

Appendix I Modelling of Culvert Blockage Scenarios

A) 50% blockage scenario

HEC-RAS Plan: plan10 River: Cat Ditch Reach: 1

Reach	River Sta	Profile	Q Total (m3/s)	Min Ch El (m)	W.S. Elev (m)	Crit W.S. (m)	E.G. Elev (m)	E.G. Slope (m/m)	Vel Chnl (m/s)	Flow Area (m2)	Top Width (m)	Froude # Chl
1	21	1 in 1 Yr	0.25	54.09	54.60		54.60	0.003066	0.39	0.65	2.11	0.22
1	21	1 in 2 Yr	0.26	54.09	54.61		54.61	0.003077	0.39	0.66	2.13	0.22
1	21	1 in 100 Yr + CC	1.25	54.09	55.09		55.11	0.003462	0.61	2.04	3.56	0.26
1	20	1 in 1 Yr	0.25	54.08	54.54		54.55	0.005870	0.51	0.49	1.69	0.30
1	20	1 in 2 Yr	0.26	54.08	54.55		54.56	0.005878	0.51	0.51	1.71	0.30
1	20	1 in 100 Yr + CC	1.25	54.08	55.01		55.04	0.006688	0.80	1.57	2.90	0.35
1	19	1 in 1 Yr	0.25	53.97	54.45		54.46	0.005800	0.50	0.50	1.74	0.30
1	19	1 in 2 Yr	0.26	53.97	54.46		54.47	0.005819	0.51	0.51	1.76	0.30
1	19	1 in 100 Yr + CC	1.25	53.97	54.91		54.94	0.006614	0.78	1.60	3.11	0.35
1	18	1 in 1 Yr	0.25	53.80	54.21		54.23	0.010191	0.62	0.40	1.57	0.39
1	18	1 in 2 Yr	0.26	53.80	54.22		54.24	0.010149	0.62	0.42	1.59	0.39
1	18	1 in 100 Yr + CC	1.25	53.80	54.67		54.71	0.009140	0.90	1.39	2.72	0.40
1	17	1 in 1 Yr	0.25	53.55	53.99		54.01	0.006191	0.51	0.49	1.71	0.31
1	17	1 in 2 Yr	0.26	53.55	54.00		54.02	0.006207	0.52	0.50	1.73	0.31
1	17	1 in 100 Yr + CC	1.25	53.55	54.45		54.48	0.007052	0.80	1.77	14.46	0.36
1	16	1 in 1 Yr	0.25	53.31	53.72		53.73	0.008587	0.58	0.43	1.63	0.36
1	16	1 in 2 Yr	0.26	53.31	53.73		53.74	0.008557	0.59	0.44	1.65	0.36
1	16	1 in 100 Yr + CC	1.25	53.31	54.16		54.19	0.008043	0.78	1.87	9.35	0.38
1	15	1 in 1 Yr	0.25	52.92	53.33		53.36	0.011498	0.66	0.38	1.44	0.41
1	15	1 in 2 Yr	0.26	52.92	53.34		53.36	0.011570	0.66	0.39	1.46	0.41
1	15	1 in 100 Yr + CC	1.25	52.92	53.75		53.80	0.013034	1.00	1.25	2.80	0.48
1	14	1 in 1 Yr	0.25	52.65	52.99		53.02	0.016981	0.74	0.34	1.54	0.50
1	14	1 in 2 Yr	0.26	52.65	53.00		53.02	0.016867	0.74	0.35	1.56	0.50
1	14	1 in 100 Yr + CC	1.25	52.65	53.37		53.44	0.017141	1.15	1.09	2.36	0.54
1	13	1 in 1 Yr	0.25	51.92	52.24		52.28	0.026785	0.89	0.28	1.27	0.61
1	13	1 in 2 Yr	0.26	51.92	52.25		52.29	0.027067	0.91	0.29	1.28	0.61
1	13	1 in 100 Yr + CC	1.25	51.92	52.63		52.72	0.025618	1.33	0.94	2.13	0.64
1	12	1 in 1 Yr	0.25	51.28	51.70		51.72	0.010540	0.63	0.40	1.50	0.39
1	12	1 in 2 Yr	0.26	51.28	51.71		51.73	0.010384	0.64	0.41	1.52	0.39
1	12	1 in 100 Yr + CC	1.25	51.28	52.22		52.25	0.007536	0.84	1.49	2.75	0.36
1	11	1 in 1 Yr	0.25	50.95	51.60		51.60	0.001339	0.29	0.86	2.22	0.15
1	11	1 in 2 Yr	0.26	50.95	51.61		51.61	0.001379	0.30	0.88	2.24	0.15
1	11	1 in 100 Yr + CC	1.25	50.95	52.07		52.09	0.002709	0.56	2.22	3.52	0.23
1	10	1 in 1 Yr	0.25	50.55	51.59		51.59	0.000185	0.14	1.79	2.96	0.06
1	10	1 in 2 Yr	0.26	50.55	51.59		51.59	0.000195	0.14	1.81	2.98	0.06
1	10	1 in 100 Yr + CC	1.25	50.55	52.02		52.03	0.000920	0.38	3.29	4.00	0.13
1	9	1 in 1 Yr	0.25	50.44	51.58	50.68	51.58	0.000073	0.10	2.52	3.54	0.04
1	9	1 in 2 Yr	0.26	50.44	51.59	50.69	51.59	0.000077	0.10	2.54	3.55	0.04
1	9	1 in 100 Yr + CC	1.25	50.44	52.00	50.96	52.00	0.000472	0.30	4.20	4.55	0.10
1	8.5		Culvert									
1	8	1 in 1 Yr	0.25	50.37	50.76		50.78	0.006330	0.52	0.48	1.72	0.31
1	8	1 in 2 Yr	0.26	50.37	50.77		50.79	0.006145	0.52	0.50	1.74	0.31
1	8	1 in 100 Yr + CC	1.25	50.37	51.18		51.22	0.008922	0.89	1.41	2.75	0.40
1	7	1 in 1 Yr	0.25	50.25	50.63		50.65	0.007583	0.54	0.47	1.88	0.34
1	7	1 in 2 Yr	0.26	50.25	50.64		50.66	0.007687	0.54	0.48	1.90	0.35
1	7	1 in 100 Yr + CC	1.25	50.25	51.02		51.06	0.008968	0.87	1.44	3.12	0.41
1	6	1 in 1 Yr	0.25	49.94	50.22		50.27	0.033459	0.95	0.26	1.35	0.69
1	6	1 in 2 Yr	0.26	49.94	50.23		50.28	0.032209	0.95	0.27	1.37	0.67
1	6	1 in 100 Yr + CC	1.25	49.94	50.68		50.74	0.015578	1.09	1.15	2.52	0.52
1	5	1 in 1 Yr	0.25	49.54	49.94		49.95	0.005748	0.51	0.49	1.59	0.29
1	5	1 in 2 Yr	0.26	49.54	49.94		49.96	0.005897	0.52	0.50	1.60	0.29
1	5	1 in 100 Yr + CC	1.25	49.54	50.40		50.44	0.008515	0.89	1.41	2.44	0.37
1	4	1 in 1 Yr	0.25	49.26	49.54		49.57	0.026391	0.86	0.29	1.41	0.60
1	4	1 in 2 Yr	0.26	49.26	49.55		49.58	0.024471	0.85	0.31	1.43	0.58
1	4	1 in 100 Yr + CC	1.25	49.26	50.20		50.22	0.004676	0.68	1.83	3.33	0.29
1	3	1 in 1 Yr	0.25	48.95	49.51		49.52	0.000697	0.23	1.11	2.56	0.11
1	3	1 in 2 Yr	0.26	48.95	49.52		49.53	0.000704	0.23	1.13	2.58	0.11
1	3	1 in 100 Yr + CC	1.25	48.95	50.17		50.18	0.000902	0.37	3.37	4.43	0.14
1	2	1 in 1 Yr	0.25	48.90	49.48		49.48	0.001354	0.28	0.89	2.30	0.14
1	2	1 in 2 Yr	0.26	48.90	49.49		49.49	0.001359	0.28	0.92	2.32	0.14
1	2	1 in 100 Yr + CC	1.25	48.90	50.13		50.14	0.001264	0.39	3.20	5.08	0.16

HEC-RAS Plan: plan10 River: Cat Ditch Reach: 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
			(m3/s)	(m)	(m)	(m)	(m)	(m/m)	(m/s)	(m2)	(m)	
1	1	1 in 1 Yr	0.25	48.89	49.43	49.06	49.43	0.000871	0.24	1.04	2.66	0.12
1	1	1 in 2 Yr	0.26	48.89	49.44	49.06	49.44	0.000870	0.24	1.07	2.69	0.12
1	1	1 in 100 Yr + CC	1.25	48.89	50.08	49.30	50.09	0.000870	0.36	3.50	4.89	0.14

B) 90% blockage scenario

HEC-RAS Plan: plan011 River: Cat Ditch Reach: 1

Reach	River Sta	Profile	Q Total (m3/s)	Min Ch El (m)	W.S. Elev (m)	Crit W.S. (m)	E.G. Elev (m)	E.G. Slope (m/m)	Vel Chnl (m/s)	Flow Area (m2)	Top Width (m)	Froude # Chl
1	21	1 in 1 Yr	0.25	54.09	54.60		54.60	0.003109	0.39	0.64	2.10	0.22
1	21	1 in 2 Yr	0.26	54.09	54.60		54.61	0.003120	0.39	0.66	2.13	0.23
1	21	1 in 100 Yr + CC	1.25	54.09	55.09		55.11	0.003460	0.61	2.04	3.56	0.26
1	20	1 in 1 Yr	0.25	54.08	54.53		54.55	0.006018	0.51	0.49	1.69	0.30
1	20	1 in 2 Yr	0.26	54.08	54.54		54.56	0.006026	0.52	0.50	1.71	0.30
1	20	1 in 100 Yr + CC	1.25	54.08	55.01		55.05	0.006682	0.79	1.57	2.90	0.34
1	19	1 in 1 Yr	0.25	53.97	54.44		54.45	0.006258	0.51	0.49	1.72	0.31
1	19	1 in 2 Yr	0.26	53.97	54.45		54.46	0.006268	0.52	0.50	1.74	0.31
1	19	1 in 100 Yr + CC	1.25	53.97	54.91		54.94	0.006603	0.78	1.61	3.11	0.35
1	18	1 in 1 Yr	0.25	53.80	54.21		54.23	0.010225	0.62	0.40	1.57	0.39
1	18	1 in 2 Yr	0.26	53.80	54.22		54.24	0.010180	0.63	0.42	1.59	0.39
1	18	1 in 100 Yr + CC	1.25	53.80	54.67		54.71	0.009143	0.90	1.39	2.72	0.40
1	17	1 in 1 Yr	0.25	53.55	54.00		54.01	0.006055	0.51	0.49	1.72	0.30
1	17	1 in 2 Yr	0.26	53.55	54.00		54.02	0.006076	0.52	0.50	1.74	0.31
1	17	1 in 100 Yr + CC	1.25	53.55	54.45		54.48	0.007011	0.79	1.78	14.59	0.36
1	16	1 in 1 Yr	0.25	53.31	53.70		53.72	0.010034	0.61	0.41	1.60	0.39
1	16	1 in 2 Yr	0.26	53.31	53.71		53.73	0.009974	0.62	0.42	1.62	0.39
1	16	1 in 100 Yr + CC	1.25	53.31	54.16		54.19	0.008003	0.78	1.87	9.36	0.38
1	15	1 in 1 Yr	0.25	52.92	53.38		53.40	0.007322	0.55	0.45	1.56	0.33
1	15	1 in 2 Yr	0.26	52.92	53.39		53.40	0.007359	0.56	0.46	1.58	0.33
1	15	1 in 100 Yr + CC	1.25	52.92	53.76		53.81	0.012329	0.98	1.28	2.83	0.46
1	14	1 in 1 Yr	0.25	52.65	52.89	52.89	52.97	0.073541	1.24	0.20	1.27	1.00
1	14	1 in 2 Yr	0.26	52.65	52.89	52.89	52.98	0.073712	1.26	0.21	1.29	1.00
1	14	1 in 100 Yr + CC	1.25	52.65	53.36		53.43	0.018532	1.18	1.06	2.34	0.56
1	13	1 in 1 Yr	0.25	51.92	52.41		52.42	0.004982	0.48	0.52	1.63	0.27
1	13	1 in 2 Yr	0.26	51.92	52.42		52.43	0.004956	0.49	0.53	1.65	0.27
1	13	1 in 100 Yr + CC	1.25	51.92	52.66		52.74	0.021670	1.25	1.00	2.19	0.59
1	12	1 in 1 Yr	0.25	51.28	52.40		52.40	0.000132	0.12	2.04	3.23	0.05
1	12	1 in 2 Yr	0.26	51.28	52.41		52.41	0.000137	0.13	2.07	3.25	0.05
1	12	1 in 100 Yr + CC	1.25	51.28	52.55		52.56	0.001842	0.49	2.55	3.64	0.19
1	11	1 in 1 Yr	0.25	50.95	52.40		52.40	0.000032	0.07	3.54	4.51	0.03
1	11	1 in 2 Yr	0.26	50.95	52.41		52.41	0.000033	0.07	3.58	4.54	0.03
1	11	1 in 100 Yr + CC	1.25	50.95	52.52		52.52	0.000647	0.30	4.27	9.65	0.12
1	10	1 in 1 Yr	0.25	50.55	52.40		52.40	0.000016	0.05	5.53	20.12	0.02
1	10	1 in 2 Yr	0.26	50.55	52.41		52.41	0.000017	0.05	5.74	23.06	0.02
1	10	1 in 100 Yr + CC	1.25	50.55	52.51		52.51	0.000249	0.18	8.78	36.16	0.07
1	9	1 in 1 Yr	0.25	50.44	52.40	50.68	52.40	0.000008	0.04	6.59	14.25	0.01
1	9	1 in 2 Yr	0.26	50.44	52.41	50.69	52.41	0.000009	0.04	6.73	15.86	0.01
1	9	1 in 100 Yr + CC	1.25	50.44	52.50	50.96	52.50	0.000147	0.16	9.27	39.47	0.06
1	8.5		Culvert									
1	8	1 in 1 Yr	0.25	50.37	50.76		50.78	0.006330	0.52	0.48	1.72	0.31
1	8	1 in 2 Yr	0.26	50.37	50.77		50.79	0.006145	0.52	0.50	1.74	0.31
1	8	1 in 100 Yr + CC	1.25	50.37	51.18		51.22	0.008922	0.89	1.41	2.75	0.40
1	7	1 in 1 Yr	0.25	50.25	50.63		50.65	0.007583	0.54	0.47	1.88	0.34
1	7	1 in 2 Yr	0.26	50.25	50.64		50.66	0.007686	0.54	0.48	1.90	0.35
1	7	1 in 100 Yr + CC	1.25	50.25	51.02		51.06	0.008968	0.87	1.44	3.12	0.41
1	6	1 in 1 Yr	0.25	49.94	50.22		50.27	0.033459	0.95	0.26	1.35	0.69
1	6	1 in 2 Yr	0.26	49.94	50.23		50.28	0.032207	0.95	0.27	1.37	0.67
1	6	1 in 100 Yr + CC	1.25	49.94	50.68		50.74	0.015578	1.09	1.15	2.52	0.52
1	5	1 in 1 Yr	0.25	49.54	49.94		49.95	0.005748	0.51	0.49	1.59	0.29
1	5	1 in 2 Yr	0.26	49.54	49.94		49.96	0.005898	0.52	0.50	1.60	0.29
1	5	1 in 100 Yr + CC	1.25	49.54	50.40		50.44	0.008515	0.89	1.41	2.44	0.37
1	4	1 in 1 Yr	0.25	49.26	49.54		49.57	0.026391	0.86	0.29	1.41	0.60
1	4	1 in 2 Yr	0.26	49.26	49.55		49.58	0.024465	0.85	0.31	1.43	0.58
1	4	1 in 100 Yr + CC	1.25	49.26	50.20		50.22	0.004676	0.68	1.83	3.33	0.29
1	3	1 in 1 Yr	0.25	48.95	49.51		49.52	0.000697	0.23	1.11	2.56	0.11
1	3	1 in 2 Yr	0.26	48.95	49.52		49.53	0.000704	0.23	1.13	2.58	0.11
1	3	1 in 100 Yr + CC	1.25	48.95	50.17		50.18	0.000902	0.37	3.37	4.43	0.14
1	2	1 in 1 Yr	0.25	48.90	49.48		49.48	0.001354	0.28	0.89	2.30	0.14
1	2	1 in 2 Yr	0.26	48.90	49.49		49.49	0.001359	0.28	0.92	2.32	0.14
1	2	1 in 100 Yr + CC	1.25	48.90	50.13		50.14	0.001264	0.39	3.20	5.08	0.16

HEC-RAS Plan: plan011 River: Cat Ditch Reach: 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
			(m3/s)	(m)	(m)	(m)	(m)	(m/m)	(m/s)	(m2)	(m)	
1	1	1 in 1 Yr	0.25	48.89	49.43	49.06	49.43	0.000871	0.24	1.04	2.66	0.12
1	1	1 in 2 Yr	0.26	48.89	49.44	49.06	49.44	0.000870	0.24	1.07	2.69	0.12
1	1	1 in 100 Yr + CC	1.25	48.89	50.08	49.30	50.09	0.000870	0.36	3.50	4.89	0.14