) – FINISHED GRADE EL.
CR16	27765.52	93944.63	5775.94	SOIL RIPRAP (12 INCH) – FINISHED GRADE EL.
CR17	27769.88	93961.99	5775.77	SOIL RIPRAP (12 INCH) – FINISHED GRADE EL.
CR18	27781.73	93978.73	5775.97	SOIL RIPRAP (12 INCH) – FINISHED GRADE EL.
CR19	27782.09	94006.03	5775.95	SOIL RIPRAP (12 INCH) – FINISHED GRADE EL.
CR20	27787.18	94029.84	5776.06	SOIL RIPRAP (12 INCH) – FINISHED GRADE EL.

HAPPY CANYON CREEK DROP STRUCTURE NO. 2 GROUTED BOULDER POINT DATA

POINT	NORTHING	EASTING	ELEVATION	DESCRIPTION
GB1	27602.62	93854.40	5774.52	24 INCH GROUTED BOULDER – TOP OF BOULDER EL.
GB2	27618.57	93837.43	5772.47	24 INCH GROUTED BOULDER – TOP OF BOULDER EL.
GB3	27655.65	93812.75	5772.47	24 INCH GROUTED BOULDER – TOP OF BOULDER EL.
GB4	27669.08	93808.70	5774.43	24 INCH GROUTED BOULDER – TOP OF BOULDER EL.
GB5	27673.96	93851.91	5768.00	24 INCH GROUTED BOULDER – TOP OF BOULDER EL.
GB6	27644.22	93870.17	5768.00	24 INCH GROUTED BOULDER – TOP OF BOULDER EL.

HAPPY CANYON CREEK DROP STRUCTURE NO. 2 DROP STRUCTURE SOIL RIPRAP POINT DATA

POINT	NORTHING	EASTING	ELEVATION	DESCRIPTION
SR1	27592.36	93852.18	5775.35	SOIL RIPRAP (12 INCH) – FINISHED GRADE EL.
SR2	27622.59	93820.43	5772.58	SOIL RIPRAP (12 INCH) – FINISHED GRADE EL.
SR3	27644.06	93807.13	5772.41	SOIL RIPRAP (12 INCH) – FINISHED GRADE EL.
SR4	27671.40	93798.60	5779.30	SOIL RIPRAP (12 INCH) – FINISHED GRADE EL.
SR5	27675.20	93818.23	5773.98	SOIL RIPRAP (12 INCH) – FINISHED GRADE EL.
SR6	27678.68	93848.83	5773.30	SOIL RIPRAP (12 INCH) – FINISHED GRADE EL.
SR7	27673.98	93851.74	5773.00	SOIL RIPRAP (12 INCH) – FINISHED GRADE EL.
SR8	27644.22	93870.17	5772.27	SOIL RIPRAP (12 INCH) – FINISHED GRADE EL.
SR9	27638.87	93873.48	5773.38	SOIL RIPRAP (12 INCH) – FINISHED GRADE EL.
SR10	27598.92	93858.34	5775.22	SOIL RIPRAP (12 INCH) – FINISHED GRADE EL.

I:\115360-01 – Compark at Belford\CADD\Hydraulics\Drawings\Happy Cyn Creek Drop Structure\, Zach.Grady

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File Name: H115360-01DROP17Δrop2 Point Data.dwg
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Sheet Revisions

Date	Comments	Initials

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Void:

BELFORD–HAPPY CANYON CREEK
HAPPY CANYON CREEK DROP STRUCTURE
DROP NO. 2 POINT DATA DETAIL

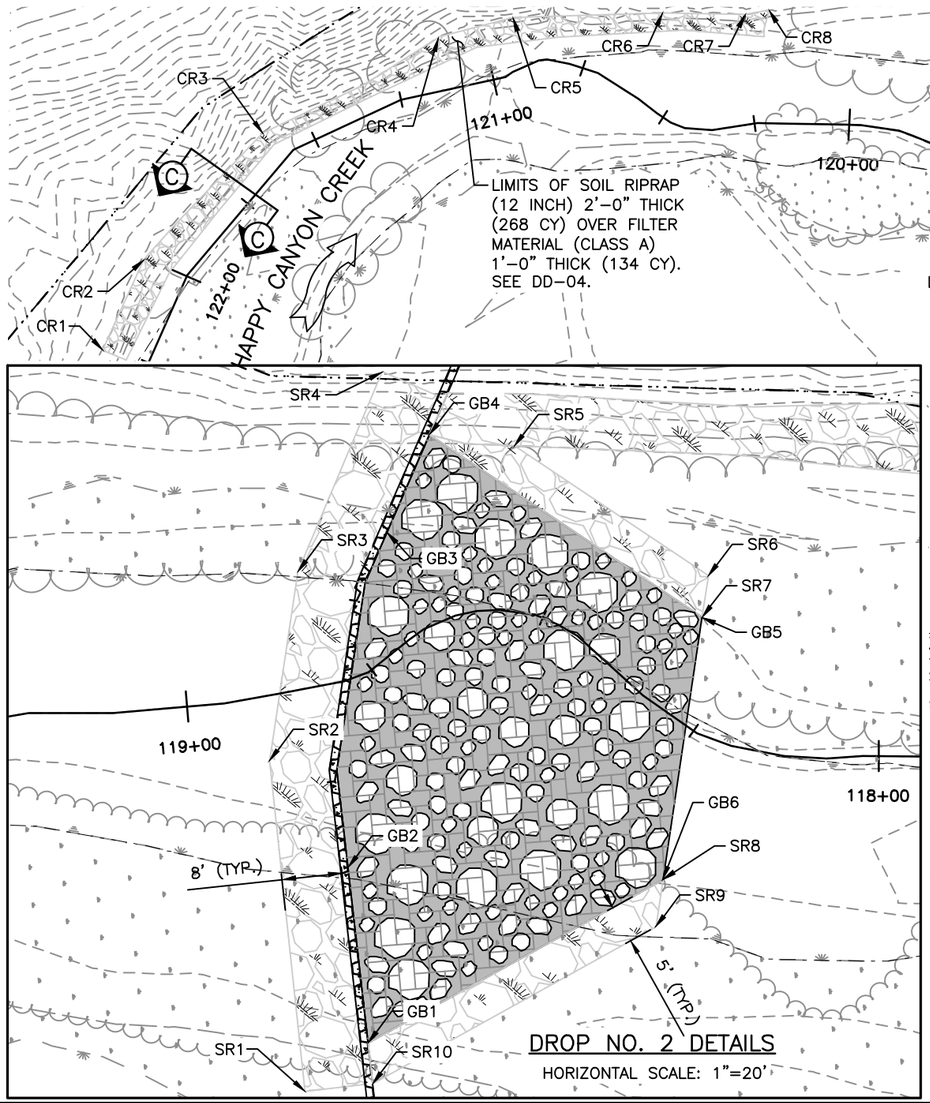
Designer: CDT
Detailer: ZJG
Subset: Drainage
Structure Numbers:
Sheets: DD–17 of 22

Project No./Code

Sheet Number

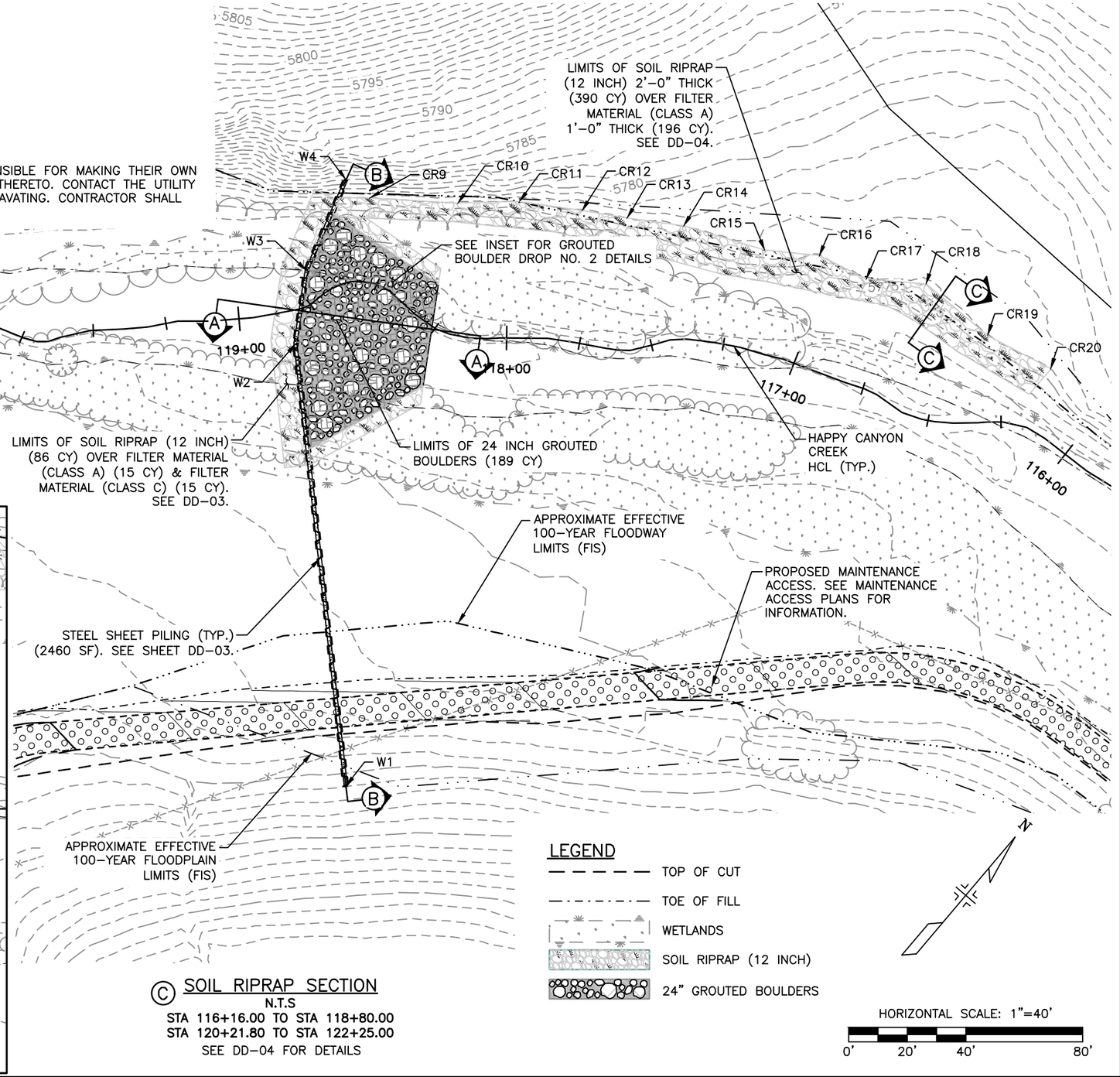
NOTES:

1. SEE SHEET DD–17 FOR DROP NO. 2 POINT DATA.
2. SEE SHEET DD–19 FOR SECTIONS A AND B.
3. SEE SHEET DD–04 FOR SOIL RIPRAP DETAILS.
4. SEE SHEET DD–05 FOR GROUTED BOULDER DETAILS.
5. SEE UTILITY PLANS FOR ADDITIONAL INFORMATION
6. UTILITY INFORMATION SHOWN IS PLOTTED FROM THE BEST AVAILABLE DATA. THE CONTRACTOR IS RESPONSIBLE FOR MAKING THEIR OWN DETERMINATION AS TO THE TYPE AND LOCATION OF UTILITIES AS MAY BE NECESSARY TO AVOID DAMAGE THERETO. CONTACT THE UTILITY NOTIFICATION CENTER OF COLORADO AT 811 FOR UTILITY LOCATIONS AT LEAST 48 HOURS PRIOR TO EXCAVATING. CONTRACTOR SHALL COORDINATE WITH UTILITY COMPANY FOR ANY UTILITIES THAT NEED RELOCATING.



DROP NO. 2 DETAILS

HORIZONTAL SCALE: 1"=20'



© SOIL RIPRAP SECTION
N.T.S
STA 116+16.00 TO STA 118+80.00
STA 120+21.80 TO STA 122+25.00
SEE DD–04 FOR DETAILS

LEGEND

- TOP OF CUT
- TOE OF FILL
- WETLANDS
- SOIL RIPRAP (12 INCH)
- 24" GROUTED BOULDERS

HORIZONTAL SCALE: 1"=40'

0' 20' 40' 80'

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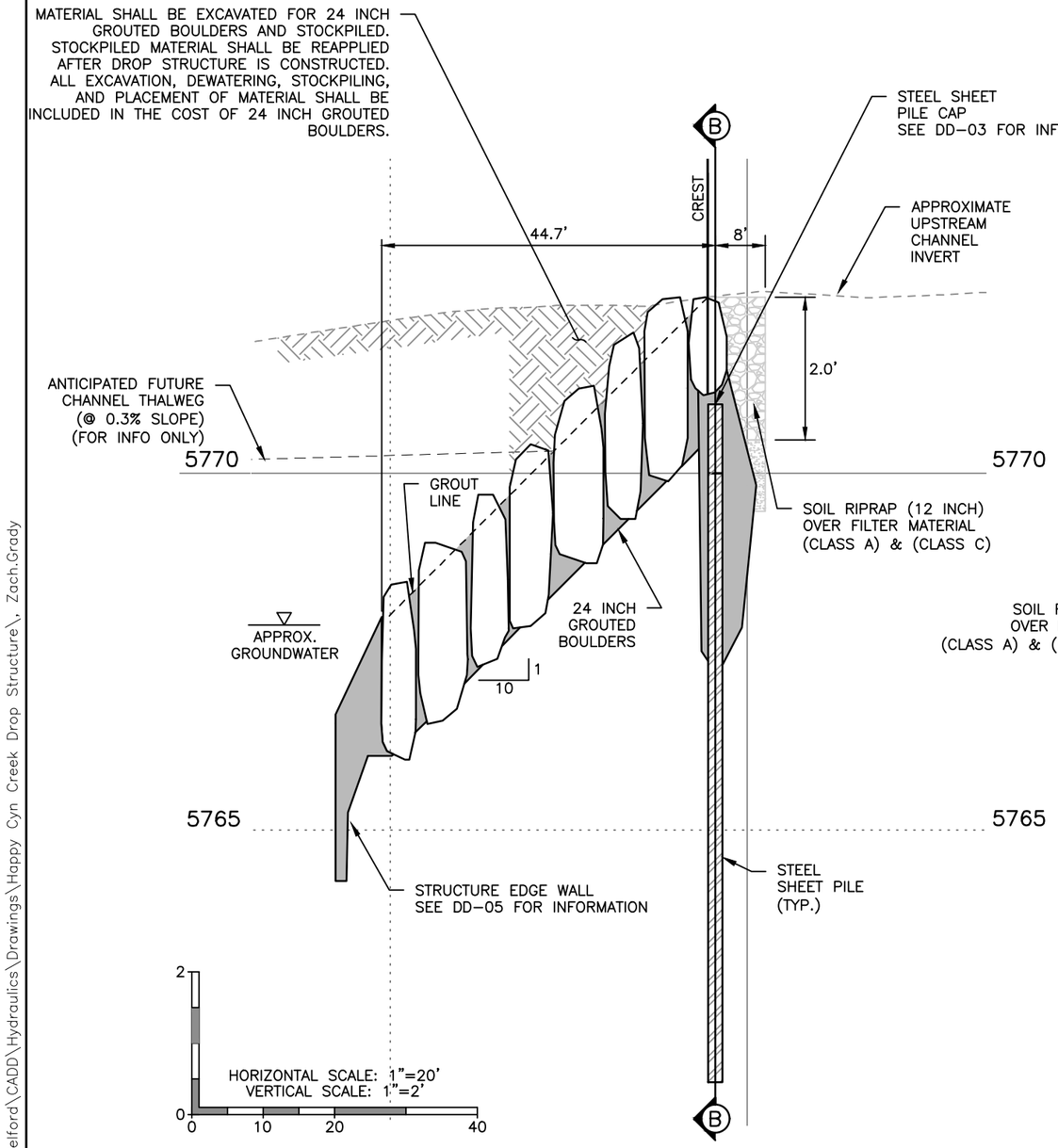
No Revisions:
Revised:
Void:

BELFORD–HAPPY CANYON CREEK
HAPPY CANYON CREEK DROP STRUCTURE
DROP NO. 2 PLAN

Designer:	CDT	Structure Numbers	
Detailer:	ZJG		
Subset:	Drainage	Sheets:	DD–18 of 22

Project No./Code

Sheet Number



Ⓐ GROUTED BOULDER DROP NO. 2 PROFILE
STA 118+49.81 TO 119+02.49

NOTES

1. UTILITY INFORMATION SHOWN IS PLOTTED FROM THE BEST AVAILABLE DATA. THE CONTRACTOR IS RESPONSIBLE FOR MAKING THEIR OWN DETERMINATION AS TO THE TYPE AND LOCATION OF UTILITIES AS MAY BE NECESSARY TO AVOID DAMAGE THERETO. CONTACT THE UTILITY NOTIFICATION CENTER OF COLORADO AT 811 FOR UTILITY LOCATIONS AT LEAST 48 HOURS PRIOR TO EXCAVATING. CONTRACTOR SHALL COORDINATE WITH UTILITY COMPANY FOR ANY UTILITIES THAT NEED RELOCATING.
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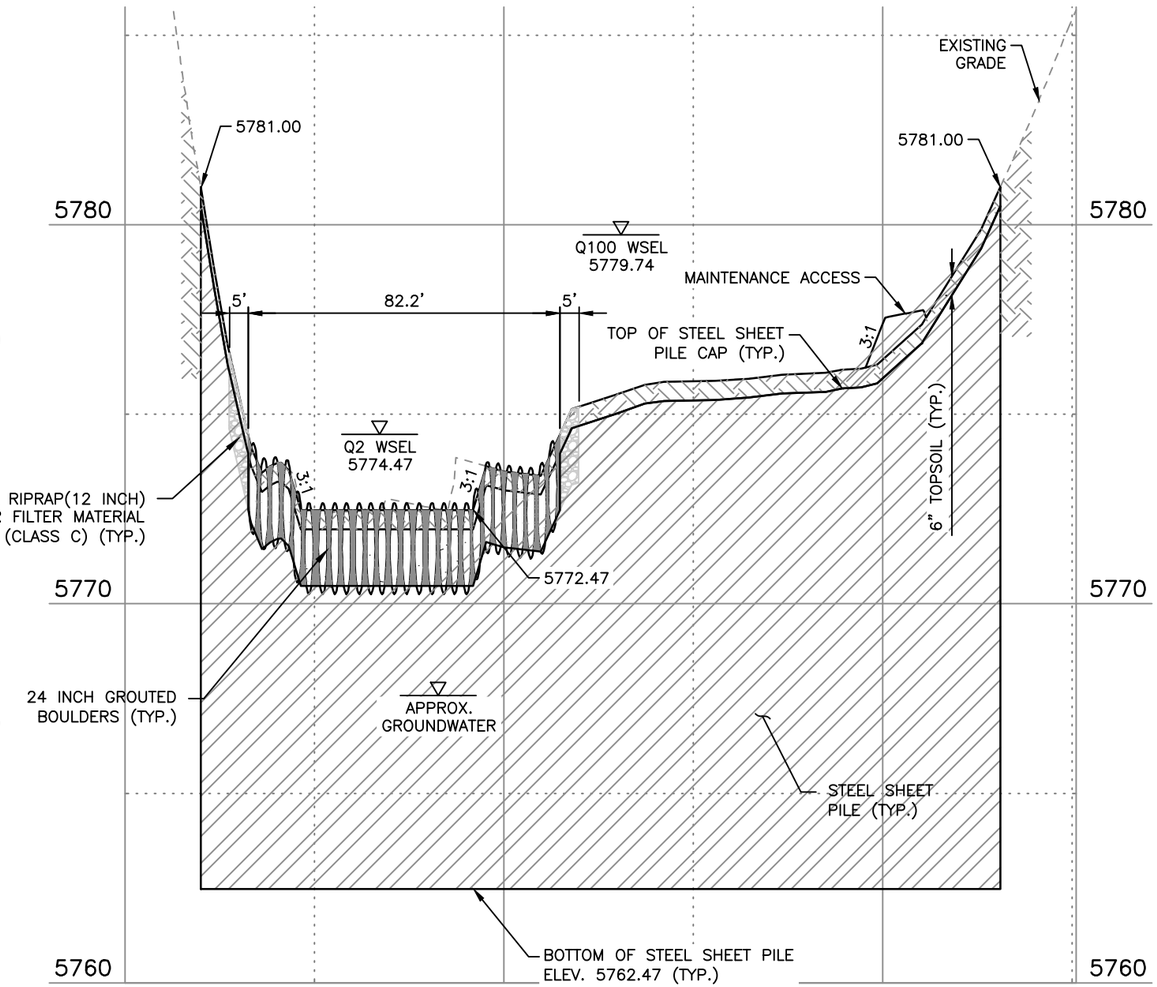

Ⓑ CREST SECTION
STATION 118+94.49

HAPPY CANYON CREEK HYDRAULICS

Q100= 8,303 C.F.S
Q100 VELOCITY = 11.93 F.P.S
FROUDE No.=0.79
FOR INFO ONLY

DROP STRUCTURE NO. 2

Print Date: 4/16/2019 9:03:07 AM	Sheet Revisions	As Constructed	BELFORD–HAPPY CANYON CREEK HAPPY CANYON CREEK DROP STRUCTURE DROP NO. 2 PROFILE/DETAILS	Project No./Code
File Name: H115360–01DROP19Δrop2 Prof Sect.dwg	R–X: Date / Comments / Initials	No Revisions:		
Horizontal Scale: As Noted Vertical Scale: As Noted		Revised:	Designer: CDT; Structure Numbers	
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HAPPY CANYON CREEK DROP STRUCTURE NO. 3 STEEL SHEET PILE CUTOFF WALL POINT DATA

POINT	NORTHING	EASTING	ELEVATION	DESCRIPTION
W1	27309.13	93921.77	5783.50	STEEL SHEET PILE WALL – TOP OF STEEL CAP EL.
W2	27304.40	93917.95	5780.00	STEEL SHEET PILE WALL – TOP OF STEEL CAP EL.
W3	27208.88	93840.75	5779.50	STEEL SHEET PILE WALL – TOP OF STEEL CAP EL.
W4	27201.63	93834.88	5775.63	STEEL SHEET PILE WALL – TOP OF STEEL CAP EL.
W5	27174.38	93805.42	5775.06	STEEL SHEET PILE WALL – TOP OF STEEL CAP EL.
W6	27143.34	93746.45	5777.76	STEEL SHEET PILE WALL – TOP OF STEEL CAP EL.
W7	27143.34	93585.23	5783.50	STEEL SHEET PILE WALL – TOP OF STEEL CAP EL.

HAPPY CANYON CREEK DROP STRUCTURE NO. 3 BANK GRADING POINT DATA

POINT	NORTHING	EASTING	ELEVATION	DESCRIPTION
G1	27326.07	93919.34	5787.00	FINISHED GRADE EL.
G2	27306.20	93950.35	5787.00	FINISHED GRADE EL.
G3	27290.13	93942.45	5782.50	FINISHED GRADE EL.
G4	27195.58	93861.83	5780.00	FINISHED GRADE EL.
G5	27228.32	93816.93	5780.00	FINISHED GRADE EL.
G6	27270.93	93781.27	5780.00	FINISHED GRADE EL.
G7	27367.70	93861.41	5782.50	FINISHED GRADE EL.
G8	27322.50	93895.78	5782.50	FINISHED GRADE EL.
G9	27343.38	93895.03	5786.00	FINISHED GRADE EL.

HAPPY CANYON CREEK DROP STRUCTURE NO. 3 GROUTED BOULDER POINT DATA

POINT	NORTHING	EASTING	ELEVATION	DESCRIPTION
GB1	27168.76	93793.68	5778.19	24 INCH GROUTED BOULDER – TOP OF BOULDER EL.
GB2	27173.42	93802.52	5777.14	24 INCH GROUTED BOULDER – TOP OF BOULDER EL.
GB3	27201.27	93833.76	5777.14	24 INCH GROUTED BOULDER – TOP OF BOULDER EL.
GB4	27203.54	93835.78	5778.40	24 INCH GROUTED BOULDER – TOP OF BOULDER EL.
GB5	27234.88	93801.59	5772.49	24 INCH GROUTED BOULDER – TOP OF BOULDER EL.
GB6	27213.15	93778.09	5772.49	24 INCH GROUTED BOULDER – TOP OF BOULDER EL.

HAPPY CANYON CREEK DROP STRUCTURE NO. 3 SOIL RIPRAP POINT DATA

POINT	NORTHING	EASTING	ELEVATION	DESCRIPTION
SR1	27140.46	93759.22	5778.01	SOIL RIPRAP (12 INCH) – FINISHED GRADE EL.
SR2	27168.09	93811.14	5777.07	SOIL RIPRAP (12 INCH) – FINISHED GRADE EL.
SR3	27195.43	93840.70	5777.55	SOIL RIPRAP (12 INCH) – FINISHED GRADE EL.
SR4	27201.78	93845.94	5779.67	SOIL RIPRAP (12 INCH) – FINISHED GRADE EL.
SR5	27238.29	93805.27	5779.59	SOIL RIPRAP (12 INCH) – FINISHED GRADE EL.
SR6	27234.88	93801.59	5778.14	SOIL RIPRAP (12 INCH) – FINISHED GRADE EL.
SR7	27213.15	93778.09	5777.80	SOIL RIPRAP (12 INCH) – FINISHED GRADE EL.
SR8	27199.57	93763.41	5777.80	SOIL RIPRAP (12 INCH) – FINISHED GRADE EL.

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Void:

BELFORD–HAPPY CANYON CREEK
HAPPY CANYON CREEK DROP STRUCTURE
DROP NO. 3 POINT DATA DETAIL

Designer: CDT
Detailer: ZJG
Subset: Drainage
Structure Numbers:
Sheets: DD–20 of 22

Project No./Code

Sheet Number

NOTES:

1. SEE SHEET DD-20 FOR DROP NO. 3 POINT DATA.
2. SEE SHEET DD-22 FOR SECTIONS A & B.
3. SEE SHEET DD-04 FOR SOIL RIPRAP DETAILS.
4. SEE SHEET DD-05 FOR GROUTED BOULDER DETAILS.
5. SEE UTILITY PLANS FOR ADDITIONAL INFORMATION
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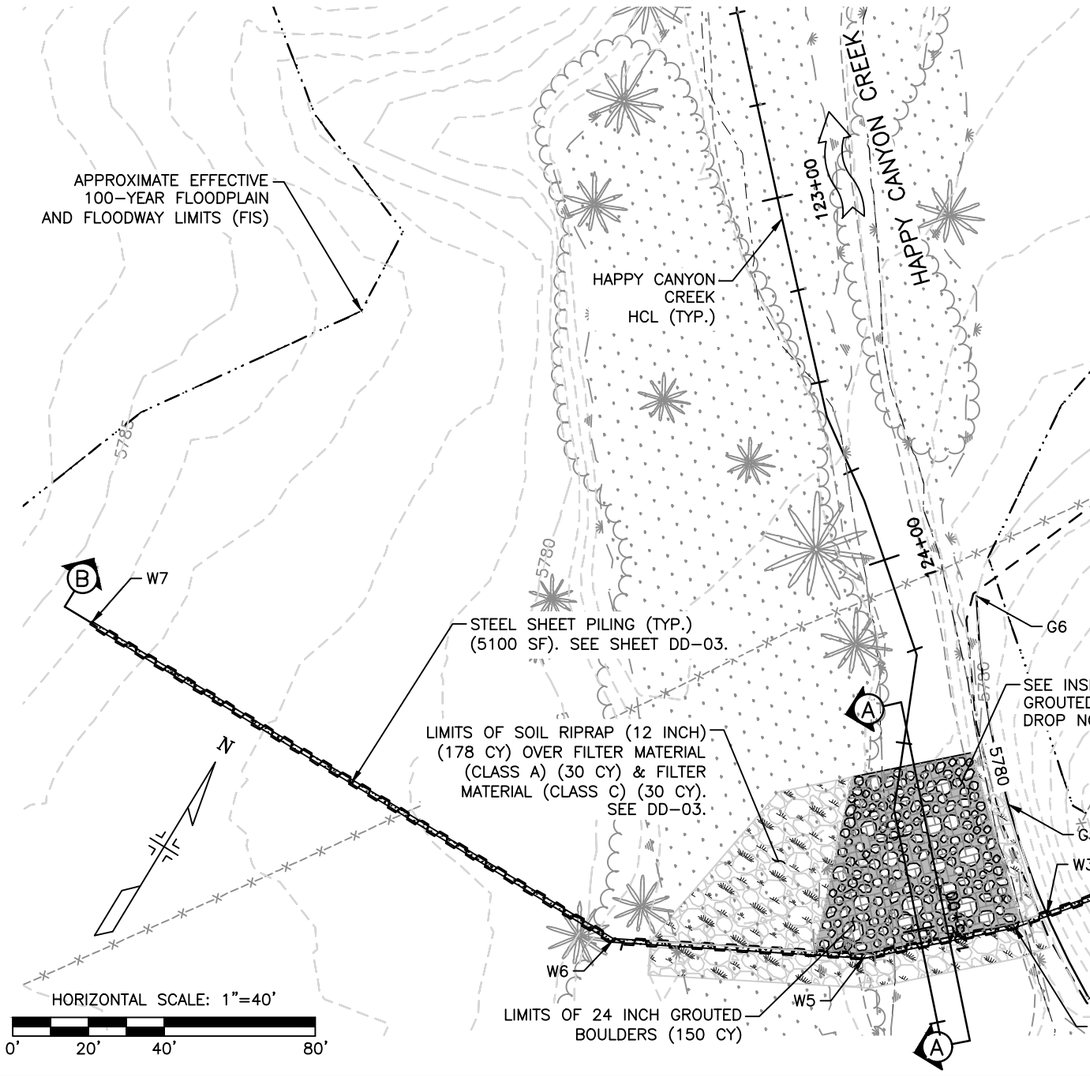
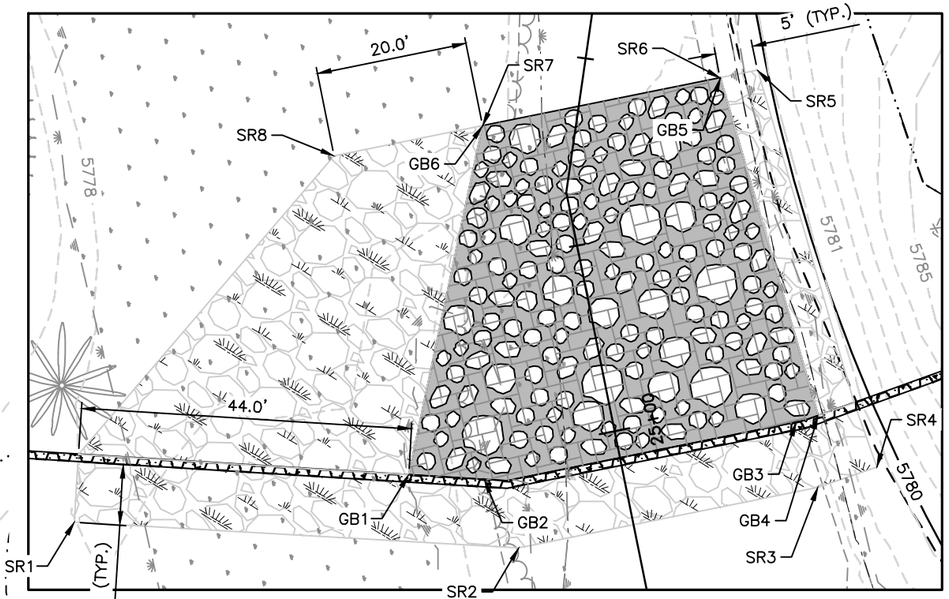
LEGEND

- TOP OF CUT
- TOE OF FILL
- WETLANDS
- SOIL RIPRAP (12 INCH)
- 24" GROUTED BOULDERS (BURIED)





DROP NO. 3 DETAILS

HORIZONTAL SCALE: 1"=20'

Print Date: 4/16/2019 9:04:19 AM		Sheet Revisions	
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Revised:
Void:

BELFORD-HAPPY CANYON CREEK
HAPPY CANYON CREEK DROP STRUCTURE
DROP NO. 3 PLAN

Designer:	CDT	Structure Numbers	
Detailer:	ZJG		
Subset:	Drainage	Sheets:	DD-21 of 22

Project No./Code

Sheet Number

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NOTES

1. UTILITY INFORMATION SHOWN IS PLOTTED FROM THE BEST AVAILABLE DATA. THE CONTRACTOR IS RESPONSIBLE FOR MAKING THEIR OWN DETERMINATION AS TO THE TYPE AND LOCATION OF UTILITIES AS MAY BE NECESSARY TO AVOID DAMAGE THERETO. CONTACT THE UTILITY NOTIFICATION CENTER OF COLORADO AT 811 FOR UTILITY LOCATIONS AT LEAST 48 HOURS PRIOR TO EXCAVATING. CONTRACTOR SHALL COORDINATE WITH UTILITY COMPANY FOR ANY UTILITIES THAT NEED RELOCATING.
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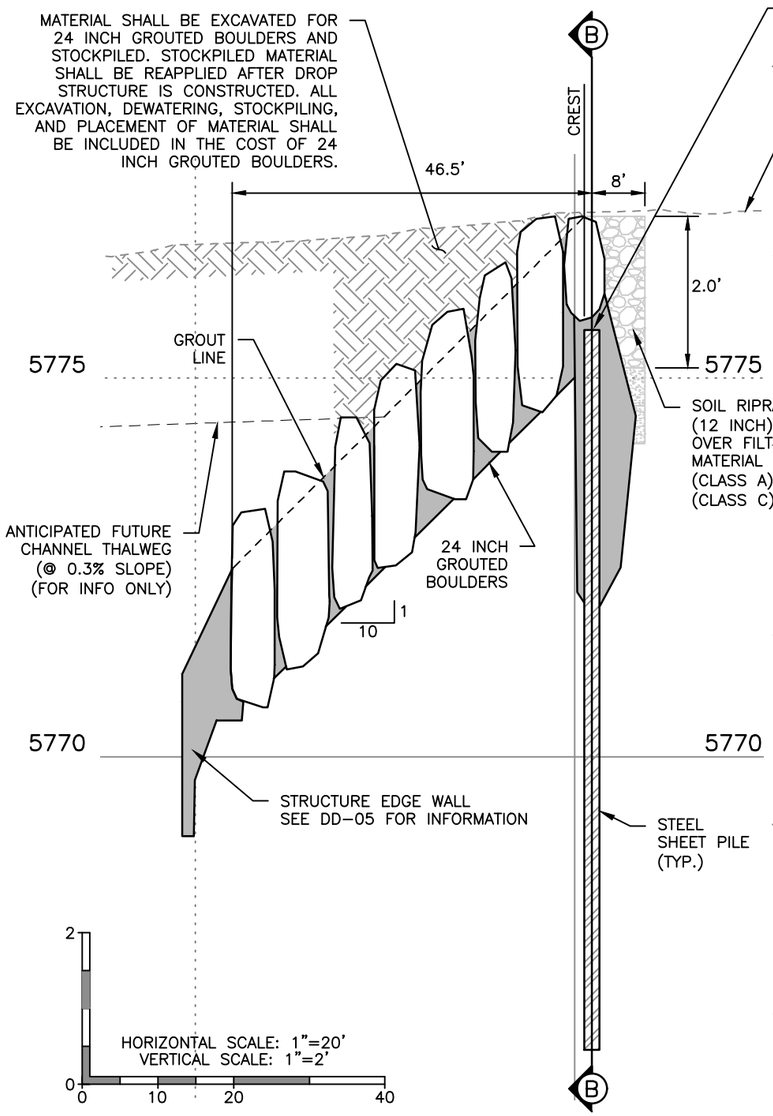
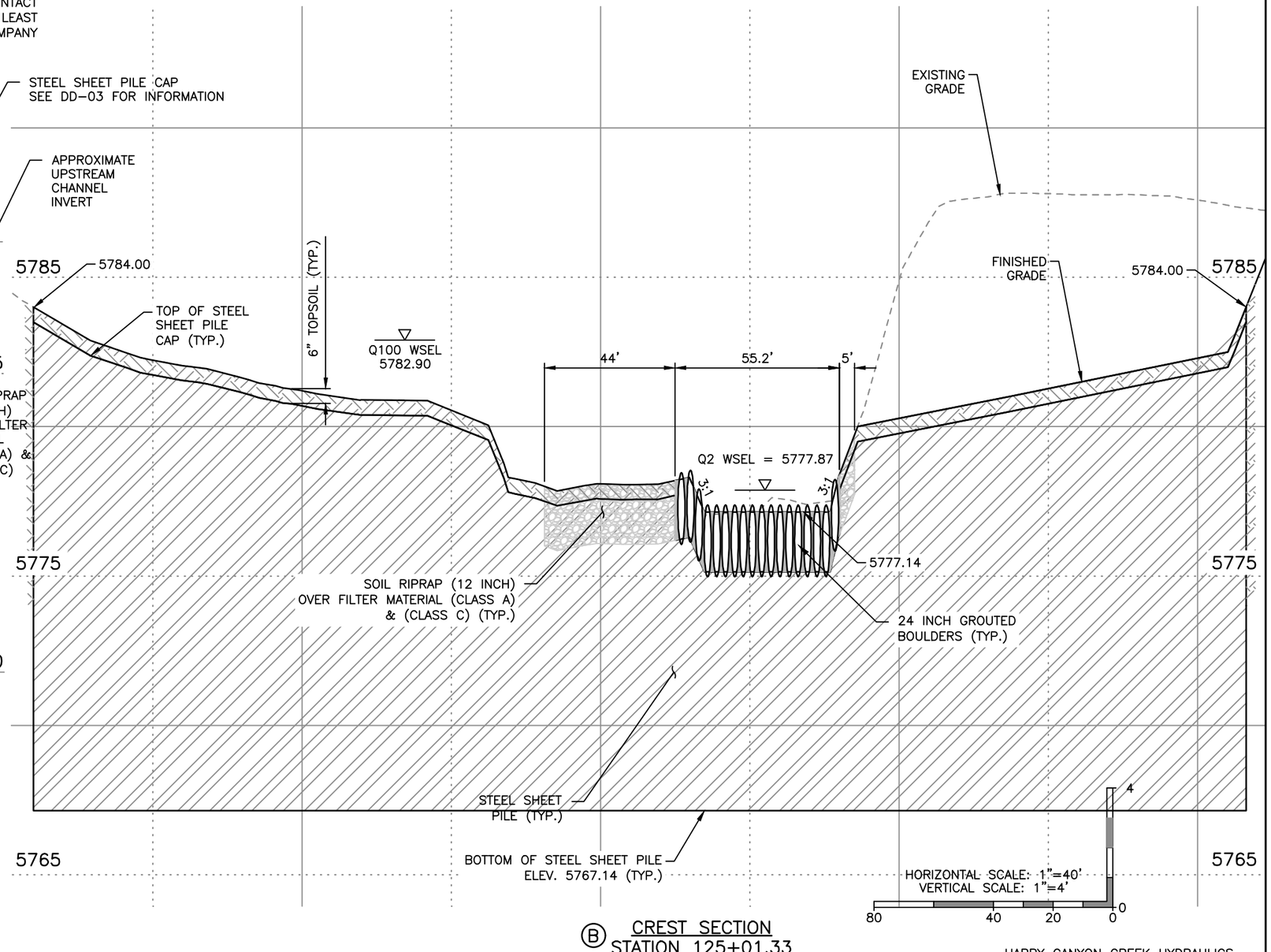


Ⓐ GROUTED BOULDER DROP NO. 3 PROFILE
STA 124+54.81 TO 125+09.33



Ⓑ CREST SECTION
STATION 125+01.33

HAPPY CANYON CREEK HYDRAULICS

Q100= 8,303 C.F.S
Q100 VELOCITY = 10.80 F.P.S
FROUDE No.=0.77

FOR INFO ONLY

DROP STRUCTURE NO. 3

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As Constructed	BELFORD-HAPPY CANYON CREEK HAPPY CANYON CREEK DROP STRUCTURE DROP NO. 3 PROFILE/DETAILS			Project No./Code
No Revisions:				
Revised:	Designer: CDT	Structure Numbers		
Void:	Detailer: ZJG			Sheet Number
	Subset: Drainage	Sheets:	DD-22 of 22	

PARKER
COLORADO

CONSTRUCTION PLANS

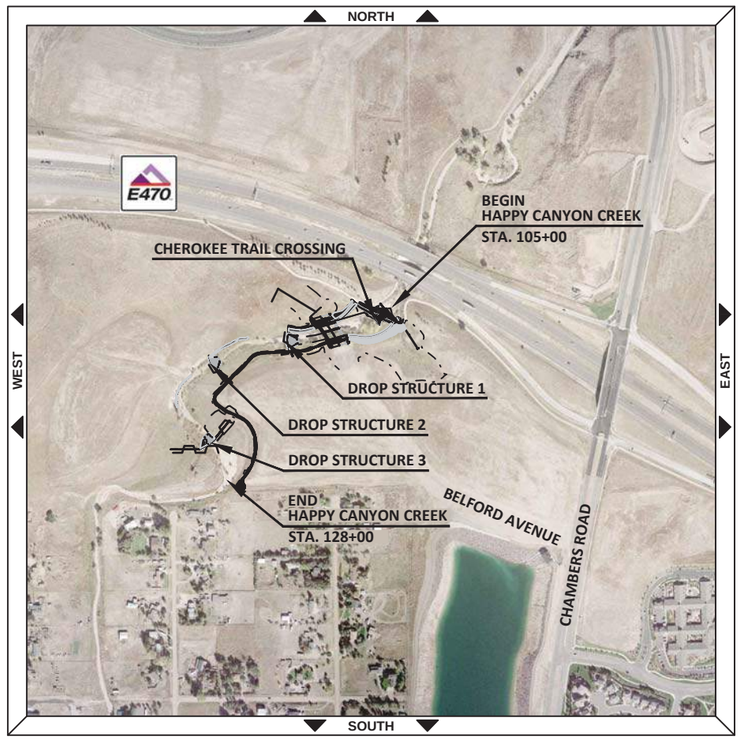
CONSTRUCTION BEST MANAGEMENT PRACTICES

BELFORD AVENUE BRIDGE AND HAPPY CANYON CREEK

TOWN OF PARKER, COUNTY OF DOUGLAS, STATE OF COLORADO

SCALE OF ORIGINAL DRAWINGS

ON PLAN 1" = 80'



INDEX OF SHEETS

SHEET NO.	SUBSET SHEETS	DESCRIPTION
83	EL–1	CBMP TITLE SHEET
84	ET–1	TABULATION OF EROSION CONTROL QUANTITIES
85–86	EI–1 TO EI–2	INITIAL CBMP PLAN
87–88	EN–1 TO EN–2	INTERIM CBMP PLAN
89–90	EF–1 TO EN–2	FINAL CBMP PLAN
91–125	ED–1 TO ED–35	CBMP STANDARD NOTES AND DETAILS

TOWN OF PARKER APPROVALS

THE TOWN OF PARKER REVIEW CONSTITUTES GENERAL COMPLIANCE WITH THE TOWNS STANDARDS AND APPROVED VARIANCES, SUBJECT TO THESE PLANS BEING STAMPED, SIGNED, AND DATED BY THE PROFESSIONAL ENGINEER OF RECORD. REVIEW BY THE TOWN DOES NOT CONSTITUTE APPROVAL OF THE PLAN DESIGN OR ACCURACY AND CORRECTNESS OF ENGINEERING CALCULATION. ERRORS IN THE DESIGN OR CALCULATIONS REMAIN THE RESPONSIBILITY OF THE REGISTERED PROFESSIONAL ENGINEER WHOSE STAMP AND SIGNATURE ARE AFFIXED TO THIS DOCUMENT.

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TOWN OF PARKER, PUBLIC WORKS DIRECTOR DATE

TOWN OF PARKER, PUBLIC WORKS MANAGER – STORMWATER DATE

TOWN OF PARKER, PUBLIC WORKS MANAGER – TRANSPORTATION DATE

BASIS OF BEARING:

THE WEST LINE OF THE SOUTHWEST QUARTER OF SECTION 6, TOWNSHIP 6 SOUTH, RANGE 66 WEST OF THE SIXTH PRINCIPAL MERIDIAN BEING MONUMENTED AS SHOWN HEREON HAVING A BEARING OF NORTH 00°29'49" WEST, AS DETERMINED BY GPS OBSERVATION FROM NGS CONTROL POINTS IN THE COLORADO CENTRAL ZONE, STATE PLAN COORDINATE SYSTEM, TOWN OF PARKER, COUNTY OF DOUGLAS, STATE OF COLORADO.

BENCHMARKS: (COMPARK SOUTH)

SOURCE BENCHMARKS:

DOUGLAS COUNTY BM 1.115010
A DOUGLAS COUNTY GIS MONUMENT SET IN CONCRETE LOCATED APPROXIMATELY 130 FEET SOUTHWESTERLY OF THE CENTERLINE OF CHAMBERS ROAD AND 95 FEET NORTHWESTERLY OF THE CENTERLINE OF COMPARK BOULEVARD.

ELEVATION = 5752.84 (NAVD 88)

SITE BENCHMARKS:

A NO. 5 REBAR WITH 2" ALUMINUM CAP STAMPED "LS 28286, 2001" FOUND AT THE SOUTHWEST CORNER OF SECTION 6, T6S, R66W LOCATED ON THE WEST LINE OF FIRST STREET APPROXIMATELY 1000 FEET NORTH OF ELM AVENUE.

ELEVATION = 5845.51

A 2.5" IRON PIPE WITH 3.25" ALUMINUM CAP STAMPED "PLS 12405, 1997" FOUND AT THE SOUTHEAST CORNER OF SECTION 6, T6S, R66W LOCATED APPROXIMATELY 960 FEET NORTH OF THE CENTERLINE OF AVENTERRA PARKWAY AND APPROXIMATELY 1050 FEET WEST OF THE CENTERLINE OF CHAMBERS ROAD.

ELEVATION = 5808.06

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Void:

BELFORD–HAPPY CANYON CREEK CBMP TITLE SHEET

Designer:	CDT	Structure Numbers	
Detailer:	KLT		
Subset:	EROSION	Sheets:	EL–1 of 1

Project No./Code

Sheet Number 87

TABULATION OF EROSION CONTROL QUANTITIES

DRAWING NUMBER	CHECK DAM (CD)	*CONCRETE WASHOUT STRUCTURE (CWA)	*VEHICLE TRACKING CONTROL (VTC)	*STABILIZED STAGING AREA (SSA)	SEEDING (NATIVE) (SMC)	MULCHING (WEED FREE STRAW) (SMC)	*CULVERT PROTECTION (CP)	DEWATERING (D)	*SEDIMENT CONTROL LOG (12 INCH) (SCL)	EROSION CONTROL BLANKET (STRAW/COCONUT) (ECB)	DIVERSION DITCH (DD)	CONSTRUCTION FENCE (CF)	SILT FENCE (SF)	#INLET PROTECTION AREA INLETS NOT IN PAVEMENT (IPAN)	##ROUGH CUT STREET CONTROL (RCSC)	TEMPORARY SEDIMENT BASIN (TSB)	TEMPORARY STREAM CONTROL (TSC)	(PTP)
	LF	EACH	EACH	SY	ACRE	ACRE	LF	LS	LF	SY	LF	LF	LF	EA	LF	EA	EA	
INITIAL (EI–1)	275	2	2	2300			40		1798		312	8838	1361				4	
INTERIM (EN–1)							60	1	1885					1	480	2		
FINAL (EF–1)					6.3	6.3				6180								
PROJECT TOTALS	275	2	2	2300	6.3	6.3	100	1	3683	6180	312	8838	1361	1	480	2	4	

1. THESE QUANTITIES HAVE BEEN TAKEN FORWARD TO THE SUMMARY OF APPROXIMATE QUANTITIES.
2. FOR DETAILS, SEE CBMP STANDARD NOTES AND DETAILS.
3. CHECK DAMS ARE NOT TO BE REMOVED UNLESS DIRECTED BY THE PROJECT ENGINEER.
4. MULCH TACKIFIER IS REQUIRED AND IS INCLUDED IN THE COST OF MULCHING.
5. SEE CBMP SHEETS FOR ADDITIONAL PLACEMENT INFORMATION.
6. LOCATION OF STOCKPILES, INCLUDING TOPSOIL, IMPORTED AGGREGATES, EXCESS MATERIALS, STORAGE AND STAGING AREAS FOR EQUIPMENT FUEL, LUBRICANT, CHEMICAL (AND OTHER MATERIALS), WASTE STORAGE, BORROW AND DISPOSAL AREAS SHALL BE LOCATED PRIOR TO CONSTRUCTION WITH IN THE DEFINED LIMITS OF CONSTRUCTION BY THE PROJECT ENGINEER.

* THESE ITEMS SHALL BE PAID FOR AS PLACE AND REMOVE.
\# THESE ITEMS SHALL BE PAID FOR AS INLET PROTECTION (EACH).
\## ROUGH CUT STREET CONTROL SHALL BE PAID FOR AS AGGREGATE BAG (LF)

ADDITIONAL SEDIMENT/EROSION CONTROL:
IT IS ESTIMATED THAT BLADING (120 HORSEPOWER), DOZING (100 HORSEPOWER), COMBINATION LOADER (125 HORSEPOWER) AND/OR BACKHOE (75 HORSEPOWER) AND/OR LABORER MAY BE REQUIRED FOR MISCELLANEOUS EROSION CONTROL WORK AS DIRECTED BY THE ENGINEER. WORK SHALL BE PAID FOR AS 208 SEDIMENT REMOVAL AND DISPOSAL (40 HRS). EROSION CONTROL MANAGEMENT WILL BE REQUIRED FOR THIS PROJECT AND SHALL BE PAID FOR AS 208 EROSION CONTROL MANAGEMENT (30 DAYS).

WATER CONTROL NOTES – TEMPORARY STREAM CONTROL

1. THE CONTRACTOR SHALL DEVELOP AND SUBMIT A WATER CONTROL PLAN TO THE TOWN OF PARKER FOR REVIEW AND APPROVAL TWO WEEKS PRIOR TO BEGINNING CONSTRUCTION. WATER CONTROL INCLUDES CHANNEL BASE FLOW, STORMWATER RUNOFF, AND GROUNDWATER. THE CONTRACTOR'S WATER CONTROL PLAN SHALL INCLUDE ALL MEANS AND METHODS NECESSARY IN CONVEYING A CLEAN WATER DIVERSION FOR WATER THROUGH AND FROM THE PROJECT SITE SO THAT THE WATER QUALITY OR PROPERTY DOWNSTREAM OF THE PROJECT LIMITS ARE NOT IMPACTED NEGATIVELY FROM THE PROJECT'S CONSTRUCTION ACTIVITIES.

2. THE CONTRACTOR'S MEANS AND METHODS INCLUDED IN THE CONTRACTOR'S APPROVED WATER CONTROL PLAN MAY INCLUDE, BUT ARE NOT LIMITED TO THE FOLLOWING: PLASTIC LINED DIVERSION DITCHES, TEMPORARY PIPING, HOSES, CUTOFF WALLS, CHECK DAMS, PUMPS, GENERATORS, SOUND PROOFING, TEMPORARY POWER, SHEET PILE, SHORING, SEDIMENT TRAPS, SEDIMENT BASINS, FILTER BAGS, REINFORCED ROCK BERMS, STREAM CROSSINGS, RIPRAP PADS, RIPRAP, CRUSHED ROCK AND ANY OTHER WATER CONTROL MEASURES NECESSARY AND APPROVED BY THE TOWN OF PARKER.

3. GIVEN THE NATURE OF THE PROJECT SITE'S TERRAIN AND SCOPE OF WORK, THE CONTRACTOR'S WATER CONTROL PLAN AND PROPOSAL SHALL ACCOUNT FOR THE NEED TO RELOCATE WATER CONTROL MEASURES AS NEEDED BASED ON THE CONTRACTOR'S ACTUAL CONSTRUCTION SEQUENCE AND SELECTED MEANS AND METHODS.

4. WATER QUALITY SHALL BE ONE OF THE CONTRACTOR'S PRIMARY CONCERNS. THE CONTRACTOR'S IMPLEMENTED WATER CONTROL PLAN WILL BE INSPECTED DAILY. IF FOR ANY REASON THE CONTRACTOR'S IMPLEMENTED WATER CONTROL PLAN NEEDS CORRECTIVE ACTION OR IF THE CONTRACTOR IS DIRECTED BY THE TOWN OF PARKER OR THE OWNER'S REPRESENTATIVE TO MAKE REPAIRS, THE CONTRACTOR SHALL MAKE SUCH CORRECTIONS IMMEDIATELY.

5. THE APPROXIMATE 2–YR DISCHARGE FOR HAPPY CANYON CREEK IS 309 CFS. THE AVERAGE BASE FLOW RATE IS UNKNOWN. THE ESTIMATED AVERAGE BASE FLOW RATE IS APPROXIMATELY 1 CFS.

6. ALL STREAM DIVERSION DITCHES NEED TO BE PLASTIC LINED AT A MINIMUM AS DIRECTED BY THE TOWN OF PARKER.

7. ALL TEMPORARY STREAM CROSSINGS SHALL BE COMPLETELY RIPRAP REINFORCED AND HAVE PLASTIC LINING UNDER THE RIPRAP. THE CONTRACTOR'S SELECTED STREAM CROSSING SHALL ACCOMMODATE PASSAGE FOR BASE FLOWS AND AT NO TIME SHALL CONTRACTORS' EQUIPMENT HAVE DIRECT CONTACT WITH ANY STREAM FLOW.

8. ALL INCIDENTAL WATER CONTROL ITEMS SHALL BE PAID FOR AS TEMPORARY STREAM CROSSING (EA).

CBMP LEGEND

- CD — CHECK DAM
- CF — CONSTRUCTION FENCE
- CP — CULVERT PROTECTION
- CWA — CONCRETE WASHOUT AREA
- D — DEWATERING
- DD — DIVERSION DITCH
- ECB — EROSION CONTROL BLANKET (STRAW/COCONUT)
- IPAN — INLET PROTECTION FOR AREA INLETS NOT IN PAVEMENT
- LOC — LIMITS OF CONSTRUCTION
- PTP — PORTABLE TOILET PROTECTION
- RCSC — ROUGH CUT STREET CONTROL
- SCL — SEDIMENT CONTROL LOG (12 INCH)
- SF — SILT FENCE
- SMC — SEEDING MULCHING AND CRIMPING
- SSA — STABILIZED STAGING AREA
- TSB — TEMPORARY SEDIMENT BASIN
- TSC — TEMPORARY STREAM CONTROL
- VTC — VEHICLE TRACKING CONTROL

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BELFORD–HAPPY CANYON CREEK
TABULATION OF
EROSION CONTROL QUANTITIES

Designer: CDT
Detailer: KLT
Subset: EROSION
Structure Numbers:
Sheets: ET–1 of 1

Project No./Code

Sheet Number 88

PROPERTY OF
470 COMPARK LLC
C/O MPV COMPARK MANAGEMENT LLC
DENVER, CO 80206

HORIZONTAL SCALE: 1"=80'
0 40 80 160

APPROXIMATE 100-YR EFFECTIVE (FIS) FLOODPLAIN LIMITS

NO WORK SHALL OCCUR IN THESE AREAS

NO WORK SHALL OCCUR IN THESE AREAS

NO WORK SHALL OCCUR IN THESE AREAS

HAPPY CANYON CREEK

LOC
DD L=125'
CD CL=130'
CF 3648 LF
SF 170 LF
SCL 70 LF
SF 180 LF
SCL 50 LF
TSC 1 EA
SCL 580 LF
SCL 320 LF
DD L=37'
TSC 1 EA
CF 213 LF
SF 128 LF
LOC
CF 417 LF

131+00 130+00 129+00 128+00 127+00 126+00 125+00 124+00 123+00 122+00 121+00 120+00 119+00 118+00 117+00

PROPERTY OF
COMPARK 190 LLC
4600 S ULSTER ST SUITE 1400
DENVER, CO 80237-2850

MATCHLINE STA. 117+00

LEGEND

- TOP OF CUT
- TOE OF FILL
- LIMITS OF CONSTRUCTION
- GENERAL FLOW DIRECTION
- WETLANDS

NOTES:

1. TEMPORARY CONSTRUCTION EASEMENTS SHALL NOT BE CLEARED AND GRUBBED UNLESS IT IS REQUIRED IN ORDER TO CONSTRUCT THE ROADWAY SECTION. THE CONTRACTOR SHALL USE PARTICULAR CARE TO MINIMIZE DAMAGE TO PLANTINGS WITHIN THE PROPERTY.
2. ALL DIRTY STREETS, CURBS, GUTTER, SIDEWALKS, LITTER AND OTHER CONSTRUCTION TRASH/DEBRIS, ETC. MUST BE THOROUGHLY CLEANED THROUGHOUT THE DAY AS THESE AREAS BECOME SOILED. NO EXCEPTIONS WILL BE MADE.
3. NO WORK SHALL OCCUR ON ANY AREA ADJACENT TO THE PROJECT OUTSIDE THE LIMITS OF CONSTRUCTION.

CBMP LEGEND

CD	CHECK DAM	
CF	CONSTRUCTION FENCE	
CP	CULVERT PROTECTION	
CWA	CONCRETE WASHOUT AREA	
D	DEWATERING	
DD	DIVERSION DITCH	
ECB	EROSION CONTROL BLANKET (STRAW/COCONUT)	
IPAN	INLET PROTECTION FOR AREA INLETS NOT IN PAVEMENT	
LOC	LIMITS OF CONSTRUCTION	
PTP	PORTABLE TOILET PROTECTION	
RCSC	ROUGH CUT STREET CONTROL	
SCL	SEDIMENT CONTROL LOG (12 INCH)	
SF	SILT FENCE	
SMC	SEEDING MULCHING AND CRIMPING	
SSA	STABILIZED STAGING AREA	
TSB	TEMPORARY SEDIMENT BASIN	
TSC	TEMPORARY STREAM CONTROL (SEE WATER CONTROL NOTES ON ET-1)	
VTC	VEHICLE TRACKING CONTROL	

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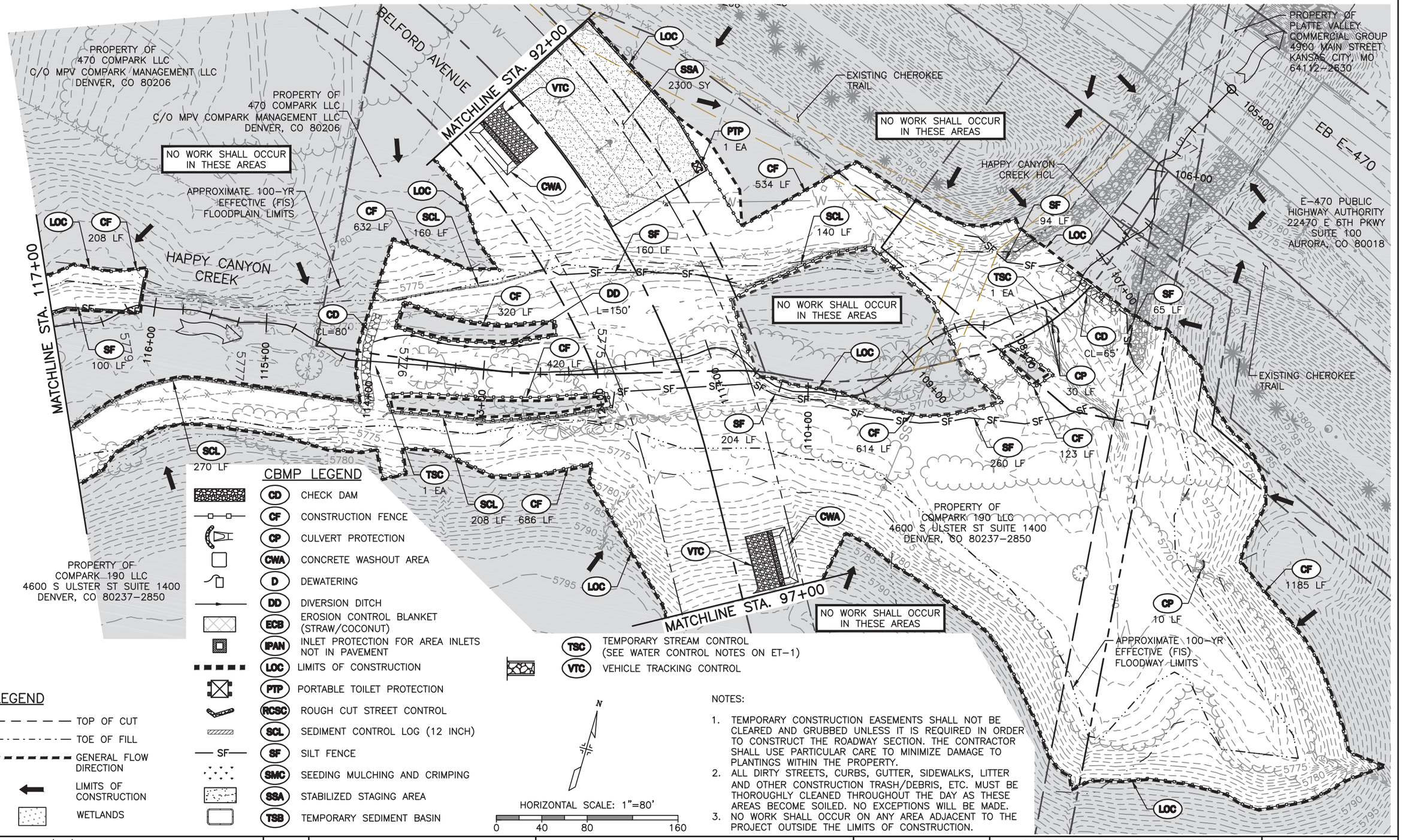
PEORIA & BELFORD INTERSECTION
HAPPY CANYON CREEK DROP STRUCTURE
INITIAL CBMP PLAN

Designer: CDT
Detailer: KLT
Subset: Erosion
Structure Numbers:
Sheets: EI-1 of 2

Project No./Code:
Sheet Number 89

I:\115360-01 - Compark at Belford\CADD\Erosion\Drawings\Happy Cyn Creek Drop Structure\, Chad.Twiss



CBMP LEGEND

CD	CHECK DAM	
CF	CONSTRUCTION FENCE	
CP	CULVERT PROTECTION	
CWA	CONCRETE WASHOUT AREA	
D	DEWATERING	
DD	DIVERSION DITCH	
ECB	EROSION CONTROL BLANKET (STRAW/COCONUT)	
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TSB	TEMPORARY SEDIMENT BASIN	
TSC	TEMPORARY STREAM CONTROL (SEE WATER CONTROL NOTES ON ET-1)	
VTC	VEHICLE TRACKING CONTROL	

LEGEND

- TOP OF CUT
- TOE OF FILL
- GENERAL FLOW DIRECTION
- LIMITS OF CONSTRUCTION
- WETLANDS

HORIZONTAL SCALE: 1"=80'

0 40 80 160

NOTES:

1. TEMPORARY CONSTRUCTION EASEMENTS SHALL NOT BE CLEARED AND GRUBBED UNLESS IT IS REQUIRED IN ORDER TO CONSTRUCT THE ROADWAY SECTION. THE CONTRACTOR SHALL USE PARTICULAR CARE TO MINIMIZE DAMAGE TO PLANTINGS WITHIN THE PROPERTY.
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3. NO WORK SHALL OCCUR ON ANY AREA ADJACENT TO THE PROJECT OUTSIDE THE LIMITS OF CONSTRUCTION.

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BELFORD-HAPPY CANYON CREEK
HAPPY CANYON CREEK DROP STRUCTURE
INITIAL CBMP PLAN

Designer:	CDT	Structure Numbers	
Detailer:	KLT		
Subset:	Erosion	Sheets:	EI-2 of 2

Project No./Code

Sheet Number 90

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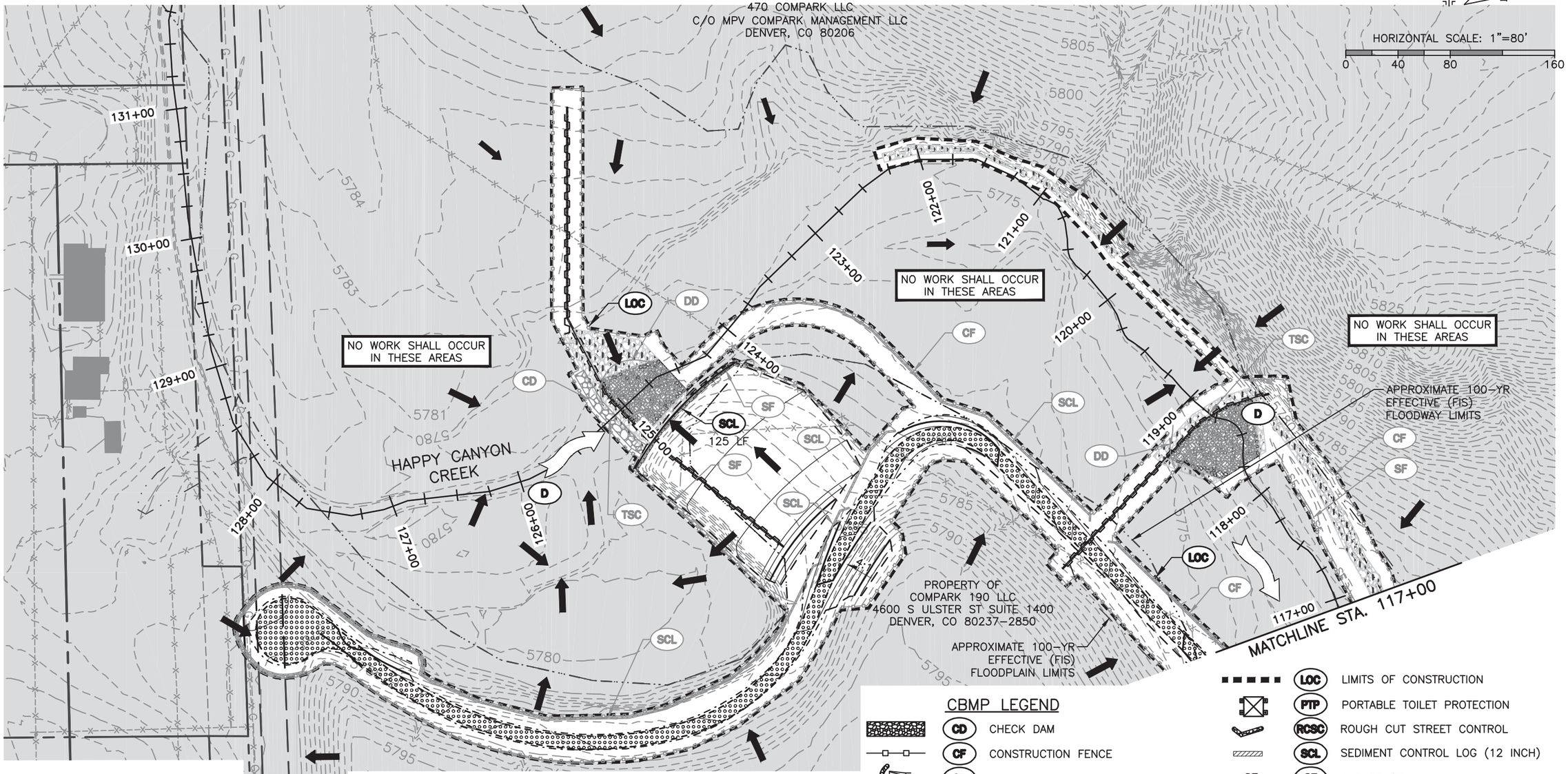

LEGEND

- TOP OF CUT
- TOE OF FILL
- LIMITS OF CONSTRUCTION
- GENERAL FLOW DIRECTION
- WETLANDS

NOTES:

1. TEMPORARY CONSTRUCTION EASEMENTS SHALL NOT BE CLEARED AND GRUBBED UNLESS IT IS REQUIRED IN ORDER TO CONSTRUCT THE ROADWAY SECTION. THE CONTRACTOR SHALL USE PARTICULAR CARE TO MINIMIZE DAMAGE TO PLANTINGS WITHIN THE PROPERTY.
2. * EROSION CONTROL ITEMS INSTALLED IN THE INITIAL EROSION CONTROL PLAN SHALL REMAIN IN PLACE FOR INTERIM PHASES OF CONSTRUCTION AND SHALL BE REMOVED, MODIFIED OR REPLACED AT THE DIRECTION OF THE PROJECT ENGINEER. THESE ITEMS SHALL BE PAID FOR AS PLACE AND REMOVE.
3. NO WORK SHALL OCCUR ON ANY AREA ADJACENT TO THE PROJECT OUTSIDE THE LIMITS OF CONSTRUCTION.

CBMP LEGEND

CD	CHECK DAM	LOC	LIMITS OF CONSTRUCTION
CF	CONSTRUCTION FENCE	PTP	PORTABLE TOILET PROTECTION
CP	CULVERT PROTECTION	RCSC	ROUGH CUT STREET CONTROL
CWA	CONCRETE WASHOUT AREA	SCL	SEDIMENT CONTROL LOG (12 INCH)
D	DEWATERING	SF	SILT FENCE
DD	DIVERSION DITCH	SMC	SEEDING MULCHING AND CRIMPING
ECB	EROSION CONTROL BLANKET (STRAW/COCONUT)	SSA	STABILIZED STAGING AREA
IPAN	INLET PROTECTION FOR AREA INLETS NOT IN PAVEMENT	TSB	TEMPORARY SEDIMENT BASIN
		TSC	TEMPORARY STREAM CONTROL (SEE WATER CONTROL NOTES SHEET ET-1)
		VTC	VEHICLE TRACKING CONTROL

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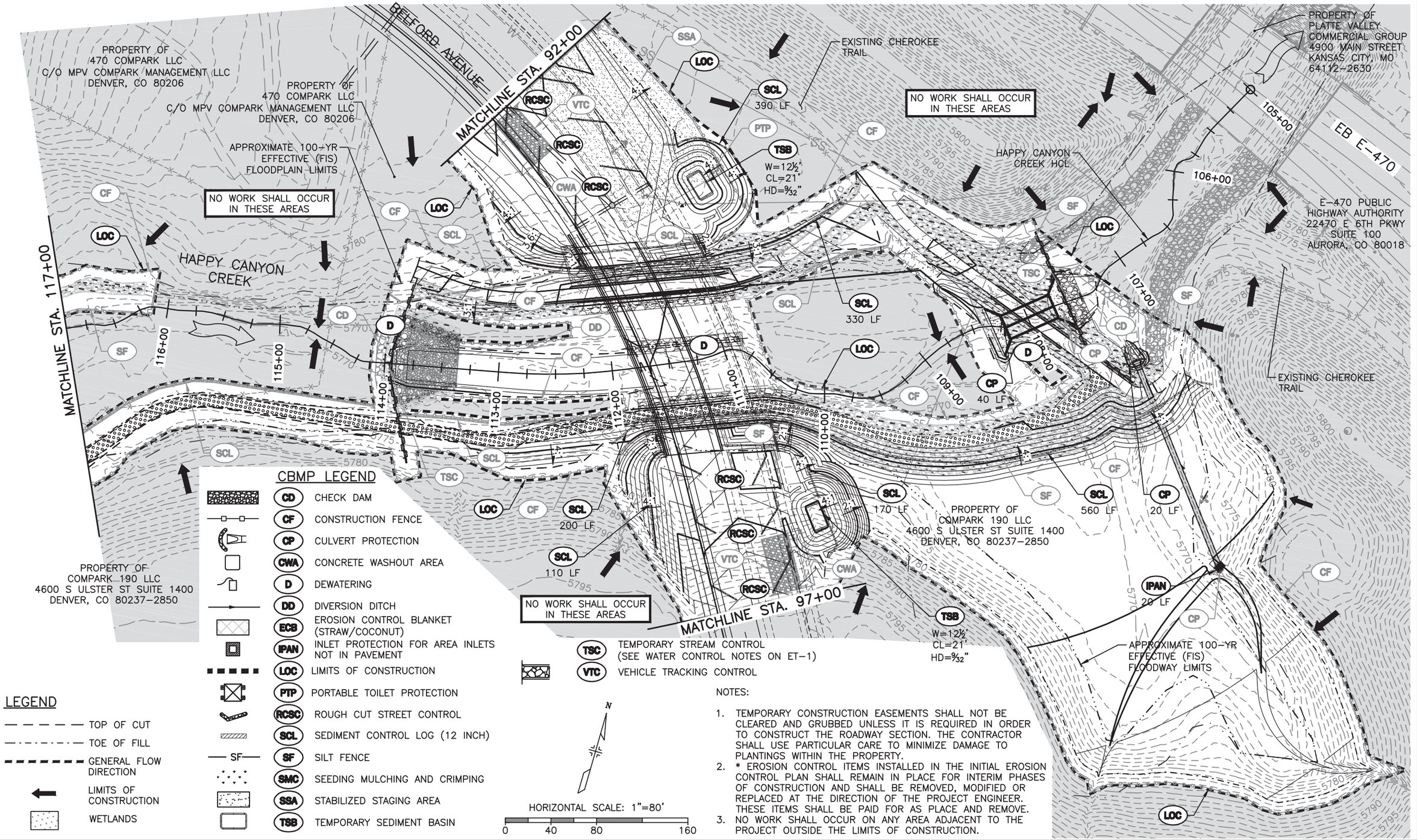
Void:

BELFORD-HAPPY CANYON CREEK
HAPPY CANYON CREEK DROP STRUCTURE
INTERIM CBMP PLAN

Designer: CDT
Detailer: KLT
Subset: Erosion
Structure Numbers:
Sheets: EN-1 of 2

Project No./Code:

Sheet Number 91



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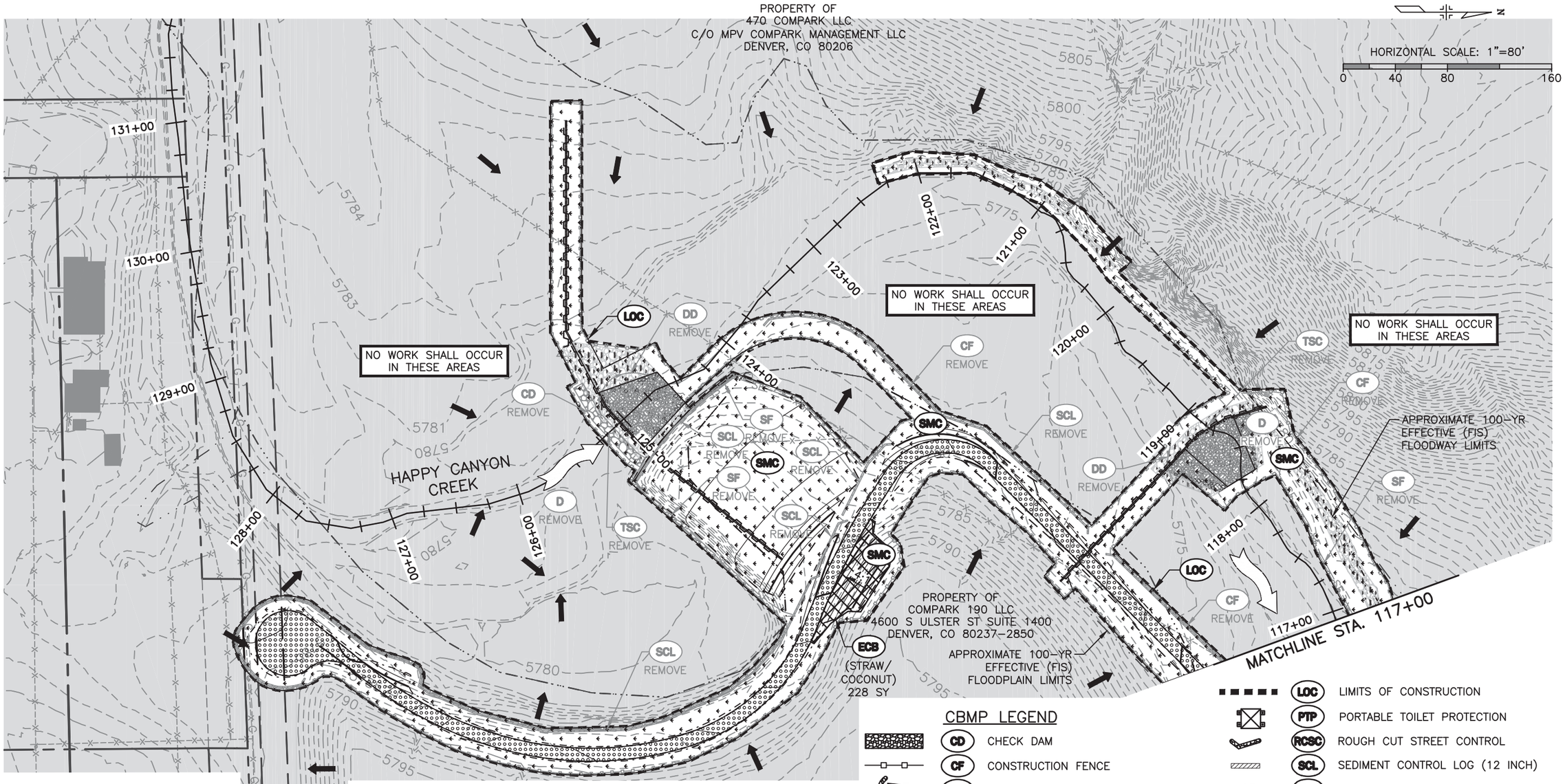
BELFORD-HAPPY CANYON CREEK
HAPPY CANYON CREEK DROP STRUCTURE
INTERIM CBMP PLAN

Designer:	CDT	Structure Numbers	
Detailer:	KLT		
Subset:	Erosion	Sheets:	EN-2 of 2

Project No./Code

Sheet Number 92



LEGEND

- TOP OF CUT
- TOE OF FILL
- LIMITS OF CONSTRUCTION
- GENERAL FLOW DIRECTION
- WETLANDS

NOTES:

1. TEMPORARY CONSTRUCTION EASEMENTS SHALL NOT BE CLEARED AND GRUBBED UNLESS IT IS REQUIRED IN ORDER TO CONSTRUCT THE ROADWAY SECTION. THE CONTRACTOR SHALL USE PARTICULAR CARE TO MINIMIZE DAMAGE TO PLANTINGS WITHIN THE PROPERTY.
2. * EROSION CONTROL ITEMS INSTALLED IN THE INITIAL EROSION CONTROL PLAN SHALL REMAIN IN PLACE FOR INTERIM PHASES OF CONSTRUCTION AND SHALL BE REMOVED, MODIFIED OR REPLACED AT THE DIRECTION OF THE PROJECT ENGINEER. THESE ITEMS SHALL BE PAID FOR AS PLACE AND REMOVE.
3. NO WORK SHALL OCCUR ON ANY AREA ADJACENT TO THE PROJECT OUTSIDE THE LIMITS OF CONSTRUCTION.

CBMP LEGEND

CD	CHECK DAM	LOC	LIMITS OF CONSTRUCTION
CF	CONSTRUCTION FENCE	PTP	PORTABLE TOILET PROTECTION
CP	CULVERT PROTECTION	RCSC	ROUGH CUT STREET CONTROL
CWA	CONCRETE WASHOUT AREA	SCL	SEDIMENT CONTROL LOG (12 INCH)
D	DEWATERING	SF	SILT FENCE
DD	DIVERSION DITCH	SMC	SEEDING MULCHING AND CRIMPING
ECB	EROSION CONTROL BLANKET (STRAW/COCONUT)	SSA	STABILIZED STAGING AREA
IPAN	INLET PROTECTION FOR AREA INLETS NOT IN PAVEMENT	TSB	TEMPORARY SEDIMENT BASIN
		TSC	TEMPORARY STREAM CONTROL (SEE WATER CONTROL NOTES SHEET ET-1)
		VTC	VEHICLE TRACKING CONTROL

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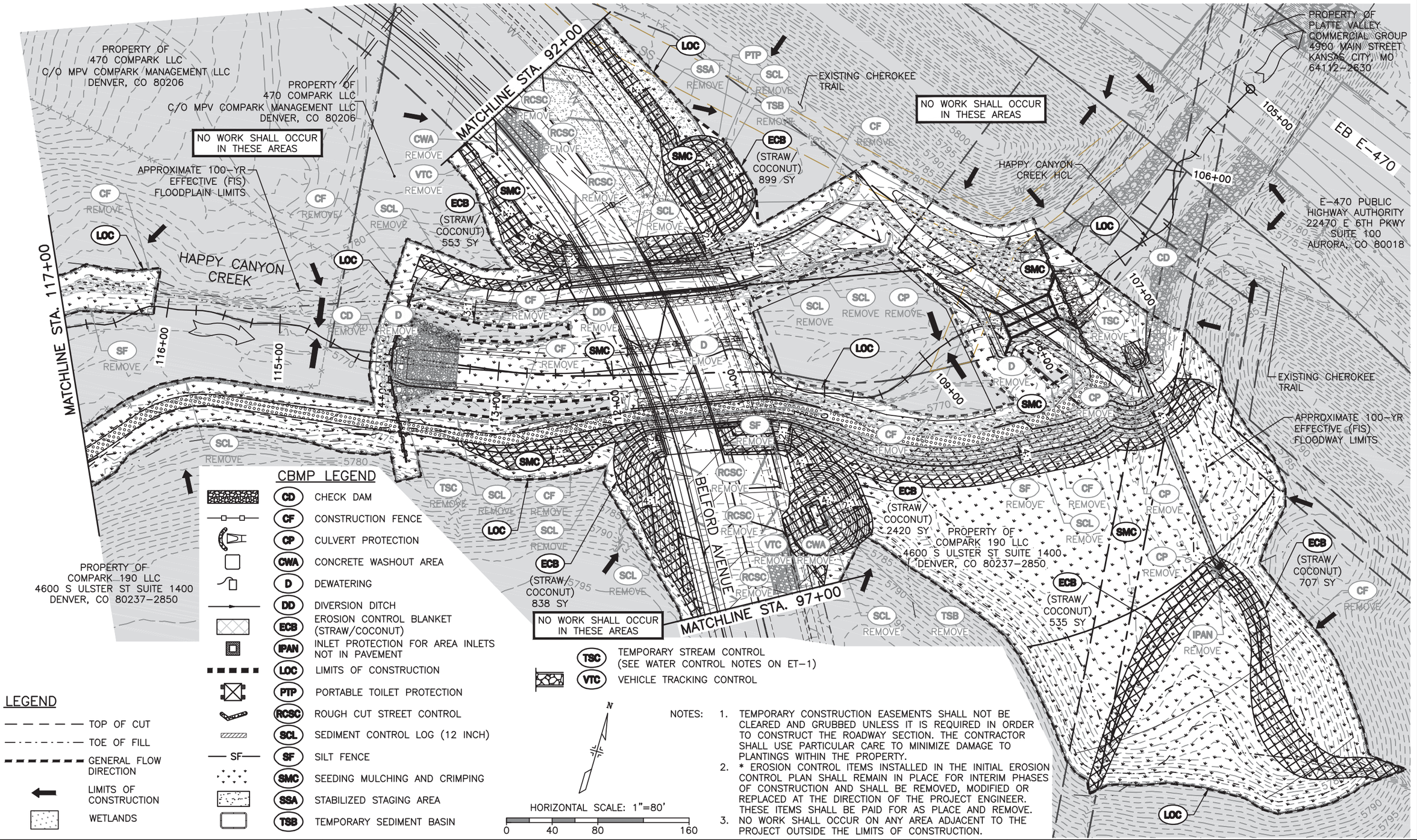
As Constructed
No Revisions:
Revised:
Void:

BELFORD-HAPPY CANYON CREEK
HAPPY CANYON CREEK DROP STRUCTURE
FINAL CBMP PLAN

Designer: CDT
Detailer: KLT
Subset: Erosion
Structure Numbers:
Sheets: EF-1 of 2

Project No./Code:
Sheet Number 93



CBMP LEGEND

CD	CHECK DAM	
CF	CONSTRUCTION FENCE	
CP	CULVERT PROTECTION	
CWA	CONCRETE WASHOUT AREA	
D	DEWATERING	
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SCL	SEDIMENT CONTROL LOG (12 INCH)	
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SSA	STABILIZED STAGING AREA	
TSB	TEMPORARY SEDIMENT BASIN	
TSC	TEMPORARY STREAM CONTROL (SEE WATER CONTROL NOTES ON ET-1)	
VTC	VEHICLE TRACKING CONTROL	

LEGEND

- TOP OF CUT
- TOE OF FILL
- GENERAL FLOW DIRECTION
- LIMITS OF CONSTRUCTION
- WETLANDS

HORIZONTAL SCALE: 1"=80'

0 40 80 160

NOTES:

1. TEMPORARY CONSTRUCTION EASEMENTS SHALL NOT BE CLEARED AND GRUBBED UNLESS IT IS REQUIRED IN ORDER TO CONSTRUCT THE ROADWAY SECTION. THE CONTRACTOR SHALL USE PARTICULAR CARE TO MINIMIZE DAMAGE TO PLANTINGS WITHIN THE PROPERTY.
2. * EROSION CONTROL ITEMS INSTALLED IN THE INITIAL EROSION CONTROL PLAN SHALL REMAIN IN PLACE FOR INTERIM PHASES OF CONSTRUCTION AND SHALL BE REMOVED, MODIFIED OR REPLACED AT THE DIRECTION OF THE PROJECT ENGINEER. THESE ITEMS SHALL BE PAID FOR AS PLACE AND REMOVE.
3. NO WORK SHALL OCCUR ON ANY AREA ADJACENT TO THE PROJECT OUTSIDE THE LIMITS OF CONSTRUCTION.

I:\115360-01 - Compark at Belford\CADD\Erosion\Drawings\Happy Cyn Creek Drop Structure\, Chad.Twiss

Print Date: 3/13/2018 11:31:12 AM
File Name: H115360-01DROP02?rosion-FIN.dwg
Horizontal Scale: 1"=80' Vertical Scale: N.T.S.

FELSBURG HOLT & ULLEVIG
6300 South Syracuse Way, Suite 600
Centennial, CO 80111
tel 303.721.1440
fax 303.721.0832

R-X	Sheet Revisions		
	Date	Comments	Initials

Manhard CONSULTING LTD
8008 E. Arapahoe Court, Suite 110, Centennial, CO 80112 ph:303.708.0500 fx:303.708.0400 manhard.com
Civil Engineers • Surveyors • Water Resource Engineers • Water & Wastewater Engineers
Construction Managers • Environmental Scientists • Landscape Architects • Planners

As Constructed
No Revisions:
Revised:
Void:

BELFORD-HAPPY CANYON CREEK
HAPPY CANYON CREEK DROP STRUCTURE
FINAL CBMP PLAN

Designer:	CDT	Structure Numbers	
Detailer:	KLT		
Subset:	Erosion	Sheets:	EF-2 of 2

Project No./Code

Sheet Number 94

APPENDIX G. EFFECTIVE TIE-IN INFORMATION

LEGEND

- EFFECTIVE FLOODWAY LIMITS
- 100 YR EFFECTIVE FLOODPLAIN LIMITS
- 100 YR PRE-PROJECT FLOODPLAIN LIMITS
- PRE-PROJECT FLOODWAY LIMITS
- 100 YR POST-PROJECT FLOODPLAIN LIMITS
- POST-PROJECT FLOODWAY LIMITS
- 500 YR EFFECTIVE FLOODPLAIN LIMITS
- 500 YR PRE-PROJECT FLOODPLAIN LIMITS
- 500 YR POST-PROJECT FLOODPLAIN LIMITS
- 100 YR EFFECTIVE BFE
- 100 YR POST-PROJECT BFE
- 12541 CROSS-SECTION TAKEN FROM FHAD
- 12436 FHU ADDED CROSS-SECTION
- FHAD CROSS-SECTION (TO BE REMOVED)
- EXISTING ROW
- EXISTING EASEMENT
- SURVEYED 1 FT CONTOURS
- WETLANDS

PROPERTY OF
E470 PUBLIC HIGHWAY AUTHORITY
22470 E 6TH PKWY SUITE 100
AURORA, CO 80018-2425

PROPERTY OF
COTTONWOOD WATER & SANITATION DISTRICT
2 INVERNESS DR E SUITE 200
CENTENNIAL, CO 80112-5509

E-470

HAPPY CANYON TRAIL

PROPOSED BELFORD OVER HAPPY CANYON CREEK CROSSING

DOWNSTREAM CROSS SECTION TIE-IN

PROPERTY OF
PLATTE VALLEY COMMERCIAL GROUP
4900 MAIN STREET
KANSAS CITY, MO 64112-2630

PROPERTY OF
COMPARK BUSINESS CAMPUS METRO DISTRICT
FKA E-470 BUSINESS METRO DISTRICT
8480 E ORCHARD RD SUITE 6200
GREENWOOD VILLAGE, CO 80111

PROPOSED DROP STRUCTURE NO. 1

HAPPY CANYON CREEK HCL

PROPOSED DROP STRUCTURE NO. 2

CHEROKEE TRAIL CROSSING

CHEROKEE TRAIL

PROPERTY OF
COMPARK 190 LLC
4600 S ULSTER ST SUITE 1400
DENVER, CO 80237-2850

PROPERTY OF
470 COMPARK LLC
C/O MPV COMPARK MANAGEMENT LLC
DENVER, CO 80206

PROPOSED DROP STRUCTURE NO. 3

PROPERTY OF
COMPARK 190 LLC
4600 S ULSTER ST SUITE 1400
DENVER, CO 80237-2850

PROPOSED BELFORD AVE.

UPSTREAM CROSS SECTION TIE-IN

CHAMBERS ROAD

FLOW

HAPPY CANYON CREEK

N

HORIZONTAL SCALE: 1"=100'

0' 50' 100' 200'

EXISTING TOPOGRAPHY SHOWN ON THE WORKMAPS FROM CROSS-SECTION 10111 TO CROSS-SECTION 12694 REPRESENTS SURVEYED 1 FOOT CONTOURS (NAVD 88). THE SURVEY AND AERIAL PHOTOGRAPHY WAS DONE 11/2015. SECTIONS 10775, 10842, 11153, AND 11772 ARE TO BE REMOVED FOR POST-PROJECT CONDITIONS.

I HEREBY AFFIRM THAT THIS DOCUMENT ENTITLED FLOODPLAIN MODIFICATION STUDY FOR HAPPY CANYON CREEK AT BELFORD AVE WAS PREPARED IN ACCORDANCE WITH APPLICABLE, VIABLE, AND PERTINENT TECHNICAL DATA AND CRITERIA FOR THE COLORADO WATER CONSERVATION BOARD, THE FEDERAL EMERGENCY AGENCY, AND DOUGLAS COUNTY, COLORADO. THE DOCUMENT, REPORT, AND ALL ATTACHMENTS SUBMITTED HEREWITH WERE PREPARED IN ACCORDANCE WITH A SYSTEM DESIGNED TO ASSURE THAT QUALIFIED PERSONNEL PROPERLY GATHERED AND EVALUATED THE NECESSARY INFORMATION AND SUPERVISED OR PREPARED THE DOCUMENT. ADDITIONALLY, I HEREBY CERTIFY THAT NO INSURABLE STRUCTURES ARE IMPACTED DUE TO THE REVISIONS DOCUMENTED IN THE CLOMR REPORT.

45344

RANDY M. GABBERT, P.E. NO. 45344

4/27/17

Print Date: 2/27/2018 10:43:41 AM
File Name: H115360-01FP-01 (Eff).dwg
Horizontal Scale: Vertical Scale:

FELSBURG HOLT & ULLEVIG
6300 South Syracuse Way, Suite 600
Centennial, CO 80111
tel 303.721.1440
fax 303.721.0832

R-X

Sheet Revisions

Date	Comments	Initials

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Civil Engineers • Surveyors • Water Resource Engineers • Water & Wastewater Engineers
Construction Managers • Environmental Scientists • Landscape Architects • Planners

As Constructed
No Revisions:
Revised:
Void:

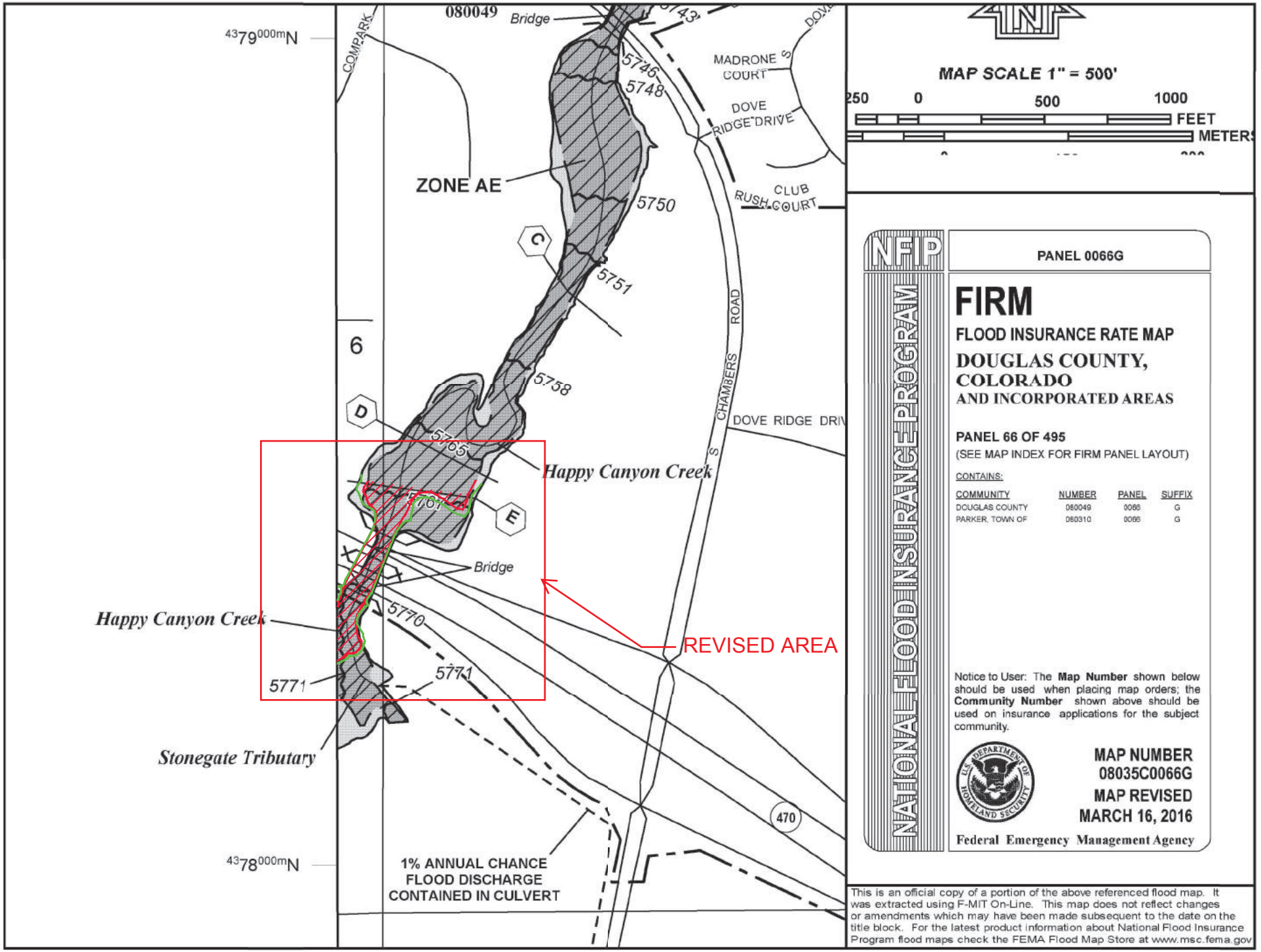
BELFORD AVE. AT HAPPY CANYON CREEK
FLOODPLAIN WORK MAP

Designer: CDT
Detailer: ZJG
Subset:
Structure Numbers:
Sheets: 1 of 1

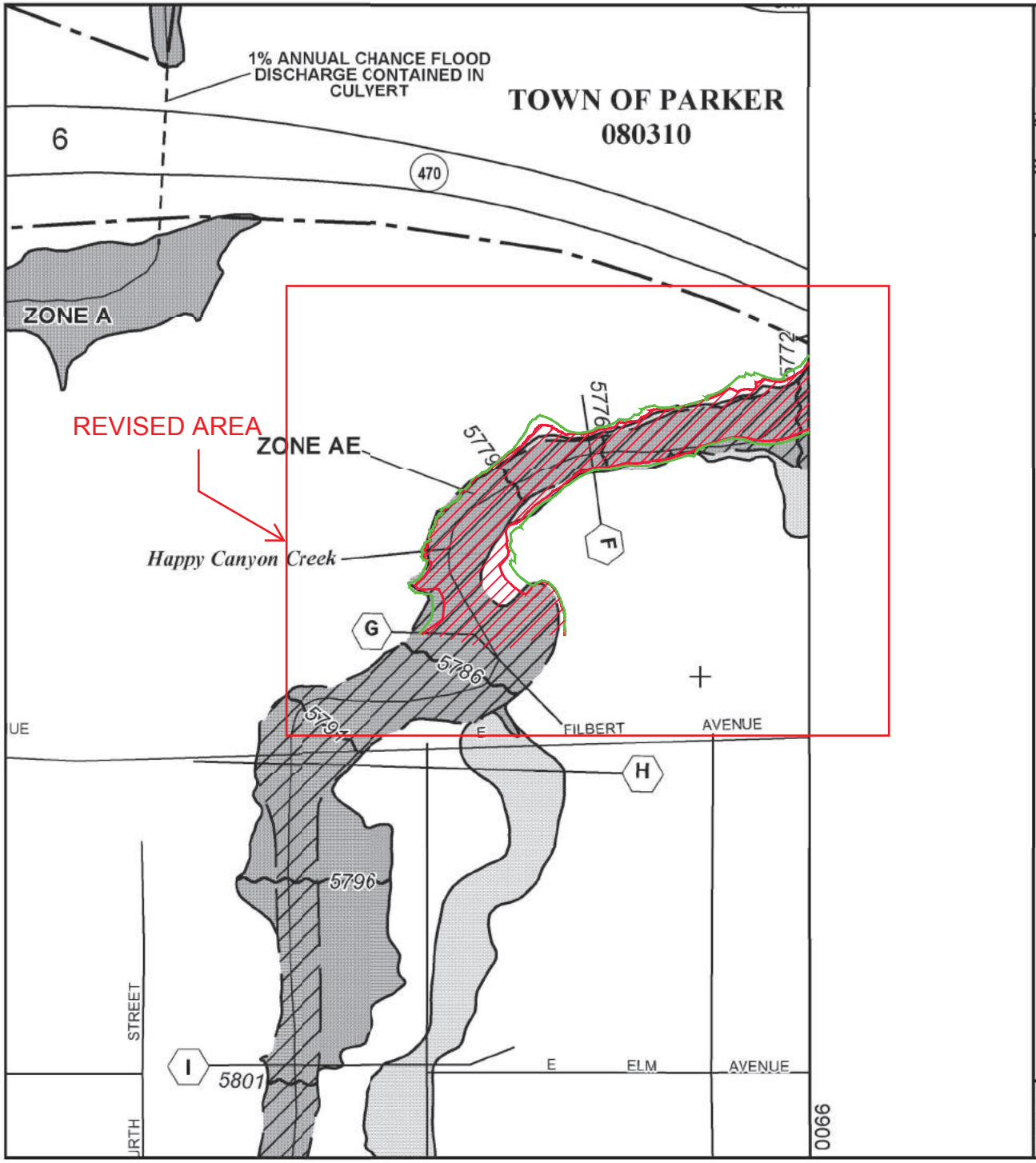
Project No./Code

Sheet Number

I:\115360-01 - Compark at Belford\CADD\Hydraulics\Drawings\, Zach.Grady



This is an official copy of a portion of the above referenced flood map. It was extracted using F-MIT On-Line. This map does not reflect changes or amendments which may have been made subsequent to the date on the title block. For the latest product information about National Flood Insurance Program flood maps check the FEMA Flood Map Store at www.msc.fema.gov



MAP SCALE 1" = 500'

250 0 500 1000

FEET

METERS

NFIP

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0062G

FIRM

FLOOD INSURANCE RATE MAP

DOUGLAS COUNTY, COLORADO AND INCORPORATED AREAS

PANEL 62 OF 495

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

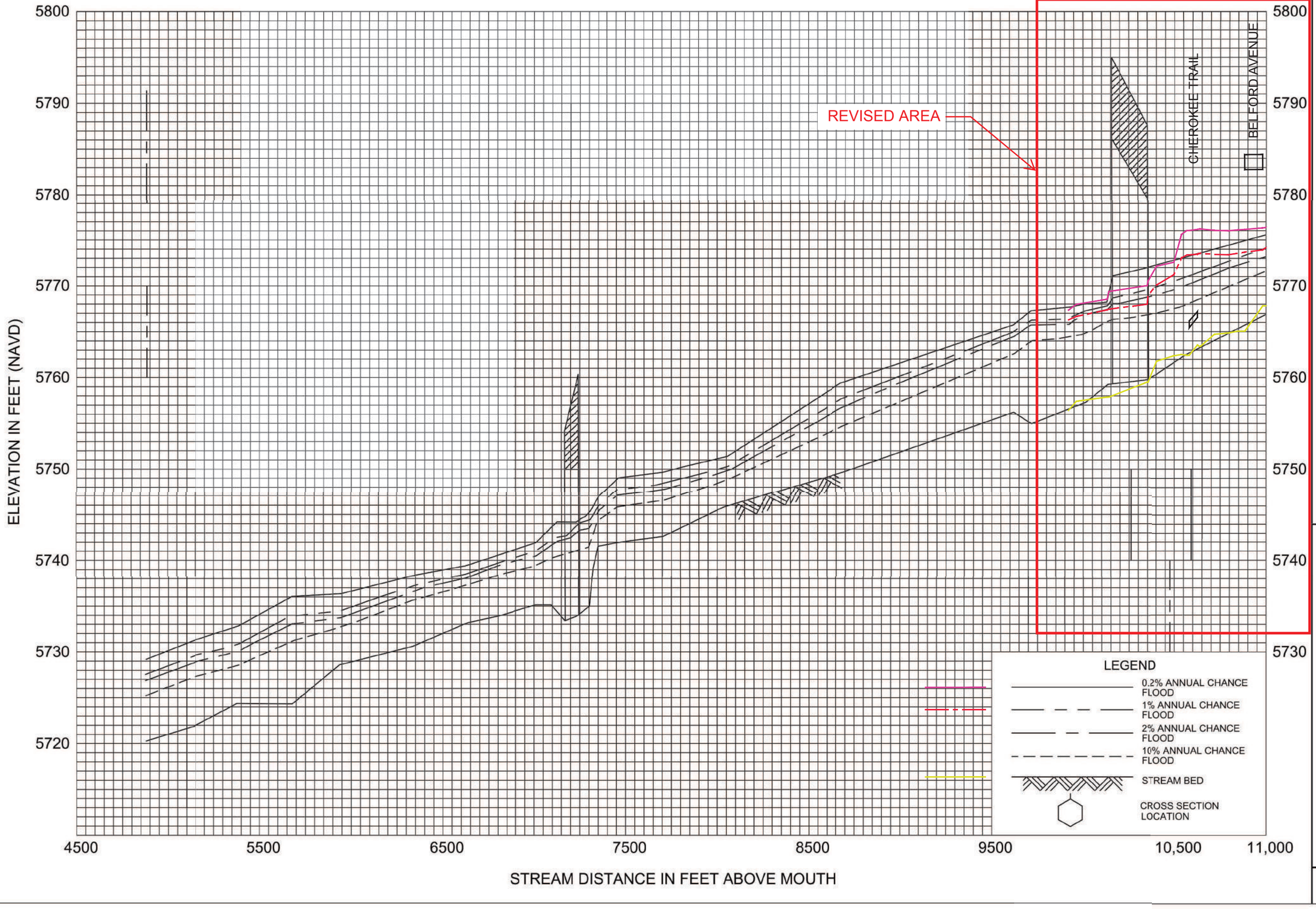
COMMUNITY	NUMBER	PANEL	SUFFIX
DOUGLAS COUNTY	080049	0062	G
LONE TREE, CITY OF	080319	0062	G
PARKER, TOWN OF	080310	0062	G

Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER
08035C0062G
MAP REVISED
MARCH 16, 2016

Federal Emergency Management Agency

This is an official copy of a portion of the above referenced flood map. It was extracted using F-MIT On-Line. This map does not reflect changes or amendments which may have been made subsequent to the date on the title block. For the latest product information about National Flood Insurance Program flood maps check the FEMA Flood Map Store at www.msc.fema.gov



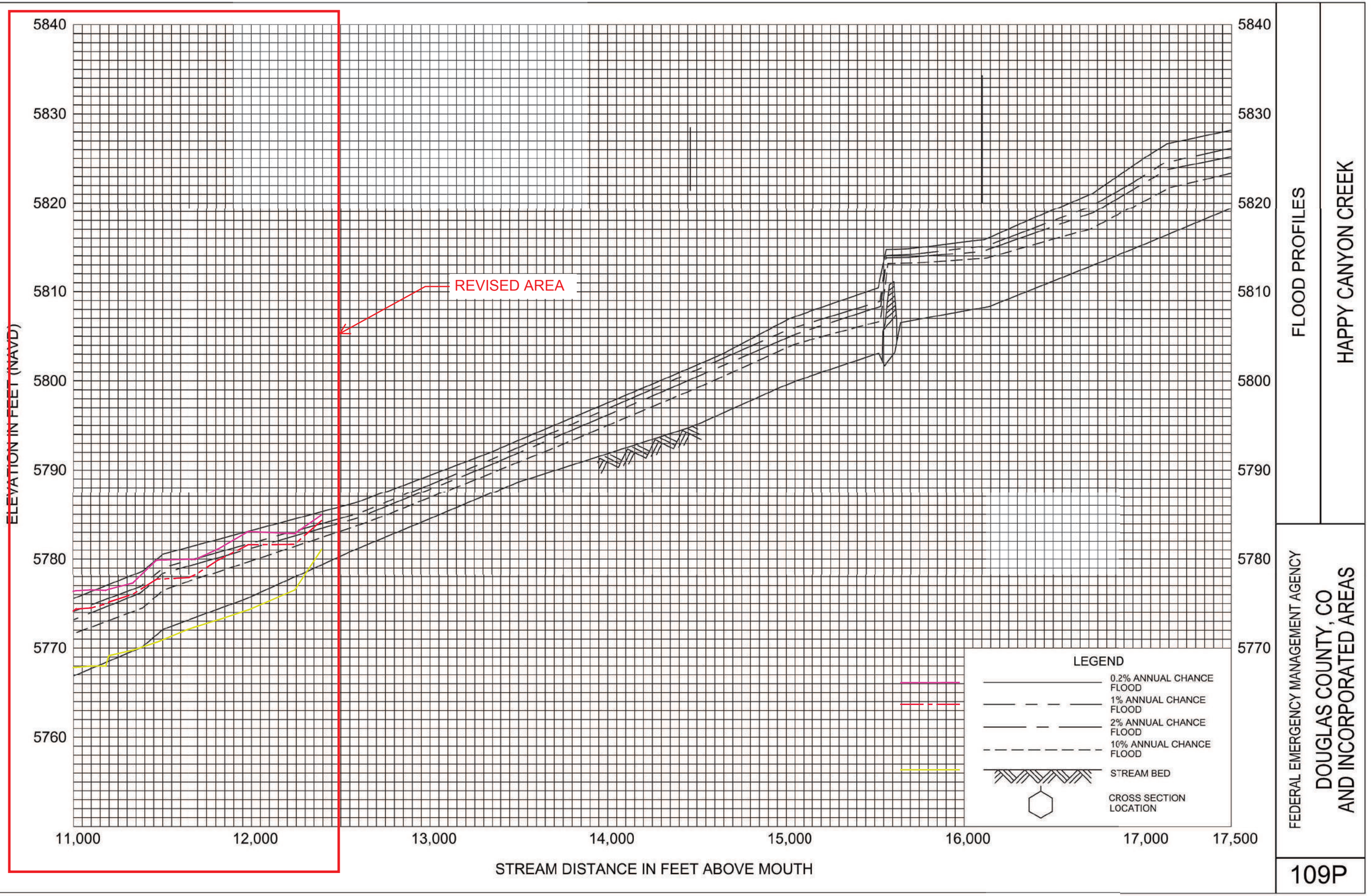
FLOOD PROFILES

HAPPY CANYON CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

DOUGLAS COUNTY, CO
AND INCORPORATED AREAS

108P



FLOOD PROFILES

HAPPY CANYON CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

DOUGLAS COUNTY, CO
AND INCORPORATED AREAS

109P

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Happy Canyon Creek								
A	5,165	150	685	10.2	5,729.7	5,729.7	5,729.7	0.0
B	6,812	265	810	7.1	5,739.7	5,739.7	5,739.7	0.0
C	8,320	102	466	12.2	5,753.4	5,753.4	5,753.4	0.0
D	9,720	350	1,395	5.2	5,766.3	5,766.3	5,766.3	0.0
E	10,111	411	915	9.0	5,766.3	5,766.3	5,766.3	0.0
F	11,494	117	526	11.4	5,776.0	5,776.0	5,776.0	0.0
G	12,541	406	742	7.7	5,784.3	5,784.3	5,784.3	0.0
H	13,490	315	880	6.3	5,792.5	5,792.5	5,793.5	1.0 [2]
I	14,470	171	825	6.8	5,800.4	5,800.4	5,801.4	1.0 [2]
J	15,020	115	607	9.2	5,805.6	5,805.6	5,806.6	1.0 [2]
K	15,570	180	920	6.1	5,808.9	5,808.9	5,809.9	1.0 [2]
L	15,640	205	1,450	3.9	5,813.9	5,813.9	5,814.9	1.0 [2]
M	16,120	110	701	8.0	5,814.9	5,814.9	5,815.9	1.0 [2]
N	16,720	100	519	10.5	5,819.1	5,819.1	5,820.1	1.0 [2]
O	17,170	81	537	10.1	5,824.4	5,824.4	5,824.4	0.0
P	17,835	142	763	7.1	5,827.7	5,827.7	5,828.7	1.0 [2]
Q	18,230	136	498	8.7	5,831.2	5,831.2	5,831.2	0.0
R	18,310	107	977	5.6	5,836.2	5,836.2	5,837.2	1.0
S	19,020	99	509	10.8	5,837.7	5,837.7	5,838.2	0.5
T	19,604	72	540	10.2	5,841.4	5,841.4	5,841.6	0.2
U	19,918	113	716	7.7	5,845.3	5,845.3	5,845.3	0.0
V	20,104	148	803	5.1	5,851.2	5,851.2	5,851.2	0.0
W	20,571	128	423	9.8	5,854.0	5,854.0	5,854.1	0.1
X	20,972	103	437	9.5	5,859.0	5,859.0	5,859.0	0.0
Y	21,036	112	575	7.2	5,860.3	5,860.3	5,860.3	0.0

Area Revised

[1] Feet Above Mouth

[2] Encroachment Limited to Channel Banks; Elevation Increase May Be Less Than 1.0 Foot

TABLE 7

FEDERAL EMERGENCY MANAGEMENT AGENCY

DOUGLAS COUNTY, CO
AND INCORPORATED AREAS

FLOODWAY DATA

HAPPY CANYON CREEK

UDFCD DLOMC Submittal - BFE Comparison Table

Project Name :	**115360-01 Compark/Belford Avenue**
Flooding Source:	**Happy Canyon Creek**
Company:	**Felsburg Holt & Ullevig**
Completed By:	**ZJG**

SOURCE DATA											COMPARISONS				
HYDRAULIC CROSS-SECTION INFO.						BASE FLOOD ELEVATIONS (NAVD)									
Effective Cross-Section ID (Letter)	Corrected Effective Cross-Section ID	Corrected Effective Stream Station	Existing Cross-Section ID	Proposed Cross-Section ID	Proposed Stream Station	EFFECTIVE	DUP. EFF.	COR. EFF.	EXISTING	PROPOSED	DUP. EFF vs. EFF.	COR. EFF. vs. EFF.	EX. vs. COR. EFF.	PP. vs. COR. EFF.	PP. vs. EFF.
						BFE	BFE	BFE	BFE	BFE	BFE	BFE	BFE	BFE	BFE
9920 (E)	10111	10111	10111	10111	10111	5766.3	5766.3	5766.3	5766.3	5766.3	0.0	0.0	0.0	0.0	0.0
-	10157	10157	10157	10157	10157	-	-	5766.7	5766.7	5766.7	-	-	0.0	0.0	-
-	10326	10326	10326	10326	10326	-	-	5767.4	5767.4	5767.4	-	-	0.0	0.0	-
-	10548	10548	10548	10548	10548	-	-	5769.0	5769.0	5769.0	-	-	0.0	0.0	-
-	10595	10597	10595	10595	10597	-	-	5770.1	5770.1	5770.2	-	-	0.0	0.0	-
-	10679	10691	10679	10679	10691	-	-	5771.2	5771.2	5771.2	-	-	0.0	0.0	-
-	10725	10735	10725	10725	10735	-	-	5772.8	5772.8	5773.1	-	-	0.0	0.3	-
-	-	-	-	10750	10764	-	-	-	-	5773.4	-	-	-	-	-
-	10775	10786	10775	-	-	-	-	5773.3	5773.3	-	-	-	0.0	-	-
-	-	-	-	10810	10823	-	-	-	-	5773.5	-	-	-	-	-
-	-	-	-	10819	10833	-	-	-	-	5773.6	-	-	-	-	-
-	-	-	-	10825	10838	-	-	-	-	5773.6	-	-	-	-	-
-	10842	10856	10842	-	-	-	-	5773.0	5773.0	-	-	-	0.0	-	-
-	10900	10922	10900	10900	10915	-	-	5773.3	5773.3	5773.5	-	-	0.0	0.2	-
-	10974	10995	10974	10974	10989	-	-	5773.0	5773.0	5773.4	-	-	0.0	0.4	-
-	11100	11050	11100	11100	11043	-	-	5772.9	5772.9	5773.6	-	-	0.0	0.6	-
-	11153	11187	11153	-	-	-	-	5774.0	5774.0	-	-	-	0.0	-	-
-	11180	11230	11180	11180	11215	-	-	5773.8	5773.8	5774.4	-	-	0.0	0.7	-
-	11280	11321	11280	11280	11312	-	-	5774.9	5774.9	5774.5	-	-	0.0	-0.3	-
-	11370	11424	11370	11370	11411	-	-	5775.3	5775.3	5774.9	-	-	0.0	-0.4	-
-	11385	11440	11385	11385	11426	-	-	5775.4	5775.4	5775.0	-	-	0.0	-0.5	-
-	11400	11458	11400	11400	11441	-	-	5775.6	5775.6	5775.2	-	-	0.0	-0.4	-
-	11410	11465	11410	11410	11447	-	-	5775.6	5775.6	5775.2	-	-	0.0	-0.4	-
11100 (F)	11494	11544	11494	11494	11526	5776.7	5776.7	5777.2	5777.2	5776.0	0.0	0.4	0.0	-1.1	-0.7
-	11620	11680	11620	11620	11662	-	-	5778.1	5778.1	5777.8	-	-	0.0	-0.3	-
-	11772	11836	11772	-	-	-	-	5778.2	5778.2	-	-	-	0.0	-	-
-	-	-	-	11800	11979	-	-	-	-	5777.9	-	-	-	-	-
-	-	-	-	11830		-	-	-	-	5778.2		-	-	-	-
-	-	-	-	11835	12011	-	-	-	-	5778.2	-	-	-	-	-
-	11959	12030	11959	11959	-	-	-	5779.9	5779.9	5779.9	-	-	0.0	-	-
-	12129	12213	12129	12129	12194	-	-	5781.6	5781.6	5781.6	-	-	0.0	0.0	-
-	12388	12478	12388	12388	12460	-	-	5781.6	5781.6	5781.7	-	-	0.0	0.1	-
12694 (G)	12541	12631	12541	12541	12613	5784.8	5784.8	5784.3	5784.3	5784.3	0.0	-0.5	0.0	-0.1	-0.5

-- = Not applicable or no direct comparison available

Information taken from Effective FIS and FIRM. Flows used were 100-yr from FIS (Q=5560 cfs @ E-470)

UDFCD LOMC AGREEMENT TABLE

PROJECT NAME:	115360-01 Compark/Belford Avenue
COMPANY:	Felsburg Holt & Ullevig
COMPLETED BY:	ZJG

Community(ies): Town of Parker & Douglas County, CO
Flooding Source(s): Happy Canyon Creek

Page: 1 **of** 1
Date: 4/19/2019

Reference Location	Stream Station	Cross Section #	Channel Distance (ft)			Cumulative Channel Distance (ft)			Base Floodplain Width (ft)			Floodway Width (ft)			Comments
			Model	Map	% Difference	Model	Map	% Difference	Model	Map	Difference (ft)	Model	Map	Difference (ft)	
		10111	0	0	#DIV/0!	0	0	#DIV/0!	411	400	11	411	400	11	*
		10157	45	45	0%	45	45	0%	199	197	2	199	197	2	*
D/S XS - E-470 Bridge		10326	169	169	0%	214	214	0%	89	88	1	89	88	1	*
U/S XS - E-470 Bridge		10548	223	223	0%	437	437	0%	107	107	1	107	107	1	*
		10595	46	48	4%	484	486	0%	100	100	0	100	100	0	*
		10679	94	94	0%	578	580	0%	96	97	1	96	97	1	*
		10725	43	44	2%	620	623	1%	138	138	0	138	138	0	*
D/S XS - E-470 Trail Crossing		10750	29	29	0%	650	653	1%	188	190	2	188	190	2	*
U/S XS - E-470 Trail Crossing		10810	59	59	0%	708	711	0%	239	237	2	239	237	2	*
		10819	9	9	5%	717	721	1%	247	244	4	247	244	4	*
		10825	6	6	4%	723	727	0%	242	238	4	242	238	4	*
		10900	77	76	1%	800	803	0%	196	199	3	196	199	3	*
		10974	74	74	0%	874	877	0%	161	161	0	161	161	0	*
D/S XS - Belford Avenue		11100	54	54	0%	928	931	0%	154	154	0	154	154	0	*
U/S XS - Belford Avenue		11180	168	169	0%	1097	1100	0%	165	160	5	165	160	5	*
		11280	87	86	1%	1183	1186	0%	161	167	5	161	167	5	*
		11370	66	66	0%	1249	1252	0%	153	151	2	153	151	2	*
		11385	15	15	0%	1264	1267	0%	141	141	1	141	141	1	*
		11400	15	15	0%	1279	1282	0%	143	142	1	143	142	1	*
		11410	6	6	0%	1285	1288	0%	141	141	0	141	141	0	*
		11494	128	129	0%	1414	1416	0%	117	117	0	117	117	0	*
		11620	136	136	0%	1550	1552	0%	203	204	1	203	204	1	*
		11800	179	179	0%	1729	1732	0%	187	187	0	187	187	0	*
		11830	30	32	5%	1759	1763	0%	191	190	0	191	190	0	*
		11835	6	6	0%	1765	1769	0%	190	191	0	190	191	0	*
		11959	130	130	0%	1895	1899	0%	192	194	2	192	194	2	*
		12129	182	182	0%	2077	2082	0%	290	276	14	290	276	14	*
		12388	259	266	3%	2336	2347	0%	283	271	13	283	271	13	*
		12541	153	153	0%	2489	2500	0%	403	422	19	403	422	19	*
ACCEPTABLE TOLERANCES =			**+/- 5% of Model**			**+/- 5% of Model**			**+/- 25 Feet**						

* - Floodway = Floodplain

APPENDIX H. PHOTOGRAPHS

Photo #1.
Looking north towards the E-470 crossing.
Photo taken from existing Cherokee Trail looking downstream.

Photo #2.
Photo taken from existing Cherokee Trail looking upstream to the south.

Photo #3.
Looking upstream towards the south. Photo taken from center of channel with Grandview Estates in the background. This location is approximately 500 feet upstream of the proposed Belford Avenue bridge crossing.

Photo #4.
Looking downstream to the north. Photo taken from center of channel with E-470 in the background. This photo was taken from the same location as Photo #3.

Federal Emergency Management Agency

Washington, D.C. 20472

November 20, 2019

CERTIFIED MAIL
RETURN RECEIPT REQUESTED

The Honorable Mike Waid
Mayor, Town of Parker
20120 East Main Street
Parker, CO 80138

IN REPLY REFER TO:
Case No.: 19-08-0690R
Community Name: Town of Parker, CO
Community No.: 080310

104

Dear Mayor Waid:

We are providing our comments with the enclosed Conditional Letter of Map Revision (CLOMR) on a proposed project within your community that, if constructed as proposed, could revise the effective Flood Insurance Study (FIS) report and Flood Insurance Rate Map for your community.

If you have any questions regarding the floodplain management regulations for your community, the National Flood Insurance Program (NFIP) in general, or technical questions regarding this CLOMR, please contact the Director, Mitigation Division of the Federal Emergency Management Agency (FEMA) Regional Office in Denver, at (303) 235-4830, or the FEMA Map Information eXchange (FMIX) toll free at 1-877-336-2627 (1-877-FEMA MAP). Additional information about the NFIP is available on our website at https://www.fema.gov/national-flood-insurance-program.

Sincerely,

Patrick "Rick" F. Sacbibit, P.E., Branch Chief
Engineering Services Branch
Federal Insurance and Mitigation Administration

Enclosure:
Conditional Letter of Map Revision Comment Document

cc: Mr. Tom Williams, P.E.
Director of Public Works/ Engineering
Town of Parker

Ms. Terri Fead, P.E.
Project Manager
Mile High Flood District

Mr. Kevin Houck, P.E., CFM
Chief, Watershed and Flood Protection Section
Colorado Water Conservation Board

Ms. Kendra Gabbert, P.E.
Felsburg Holt & Ullevig

Ms. Amie Drucker, P.E.
Project Manager
Manhard Consulting

Mr. Zachary Grady
Felsburg Holt & Ullevig

DEPARTMENT OF THE ARMY
CORPS OF ENGINEERS, OMAHA DISTRICT
DENVER REGULATORY OFFICE, 9307 SOUTH WADSWORTH BOULEVARD
LITTLETON, COLORADO 80128-6901

November 13, 2017

SUBJECT: Nationwide Permit Verification – Corps File No. NWO-2017-01897-DEN, Compark South Project, Douglas County, Colorado

Michael Vickers
Belford South Metropolitan District
8390 East Crescent Parkway, Suite 500
Greenwood Village, CO 80111

Dear Mr. Vickers:

This letter is in reference to the proposed project located at approximately 39.553041°N, -104.821996°W, in Douglas County, Colorado. The work as described in your submittal will consist of constructing a road bridge crossing over Happy Canyon Creek, replacing an existing pedestrian bridge over Happy Canyon Creek, and installing three buried channel stabilization structures in Happy Canyon Creek, all in direct support of a residential development. This project will cause temporary impacts to 0.486 acre of Happy Canyon Creek and to 0.1657 acre of adjacent wetlands, and will cause permanent impacts to 0.049 acre of Happy Canyon Creek.

Based on the information provided, this office has determined that the work is authorized by the **Department of the Army Nationwide Permit (NWP) 29, Residential Developments**, found in the January 6, 2017, Federal Register. Enclosed is a fact sheet, which fully describes this Nationwide Permit and lists the General Conditions, and Colorado Regional Conditions, which must be adhered to for this authorization to remain valid. In addition, the following Special Conditions must be followed:

1. In order for this Nationwide Permit verification to be valid, 0.1657 acre of wetland shall be restored where impacted.
2. The created wetlands will be considered successful and self-sustaining when the following conditions have been met without intervention in the form of irrigation, removal of undesirable vegetation or replanting of desirable vegetation for a period of two consecutive years, as determined by the Corps of Engineers:
    a) At least 80 % (determined by ocular estimate of herbaceous and shrub foliar cover) of the mitigation site is vegetated, with at least 50% of the total number of dominant species present will consist of species rated as facultative or wetter.
    b) Those species shown on the Colorado Noxious Weed Inventory list-A shall be 100% eradicated. Those species shown on list-B shall be no more than 5% or less of the total cover in the mitigation area. The lists can be found at http://www.colorado.gov/cs/Satellite/ag_Conservation/CBON/1251618874438

3. A mitigation monitoring report documenting growing season conditions shall be sent to the Denver Regulatory Office prior to December 31st of each year, for a period of at least three years, or until the Corps of Engineers determines that the 0.1657 acre of wetlands has successfully developed.

4. Annual reports shall be formatted per the attached Annual Mitigation Monitoring Report Formatting Requirements. If the authorized work has not yet started, please state so in the annual mitigation monitoring report.

Although an Individual Department of the Army permit will not be required for this work, this does not eliminate the requirement that any other applicable federal, state, tribal or local permits be obtained as required. Please be advised that deviations from the original plans and specifications of this project could require additional authorization from this office.

The applicant is responsible for all work accomplished in accordance with the terms and conditions of the nationwide permit. If a contractor or other authorized representative will be accomplishing the work authorized by the nationwide permit on behalf of the applicant, it is strongly recommended that they be provided a copy of this letter and the enclosed conditions so that they are aware of the limitations of the applicable nationwide permit. Any activity which fails to comply with all the terms and conditions of the nationwide permit will be considered unauthorized and subject to appropriate enforcement action.

This verification will be valid until March 18, 2022. In compliance with General Condition 30, the enclosed "Certification of Completed Work" form (blue) must be signed and returned to this office upon completion of the authorized work and any required mitigation.

If there are any questions please feel free to contact Angelle Greer at (303) 979-4120 or by e-mail at Angelle.V.Greer@usace.army.mil, and reference **Corps File No. NWO-2017-01897-DEN**.

Sincerely,

Aaron Eilers
Chief, Denver Regulatory Office

Enclosure(s)
Nationwide Permit 29, Residential Developments
Certification of Completed Work
Annual Mitigation Monitoring Report Format Requirements

Copies Furnished:
Esa Crumb, ERO Resources Corporation, 1842 Clarkson Street, Denver, CO/80218

Public Works - Stormwater Division
20120 E. Mainstreet
Parker, Colorado 80138
303.840.9546

PERMIT #: _____

DATE: 03.15.2021

FLOODPLAIN DEVELOPMENT PERMIT APPLICATION

Applicant Information

Owner: Larry Jacobson	Contractor: TBD
Address: 8390 E. Crescent Parkway, Suite 300	Address: TBD
c/o CliftonLarsonAllen LLP Greenwood Village, CO 80111	TBD
Phone: N/A	Phone: TBD
Contact Name: Rick Moore, Manhard Consulting LTD	Contact Name: TBD
Contact Phone and Email: 303.531.3500 rmoore@manhard.com	Contact Phone and Email: TBD

Project Information

Project Location/Directions:

Located at Happy Canyon Creek south of E-470 and west of Chambers Road

☒ Bridge/Culvert	☐ Utility Line	☐ Substantial Improvement >50%
☐ New Structure	☐ Structure Addition	☐ Manufactured (Mobile) Home
☒ Non-Residential	☒ Grading/Fill	☒ Channelization
☐ Levee	☒ Trail Construction	☒ Drainage Infrastructure Improvement

Project Description:

New bridge for Belford Ave. over Happy Canyon Creek, trail improvements and channel grade control structures.

Flood Hazard Data

Watercourse Name: Happy Canyon Creek

The proposed project is in the: ☒ Floodway ☒ Floodway Fringe

Flood Zone: ☐ A ☒ AE ☒ X (Shaded) ☐ Other (Specify) _____

Base Flood (1% Annual Chance Flood) Elevation at project site: 5576

Flood Insurance Rate Map Number: 08035C0062H & 08035C0066H Effective: September 9, 2020

*Attach a copy of FIRM with approximate limits of proposed project shown

Elevation required for lowest floor: N/A Floodproofing: N/A

Proposal Review Checklist

Yes/No	Site development plans are complete/attached and depict flood hazard data
If "No", Explain:	
Yes/No	Engineering data and analysis is attached (Signed/Sealed by a Professional Engineer)
If "No", Explain:	
Yes/No	Floodway Certificate and data documents no increase in base flood elevation
If "No", Explain: N/A - Approved CLOMR from FEMA attached	
Yes/No	Subdivision proposals minimize flood damage and protect utilities
If "No", Explain:	
Yes/No	Lowest floor elevations are two feet above the base (1% Annual Chance) flood level
If "No", Explain: N/A	
Yes/No	Manufactured homes address elevation and anchoring requirements
If "No", Explain: N/A	
Yes/No	Floodproofing certification by a registered Professional Engineer or Architect
If "No", Explain:	

Structure Information

See Attached	Elevation in relation to mean sea level of lowest floor (including basement)*
See Attached	Elevation in relation to mean sea level to which structure has been floodproofed*
*If more than one structure, attach list with respective elevations	

Applicant Signature

Property Owner Name: _____ Title: _____
Property Owner Signature (Required): _____ Date: _____
Owner's Designated Agent: Name:_____ Company:_____
Owner's Designated Agent Signature: _____ Date:_____
**Note: Applicant is responsible for obtaining all other applicable federal, state and local permits*

Permit Action

Recommendation for approval Designated Town Authority: _____ Date:_____	
	Permit Approved: The information submitted for the proposed project was reviewed and is in compliance with Town floodplain regulations.
	Permit Denied: The proposed project does not meet Town floodplain regulations
	Variance Granted: A variance was granted from the base (1% Annual Chance) flood elevations established by FEMA consistent with variance requirements fo NFIP regulations Part 60.6 (variance action documentation is attached)
Floodplain Administrator's Signature: _____ Date:_____	
Comments:_____	

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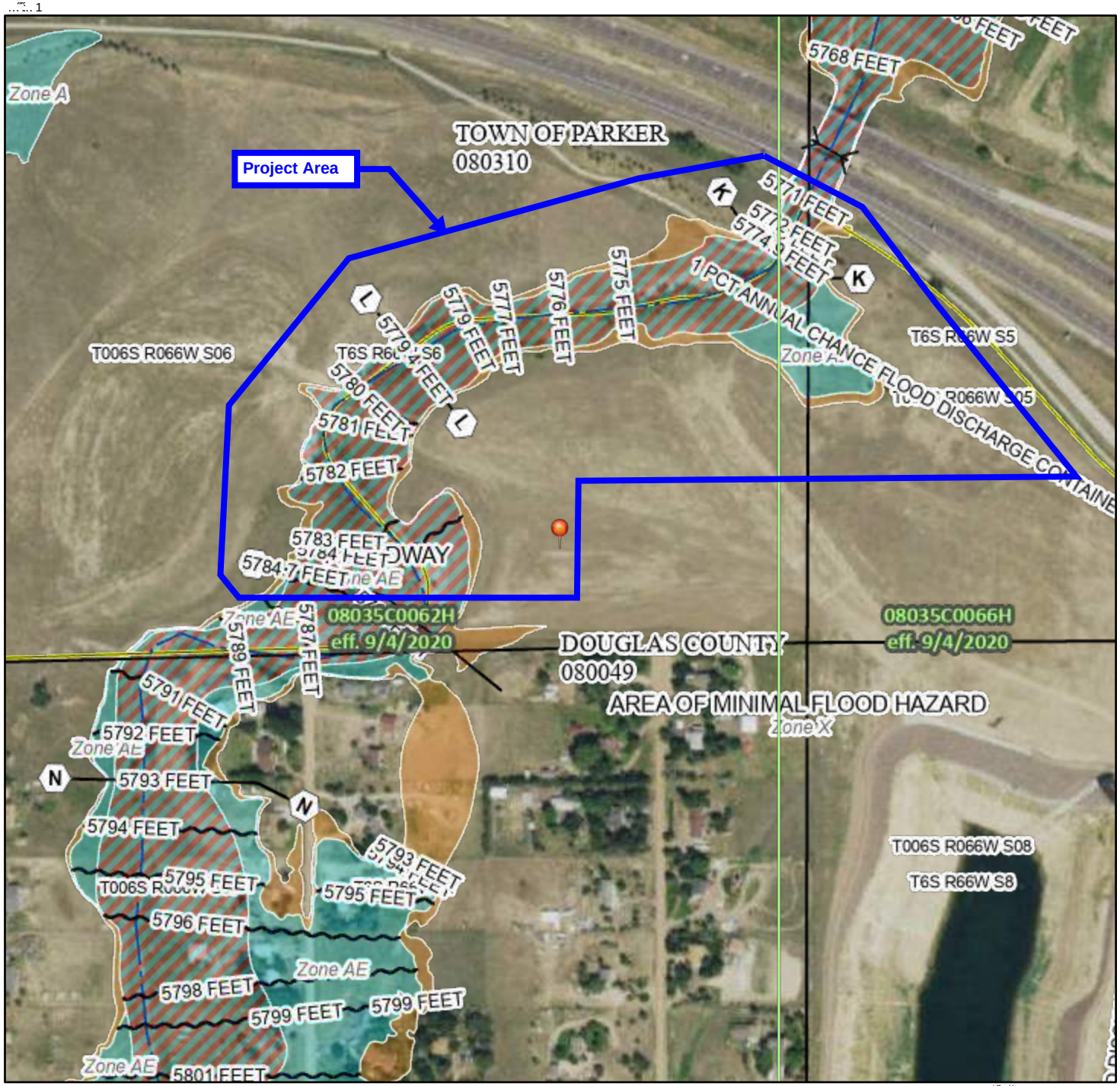
FEMA



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Federal Emergency Management Agency

Washington, D.C. 20472

November 20, 2019

CERTIFIED MAIL
RETURN RECEIPT REQUESTED

The Honorable Mike Waid
Mayor, Town of Parker
20120 East Main Street
Parker, CO 80138

IN REPLY REFER TO:
Case No.: 19-08-0690R
Community Name: Town of Parker, CO
Community No.: 080310

104

Dear Mayor Waid:

We are providing our comments with the enclosed Conditional Letter of Map Revision (CLOMR) on a proposed project within your community that, if constructed as proposed, could revise the effective Flood Insurance Study (FIS) report and Flood Insurance Rate Map for your community.

If you have any questions regarding the floodplain management regulations for your community, the National Flood Insurance Program (NFIP) in general, or technical questions regarding this CLOMR, please contact the Director, Mitigation Division of the Federal Emergency Management Agency (FEMA) Regional Office in Denver, at (303) 235-4830, or the FEMA Map Information eXchange (FMIX) toll free at 1-877-336-2627 (1-877-FEMA MAP). Additional information about the NFIP is available on our website at https://www.fema.gov/national-flood-insurance-program.

Sincerely,

Patrick "Rick" F. Sacbibit, P.E., Branch Chief
Engineering Services Branch
Federal Insurance and Mitigation Administration

Enclosure:
Conditional Letter of Map Revision Comment Document

cc: Mr. Tom Williams, P.E.
Director of Public Works/ Engineering
Town of Parker

Ms. Terri Fead, P.E.
Project Manager
Mile High Flood District

Mr. Kevin Houck, P.E., CFM
Chief, Watershed and Flood Protection Section
Colorado Water Conservation Board

Ms. Kendra Gabbert, P.E.
Felsburg Holt & Ullevig

Ms. Amie Drucker, P.E.
Project Manager
Manhard Consulting

Mr. Zachary Grady
Felsburg Holt & Ullevig

LEGEND

- FHAD FLOODWAY LIMITS
- 100 YR FHAD FLOODPLAIN LIMITS
- 100 YR PRE–PROJECT FLOODPLAIN LIMITS
- PRE–PROJECT FLOODWAY LIMITS
- 100 YR POST–PROJECT FLOODPLAIN LIMITS
- POST–PROJECT FLOODWAY LIMITS
- 500 YR FHAD FLOODPLAIN LIMITS
- 500 YR PRE–PROJECT FLOODPLAIN LIMITS
- 500 YR POST–PROJECT FLOODPLAIN LIMITS
- 100 YR FHAD BFE
- 100 YR POST–PROJECT BFE
- 12541 2014 FHAD CROSS–SECTION
- 12436 FHU ADDED CROSS–SECTION
- 11772 2014 FHAD CROSS–SECTION (TO BE REMOVED)
- EXISTING ROW
- EXISTING EASEMENT
- SURVEYED 1 FT CONTOURS (VERTICAL DATUM =NAVD 88)
- WETLANDS

PROPERTY OF
E470 PUBLIC HIGHWAY AUTHORITY
22470 E 6TH PKWY SUITE 100
AURORA, CO 80018–2425

PROPERTY OF
COTTONWOOD WATER & SANITATION DISTRICT
2 INVERNESS DR E SUITE 200
CENTENNIAL, CO 80112–5509

E–470

HAPPY CANYON TRAIL

DOWNSTREAM CROSS SECTION TIE–IN

PROPOSED BELFORD OVER HAPPY CANYON CREEK CROSSING

PROPERTY OF
PLATTE VALLEY COMMERCIAL GROUP
4900 MAIN STREET
KANSAS CITY, MO 64112–2630

PROPOSED DROP STRUCTURE NO. 1

HAPPY CANYON CREEK HCL

PROPERTY OF
COMPARK BUSINESS CAMPUS METRO DISTRICT
FKA E–470 BUSINESS METRO DISTRICT
8480 E ORCHARD RD SUITE 6200
GREENWOOD VILLAGE, CO 80111

PROPOSED DROP STRUCTURE NO. 2

CHEROKEE TRAIL CROSSING

CHEROKEE TRAIL

PROPERTY OF
COMPARK 190 LLC
4600 S ULSTER ST SUITE 1400
DENVER, CO 80237–2850

PROPERTY OF
470 COMPARK LLC
C/O MPV COMPARK MANAGEMENT LLC
DENVER, CO 80206

PROPOSED DROP STRUCTURE NO. 3

PROPERTY OF
COMPARK 190 LLC
4600 S ULSTER ST SUITE 1400
DENVER, CO 80237–2850

PROPOSED BELFORD AVE.

UPSTREAM CROSS SECTION TIE–IN

CHAMBERS ROAD

FLOW

HAPPY CANYON CREEK

N

HORIZONTAL SCALE: 1"=200'
0' 100' 200' 400'

TOPOGRAPHY SHOWN ON THE WORKMAP REPRESENTS SURVEYED 1 FOOT CONTOURS (NAVD 88) DATUM, COLORADO STATE PLANE, CENTRAL ZONE. THE SURVEY AND AERIAL PHOTOGRAPHY WAS DONE 11/2015. SECTIONS 10775, 10842, 11153, AND 11772 ARE TO BE REMOVED FOR POST–PROJECT CONDITIONS. THE 1 PERCENT ANNUAL–CHANCE FLOODPLAIN HAVE BEEN DELINEATED BASED ON THE SURVEYED 1 FOOT CONTOURS & (NAVD 88) DATUM.

I HEREBY AFFIRM THAT THIS DOCUMENT ENTITLED FLOODPLAIN MODIFICATION STUDY FOR HAPPY CANYON CREEK AT BELFORD AVE WAS PREPARED IN ACCORDANCE WITH APPLICABLE, VIABLE, AND PERTINENT TECHNICAL DATA AND CRITERIA FOR THE COLORADO WATER CONSERVATION BOARD, THE FEDERAL EMERGENCY AGENCY, AND DOUGLAS COUNTY, COLORADO. THE DOCUMENT, REPORT, AND ALL ATTACHMENTS SUBMITTED HEREWITH WERE PREPARED IN ACCORDANCE WITH A SYSTEM DESIGNED TO ASSURE THAT QUALIFIED PERSONNEL PROPERLY GATHERED AND EVALUATED THE NECESSARY INFORMATION AND ACCURATELY PREPARED THE DOCUMENT. ADDITIONALLY, I HEREBY CERTIFY THAT NO INSURABLE STRUCTURES ARE IMPACTED DUE TO THE REVISIONS DOCUMENTED IN THIS CLOMR REPORT.

KENDRA M. GABBERT, P.E. NO. 45344

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Print Date: 3/12/2021 1:52:02 PM
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Horizontal Scale: Vertical Scale:

FELSBURG HOLT & ULLEVIG
6400 South Fiddlers Green Circle, Suite 1500
Greenwood Village, CO 80111
Phone: 303.721.1440
www.FHUENG.com

R–X

Sheet Revisions

Date	Comments	Initials

Manhard CONSULTING LTD
8008 E. Arapahoe Court, Suite 110, Centennial, CO 80112 ph:303.708.0500 fx:303.708.0400 manhard.com
Civil Engineers • Surveyors • Water Resource Engineers • Water & Wastewater Engineers
Construction Managers • Environmental Scientists • Landscape Architects • Planners

As Constructed
No Revisions:
Revised:
Void:

BELFORD–HAPPY CANYON CREEK FLOODPLAIN WORK MAP (FOR FHAD)

Designer: CDT
Detailer: ZJG
Subset:
Structure Numbers:
Sheets: 1 of 1

Project No./Code

Sheet Number

LEGEND

- FHAD FLOODWAY LIMITS
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2 INVERNESS DR E SUITE 200
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E-470

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N

HORIZONTAL SCALE: 1"=100'
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FKA E-470 BUSINESS METRO DISTRICT
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C/O MPV COMPARK MANAGEMENT LLC
DENVER, CO 80206

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4600 S ULSTER ST SUITE 1400
DENVER, CO 80237-2850

PROPOSED BELFORD AVE.

UPSTREAM CROSS SECTION TIE-IN

CHAMBERS ROAD

FLOW

HAPPY CANYON CREEK

EXISTING TOPOGRAPHY SHOWN ON THE WORKMAPS FROM CROSS-SECTION 10111 TO CROSS-SECTION 12694 REPRESENTS SURVEYED 1 FOOT CONTOURS (NAVD 88). THE SURVEY AND AERIAL PHOTOGRAPHY WAS DONE 11/2015. SECTIONS 10775, 10842, 11153, AND 11772 ARE TO BE REMOVED FOR POST-PROJECT CONDITIONS.

I HEREBY AFFIRM THAT THIS DOCUMENT ENTITLED FLOODPLAIN MODIFICATION STUDY FOR HAPPY CANYON CREEK AT BELFORD AVE WAS PREPARED IN ACCORDANCE WITH APPLICABLE, VIABLE, AND PERTINENT TECHNICAL DATA AND CRITERIA FOR THE COLORADO WATER CONSERVATION BOARD, THE FEDERAL EMERGENCY AGENCY, AND DOUGLAS COUNTY, COLORADO. THIS DOCUMENT, REPORT, AND ALL ATTACHMENTS SUBMITTED HEREWITH WERE PREPARED IN ACCORDANCE WITH A SYSTEM DESIGNED TO ASSURE THAT QUALIFIED PERSONNEL PROPERLY GATHERED AND EVALUATED THE NECESSARY INFORMATION AND DATA REGARDING THE DOCUMENT. ADDITIONALLY, I HEREBY CERTIFY THAT NO INSURABLE STRUCTURES ARE IMPACTED DUE TO THE REVISIONS DOCUMENTED IN THIS CLOMR REPORT.

COLORADO 45344 REGISTERED PROFESSIONAL ENGINEER

45344

4/23/19

KENDRA M. GABBERT, P.E. #45344

Print Date: 4/19/2019 9:21:25 AM	(R-X)	Sheet Revisions			As Constructed
File Name: H115360-01FP-01 (FHAD).dwg		Date	Comments	Initials	No Revisions:
Horizontal Scale: Vertical Scale:					Revised:
FELSBURG HOLT & ULLEVIG 6300 South Syracuse Way, Suite 600 Centennial, CO 80111 tel 303.721.1440 fax 303.721.0832					Void:

Manhard CONSULTING LTD
8008 E. Arapahoe Court, Suite 110, Centennial, CO 80112 ph:303.708.0500 fx:303.708.0400 manhard.com
Civil Engineers • Surveyors • Water Resource Engineers • Water & Wastewater Engineers
Construction Managers • Environmental Scientists • Landscape Architects • Planners

BELFORD AVE. / HAPPY CANYON CREEK FLOODPLAIN WORK MAP

Designer:	CDT	Structure Numbers	
Detailer:	ZJG		
Subset:		Sheets:	1 of 1

Project No./Code

Sheet Number

I:\115360-01 - Compark at Belford\CADD\Hydraulics\Drawings_Zach.Grady