

FLOODPLAIN ASSESSMENT

125 ARTHUR STREET WEST

**TOWN OF THE BLUE MOUNTAINS
GREY COUNTY**

PREPARED FOR:

THE BLUE MEADOWS INC.



PREPARED BY:

**C.F. CROZIER & ASSOCIATES INC.
1 FIRST STREET, SUITE 200
COLLINGWOOD, ON L9Y 1A1**

FEBRUARY 2022

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1.0 INTRODUCTION

CF Crozier & Associates (Crozier) was retained by The Blue Meadows Inc. to complete a Floodplain Analysis for a proposed residential and commercial development in the Town of The Blue Mountains.

The Subject Lands are legally described as part of Lots 40 to 47 on the Southwest side of Arthur Street; all of Lots 40 to 44 and part of Lots 46 to 49 on the Northeast side of Louisa Street; all of Park Lots 11 to 14 on the Southwest side of Louisa Street; part of Park Lots 11 to 12 and all of Park Lots 13 to 15 on the Northeast side of Alice Street; part of Louisa Street; part of Minto Street; and, part of Albert Street. The Subject Lands are bounded by Arthur Street West to the north, Lansdowne Street South to the east, Alice Street West to the south and Little Beaver Creek to the west. Refer to Figure 1 for the Site Location Plan.

The Subject Lands are approximately 5.21 ha in size and are designated as Hazard, Downtown Area and Community Living Area in the Town of The Blue Mountains Official Plan (June 2016). The site is zoned as Development (D) and Residential One (R1-1) in the Town of The Blue Mountains Zoning By-Law (2018). The proposed development will include approximately 3.75 ha of residential development, 1.11 ha of mixed commercial / residential development, and a 0.26 ha stormwater management block.

The purpose of this study is as follows:

- 1) Establish the Regulatory Floodline (100yr or Regional) on the Subject Lands; and,
- 2) Complete an Erosion Hazard Assessment to establish the stable top-of-slope for the Subject Lands.

2.0 SITE DESCRIPTION

The Subject Lands currently consist of open lots and two existing homes, one fronting onto Arthur Street and the other fronting onto Lansdowne Street. The Little Beaver Creek is located to the west of the Subject Lands and features moderate tree cover within the riparian corridor. The Creek traverses the site from south to north, entering and exiting the site via 6.10 m span by 3.5 m rise box culverts at Alice Street West and Arthur Street West, respectively. The waterway is generally straight and contained within a well-defined channel throughout the site.

On-site soils are classified as Brighton Sand, which is considered as Hydrologic Soil Group A (Ontario Soil Survey Complex, 2020).

3.0 STUDY AREA AND TOPOGRAPHIC DATA

The study area is defined as the Little Beaver Creek catchment contributing to the Arthur Street West culvert located at the northwest limit of the Subject Lands. The catchment extends from Foster Street to Arthur Street West and covers approximately 1,135 ha.

Due to the total size of this catchment area, topographic survey for the entire catchment was impractical. As such, aerial-based topographic data from the Ministry of Natural Resources and Forestry's (MNRF) Ontario Flow Assessment Tool (OFAT) was used and supplemented with topographic survey of the Subject Lands.

4.0 HYDROLOGIC MODELING

4.1 Watershed Drainage Conditions

The Little Beaver Creek watershed delineation was prepared utilizing the Ministry of Natural Resources OFAT database. Refer to Figure 2 for the Little Beaver Creek watershed delineation.

At the hydrologic point of interest located at the Arthur Street West culvert, Little Beaver Creek has a contributing area of 1,135 ha with the catchment originating approximately 8.9 km upstream of Subject Lands. Land use within the watershed is predominantly agricultural lands with scattered wooded areas, swamps and various roads and buildings. Downstream of the Subject Lands, Little Beaver Creek continues to flow in a northward direction and ultimately discharges into Georgian Bay.

4.2 Hydrologic Model

Hydrologic modeling was undertaken to establish 100 year and Regional (Timmins) Storm peak flow rates of the Little Beaver Creek and its tributaries using Visual OTTHYMO Version 6.1.

Soil types were obtained from the Ontario Soil Survey Complex and land uses were obtained from OFAT in order to determine the Curve Number (CN) values for the watershed. Time of concentration was calculated using the Bransby Williams method. Refer to Appendix A for the hydrologic parameter sheet. Table 1 provides the peak flow values for Little Beaver Creek.

Table 1: Little Beaver Creek Peak Flow Rates

Event	Peak Flow Rate (m ³ /s)
2 Year	9.22
5 Year	15.41
10 Year	19.92
25 Year	25.88
50 Year	30.49
100 Year	35.09
Regional	62.42

The peak flow rates presented in Table 1 are the flow rates used in the hydraulic model presented in Section 5.05.0.

5.0 EXISTING FLOODPLAIN MODELING

5.1 Hydraulic Model Setup

Floodplain analysis for the Subject Lands was performed using U.S. Army Corps' HEC-RAS hydraulic computer model, Version 5.0.6. The purpose of the analysis is to establish the existing Regulatory floodline across the study area based on topographic survey of the Subject Lands.

As previously stated, the Little Beaver Creek enters the site from the south via a box culvert at Alice Street West and flows in a northerly direction to the box culvert at Alfred Street West. The topographic survey was used to establish the culvert inverts, road profile and channel/riverbank elevations.

Thirteen (13) cross sections were extended across the Subject Lands with seven (7) additional cross sections located downstream. Geometric data for the cross sections was based on the topographic survey (Rudy Mak Surveying Ltd., 2020).

Based on observation during site reconnaissance, Manning's roughness values were selected at 0.04 for the main channel which reflects natural watercourse with some weeds and heavy brush on the banks; while the overbank areas were selected at 0.08 which reflects areas with light to medium brush and trees. A subcritical flow regime was modeled to conservatively estimate the hydraulic profile. The downstream boundary condition was set at normal depth with an energy slope of 0.001.

5.2 Results

The floodplain is characterized by an overall slope of 0.02% between the upstream and downstream limits within the Subject Lands. The slope of the main channel is approximately 0.6%. The relatively flat profile and wide floodplain immediately upstream of the Arthur Street culvert crossing is indicative of a floodplain dictated by backwater effects caused by the Arthur Street road deck at the northern limit of the Subject Lands.

Results from the existing condition hydraulic analysis of the Little Beaver Creek are presented in Table 2 and the extents of the Regional and 100 Year floodplains are shown on Figure 3. Refer to Appendix B for the detailed HEC-RAS outputs.

Table 2: Existing Conditions Regional Water Surface Elevations

Cross Section ID	Location	Regional Water Surface Elevation (m)
464	Subject Lands	192.89
457		192.89
436		192.90
397		192.88
367		192.88
336		192.88
303		192.86
269		192.86
240		192.86
193		192.84
167		192.83
134		192.82
129		192.74
104	Downstream of Subject Lands	192.00
100		192.01

6.0 EROSION HAZARD ASSESSMENT

The Little Beaver Creek is a confined system that also poses an erosion hazard. Following the methodology of "Understanding Natural Hazards" (MNR, 2001) the total erosion hazard, consisting of the toe erosion, stable slope and erosion access allowance were mapped and included in the overall constraint delineation.

Mapping has been completed based on site topographic data, and is considered an approximation of the erosion hazard lines. Please refer to Figure 3 illustrating each of the individual setbacks and allowances.

6.1 Toe Erosion Allowance

Due to the banks of the Little Beaver Creek experiencing heavy erosion as well as the soil composition being a majority of sand, the toe erosion allowance has been determined to be 15m in accordance with MNR technical guidelines.

6.2 Stable Slope Setback

As it can be seen on Figure 3, the stable slope allowance represents the distance from the toe of slope required to obtain the top of bank elevation at a 3:1 side slope. The toe of slope is determined from the greater of either a 15m toe erosion allowance, or the actual toe of slope.

6.3 Erosion Access Allowance

Given the areas of unstable slopes, the minimum erosion access allowance of 6m was provided in those specific areas to provide access for slope maintenance and rehabilitation. No further erosion access allowance was deemed necessary for slopes not exceeding 3:1.

7.0 CONCLUSIONS

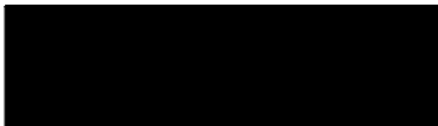
Based on the foregoing we conclude the following:

- The Little Beaver Creek is contained within it's valley during the Regulatory flood event.
- The Erosion Hazard limit is the constraining Natural Hazard for the eastern side of the Little Beaver Creek.
- The Development Limit on the west side of the Little Beaver Creek is determined by both the Floodplain and Erosion Hazard Limit.

Given the above noted conclusions, the proposed development as shown on the attached Concept Plan is supportable with respect to flood and erosion hazards.

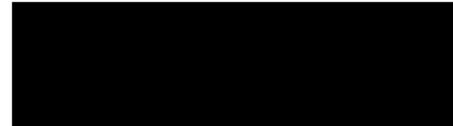
Respectfully submitted,

C.F. CROZIER & ASSOCIATES INC.



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APPENDIX A

Hydrologic Parameters



Project Name: 125 Arthur St. West
 Project Number: 598-5414
 Date: 2020-08-04
 By: Z. Holland
 Checked By: N. O'Connor

D.A. NAME
 D.A. AREA (ha) **1135**

Hydrologic Parameters: CALIB NASHYD Command
Pre Development Drainage Area: Catchment Pre Dev

Curve Number Calculation

Soil Types Present:				
Type	ID	Hydrologic Group	% Area	Area
Brighton Sand	BGH	A	27	306.5
Listowel Silt Loam	LTW	B	1	11.4
Vincent Silty Clay Loam	VCT	C	72	817.2
				0
Total Area				1135

Impervious Landuses Present:													
		Roadway		Sidewalk		Driveway		Building		SWMF		Subtotals	
Soils	Area (ha)	CN	Area	CN	Area	CN	Area (ha)	CN	Area	CN	Area	A*CN	
BGH	59.0	98		98		98		98		98	59.0	5779.325	
LTW	0.4	98		98		98		98		98	0.4	34.86	
VCT	10.8	98		98		98		98		98	10.8	1056.60	
0		98		98		98		98		98	0.0	0	
Subtotal Area	70.11		0		0		0		0				

Pervious Landuses Present:													
		Woodland		Meadow		Wetland		Lawn		Cultivated		Subtotals	
Soils	Area (ha)	CN	Area	CN	Area	CN	Area (ha)	CN	Area	CN	Area	A*CN	
BGH	0.00		0.00		38.72	50	0.00	49	208.76	62	247.48	14878.94	
LTW	0.00		0.00		0.00		0.00		10.99	74	10.99	813.58	
VCT	59.33	73	0.00		24.44	50	0.00		722.65	82	806.42	64810.38	
0	0.00		0.00		0.00		0.00		0.00		0.00	0.00	
Subtotal Area	59.33		0.00		63.16		0.00		942.40				

		Composite Area Calculations		Total Pervious Area		1064.89
				Total Impervious Area		70.11
				% Impervious		6.18%
				Composite Curve Number		77.0
				Total Area Check		1135.00

Initial Abstraction and Tp Calculations

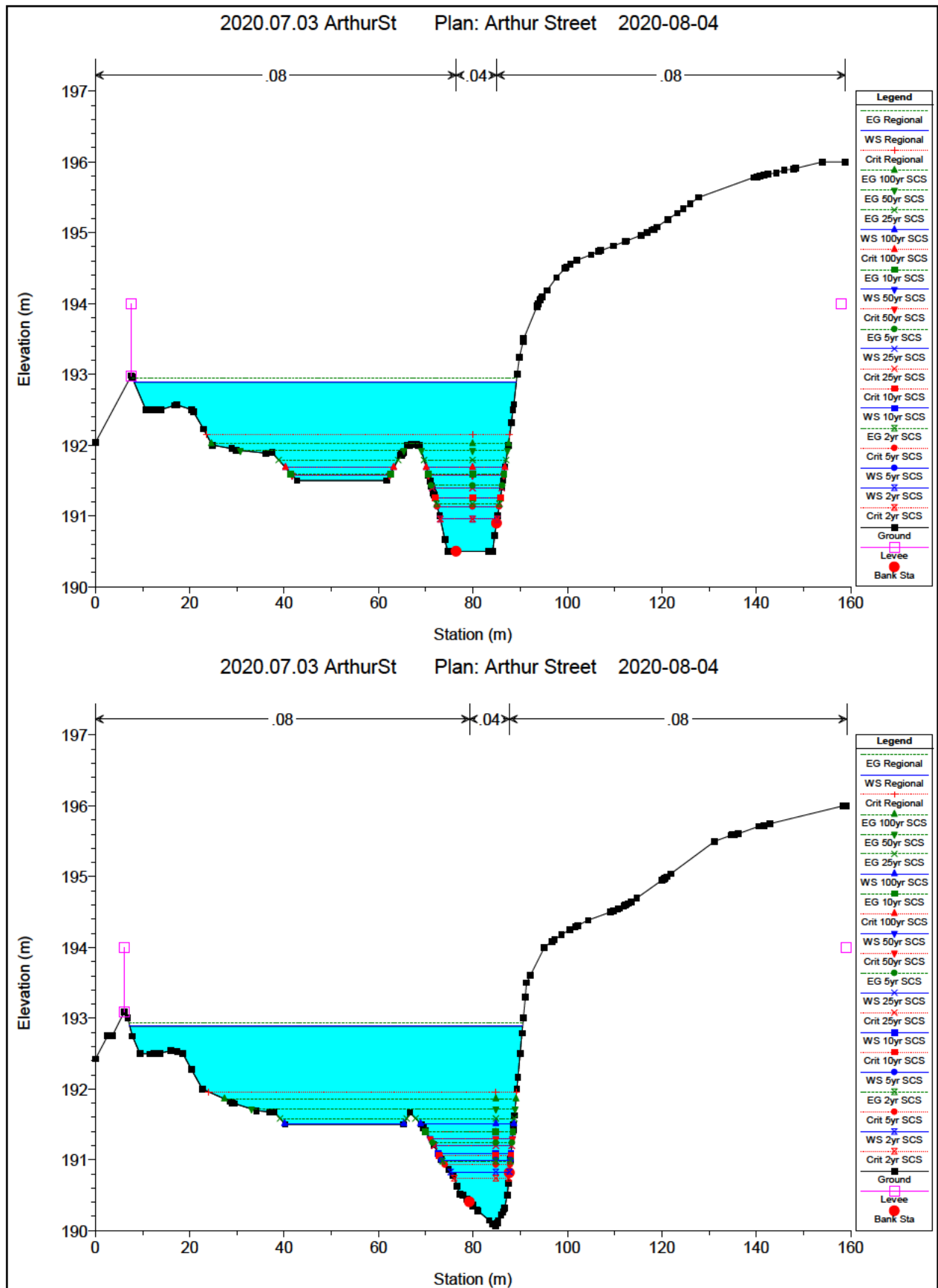
Initial Abstraction				Composite Runoff Coefficient							
Landuse	IA (mm)	Area (ha)	A * IA	Brighton Sand		Listowel Silt Loam		Vincent Silty		0	
				RC	Area	RC	Area	RC	Area	RC	Area
Woodland	10	59.331	593.312		0.00		0	0.42	59		0
Meadow	8	0	0		0		0		0		0
Wetland	16	63.157	1010.512	0.05	39		0	0.05	24		0
Lawn	5	0	0		0.00		0		0		0
Cultivated	7	942.4	6596.813	0.22	209	0.35	11	0.55	723		0
Impervious	2	70.11	140.22	0.81	58.97	0.81	0.4	0.81	11		0
Composite IA		1135	7.35	Composite Runoff Coefficient							

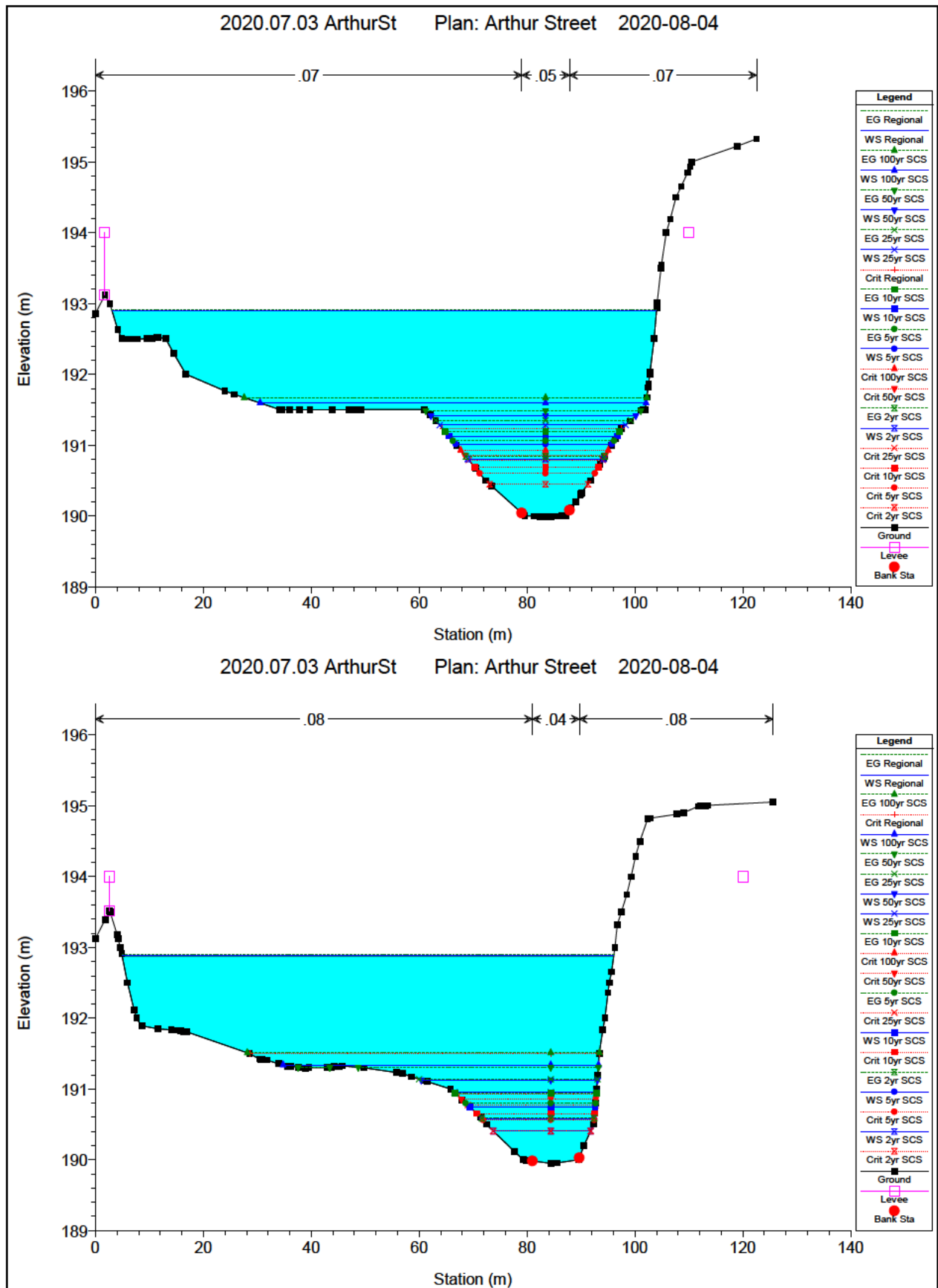
Time to Peak Inputs						Uplands			Bransby Williams		Airport	
Flow Path Description	Length (m)	Drop (m)	Slope (%)	V/S ^{0.5}	Velocity (m/s)	Tc (hr)	Tp (hr)	TOTAL Tp (hr)	Tc (hr)	Tp (hr)	Tc (hr)	Tp (hr)
Overland	100	44	44.00%	2.3	1.53	0.02	0.01	0.01	3.75	2.51	2.66	1.78
Channel	8938	124	1.39%	4.6	0.54	4.58	3.07	3.07				

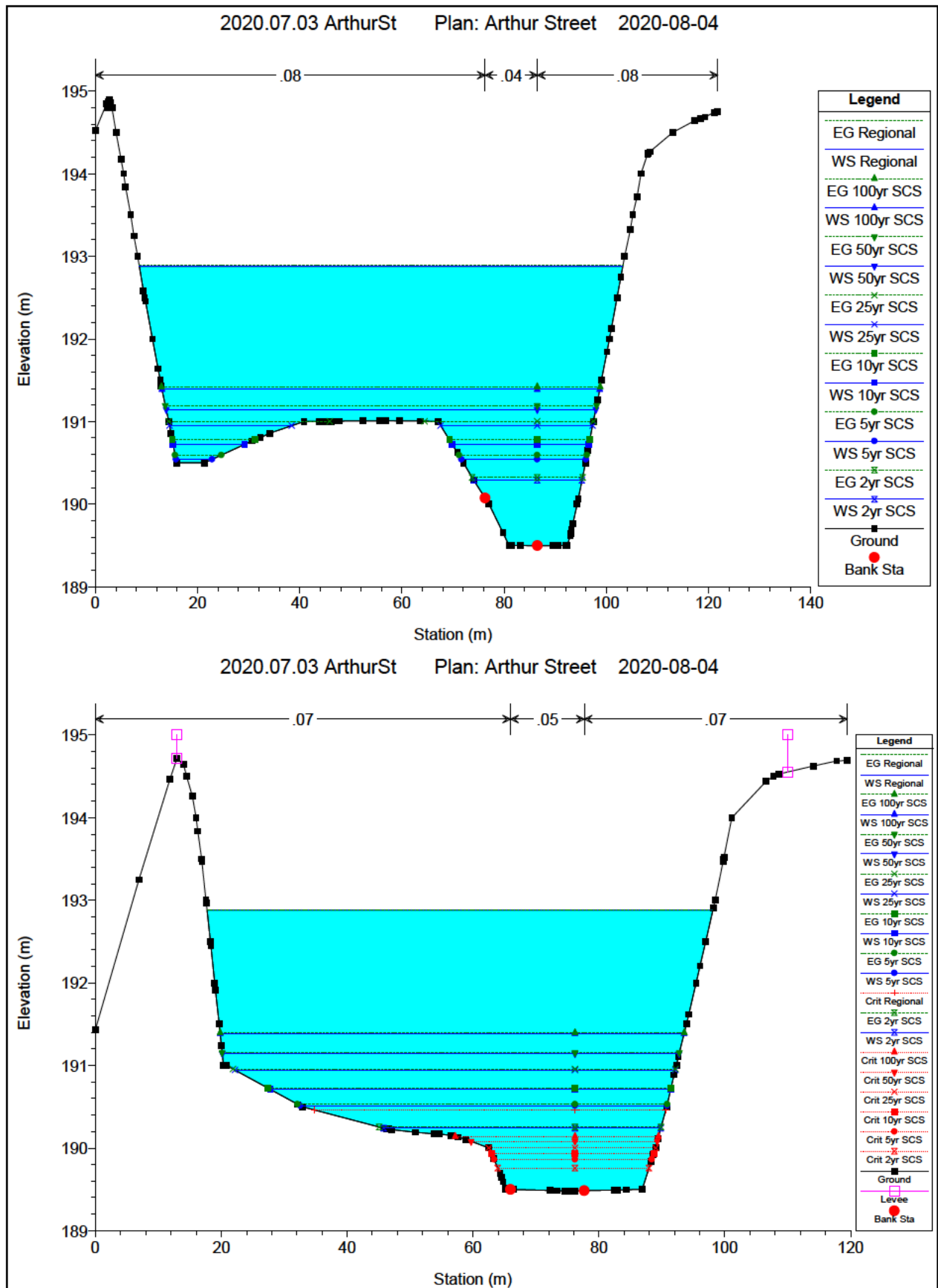
Appropriate calculated time to peak:						2.51	Appropriate Method:		Bransby			
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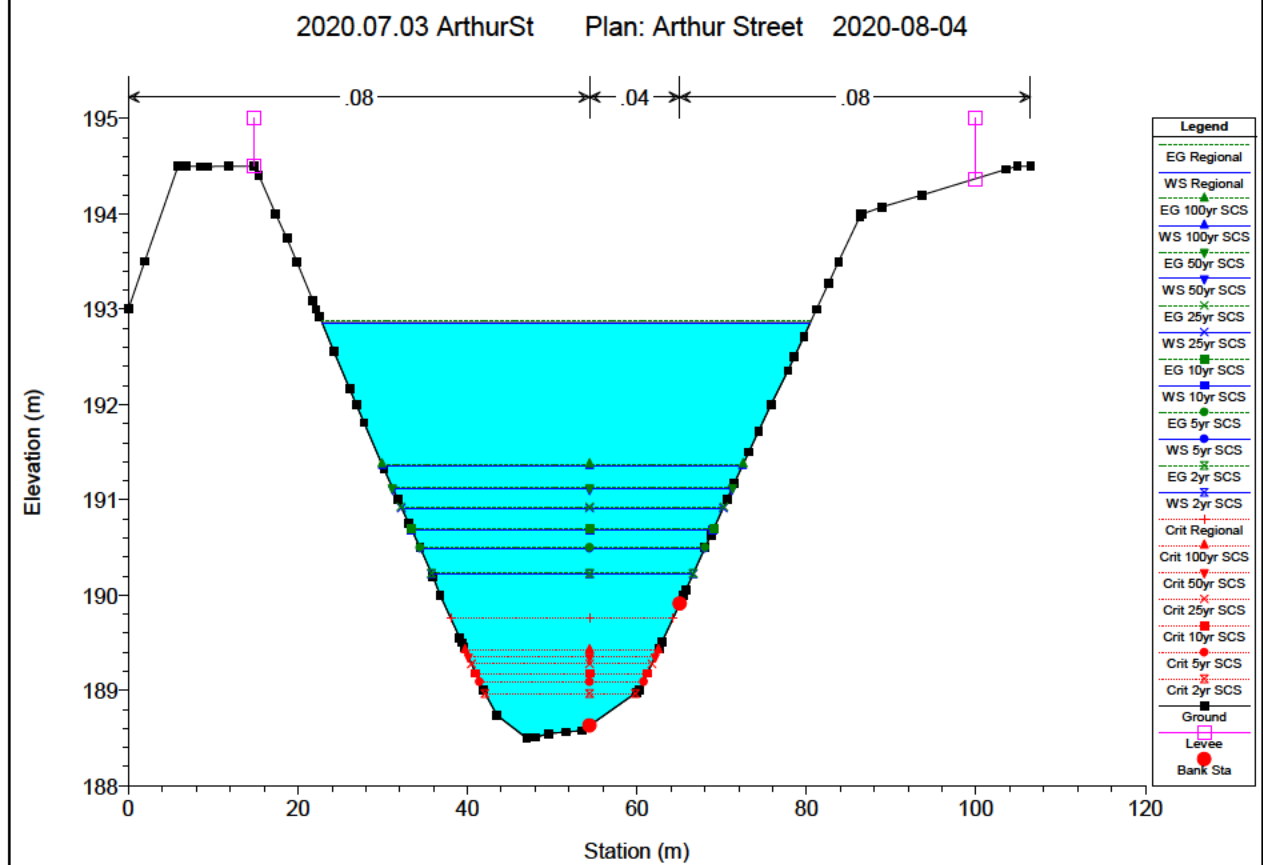
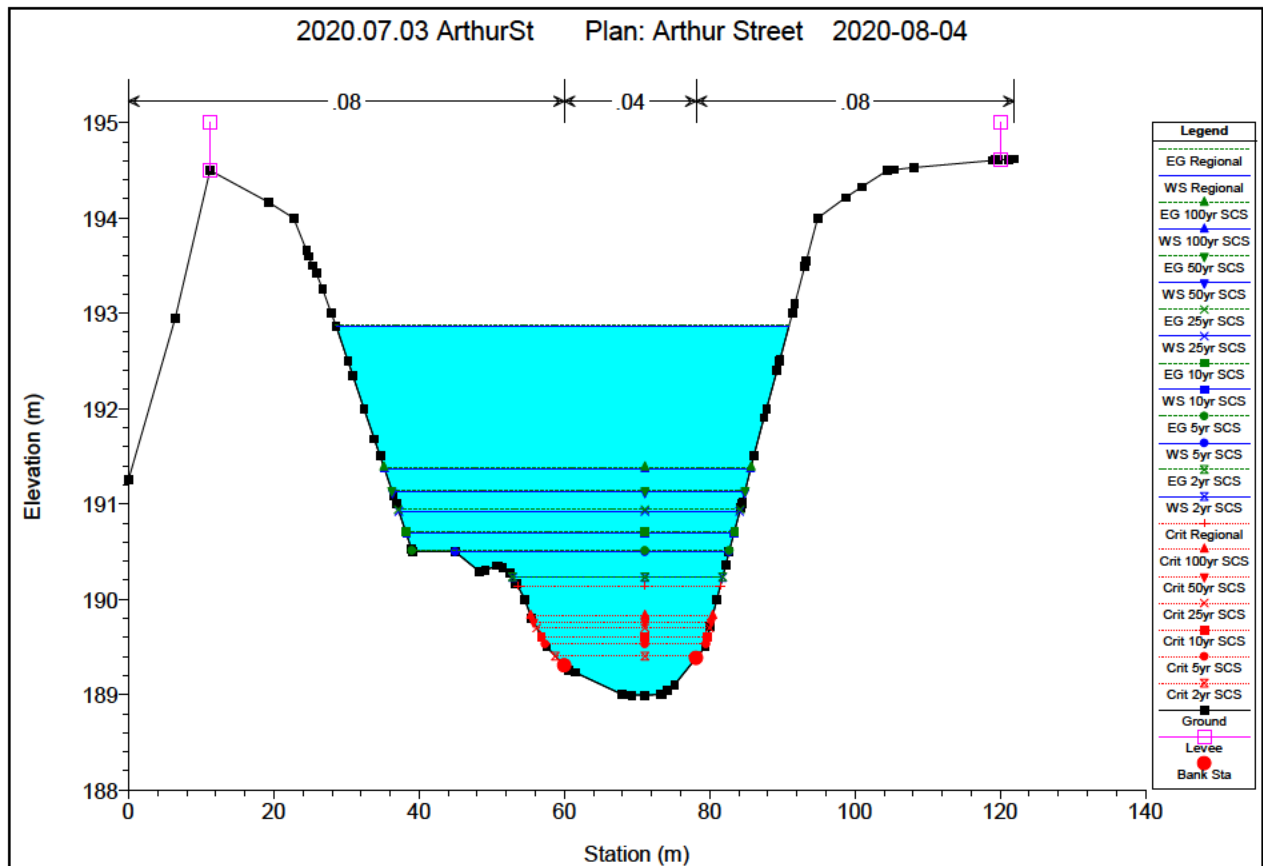
APPENDIX B

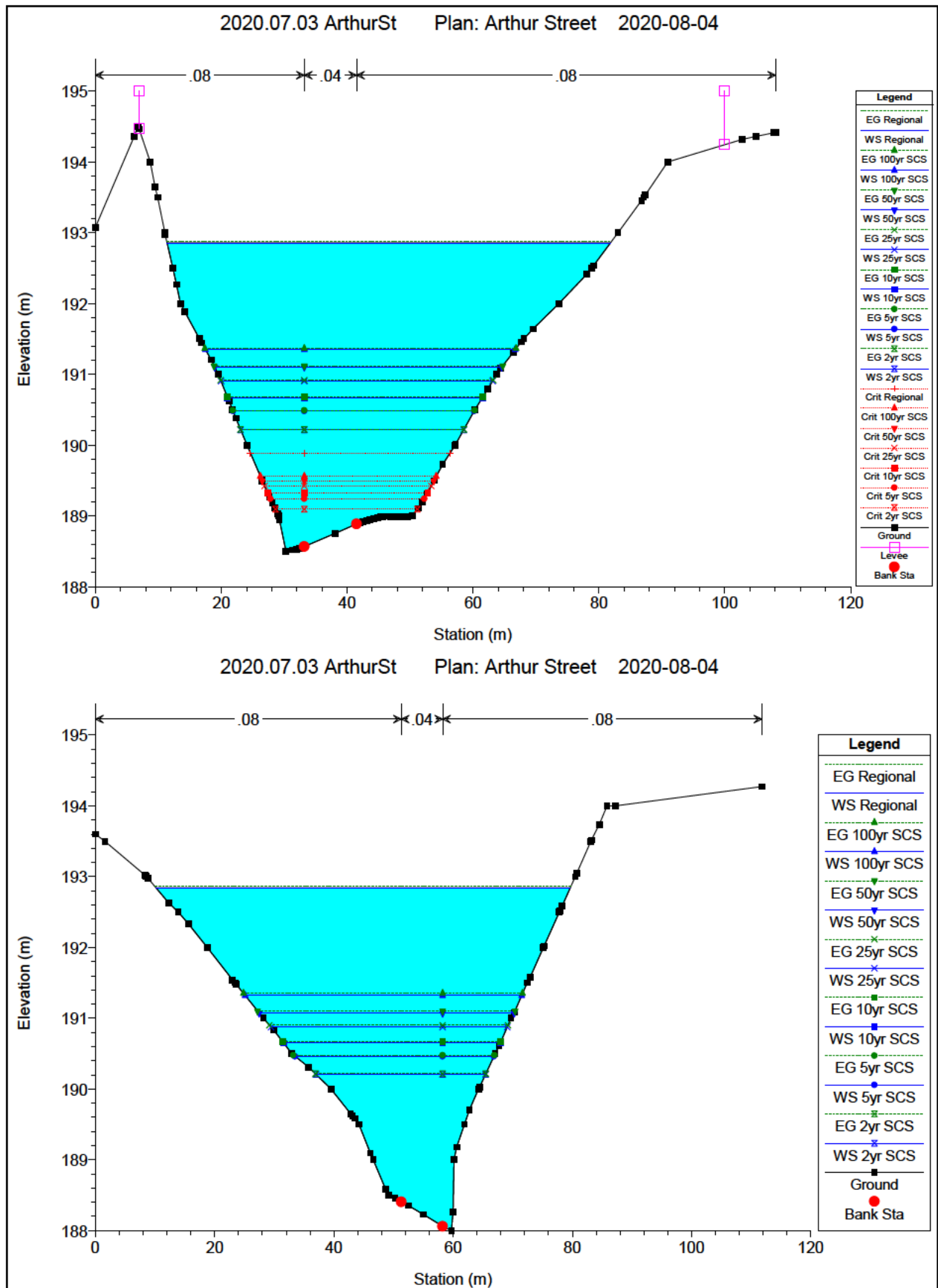
HEC-RAS Outputs

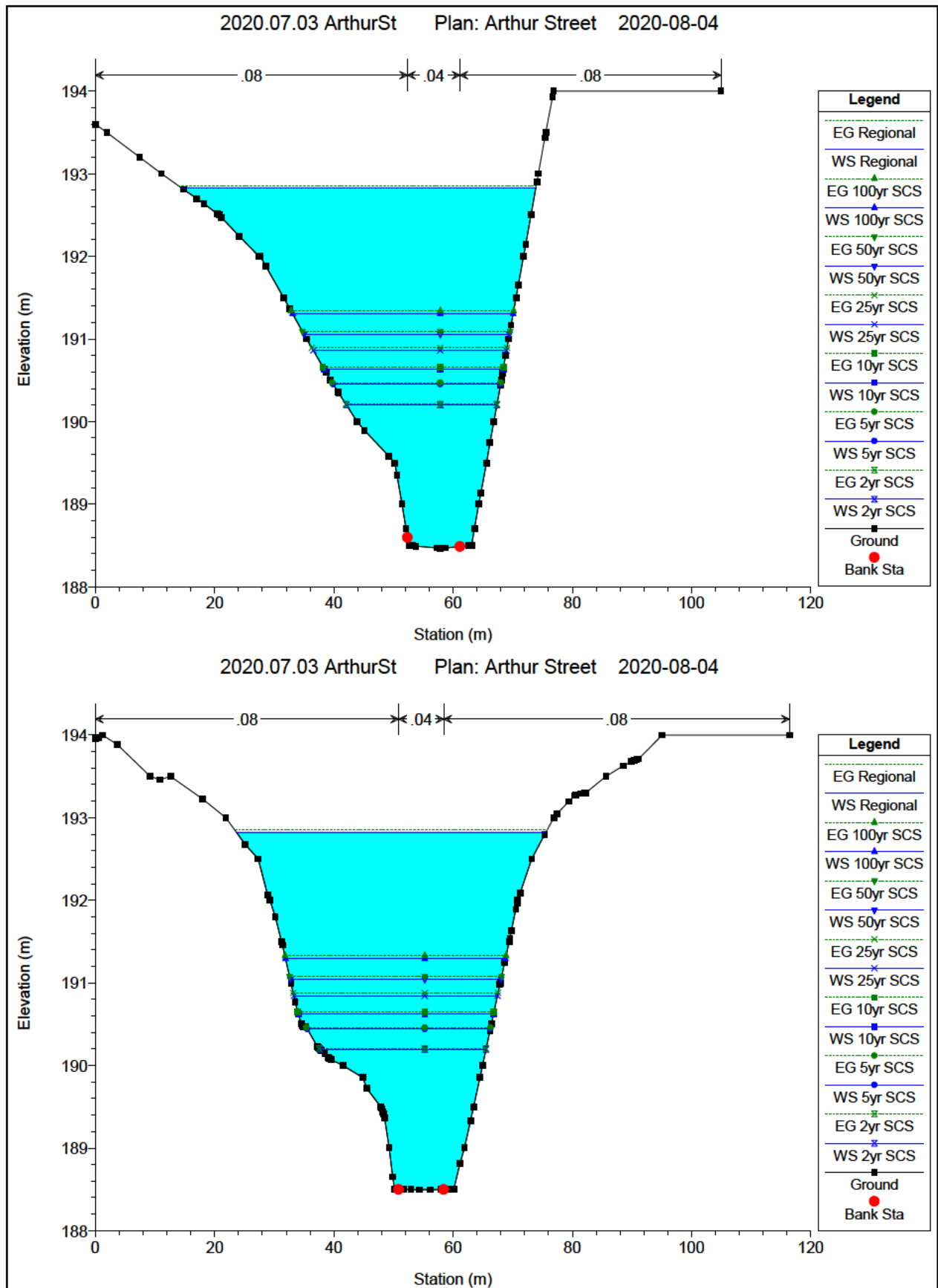


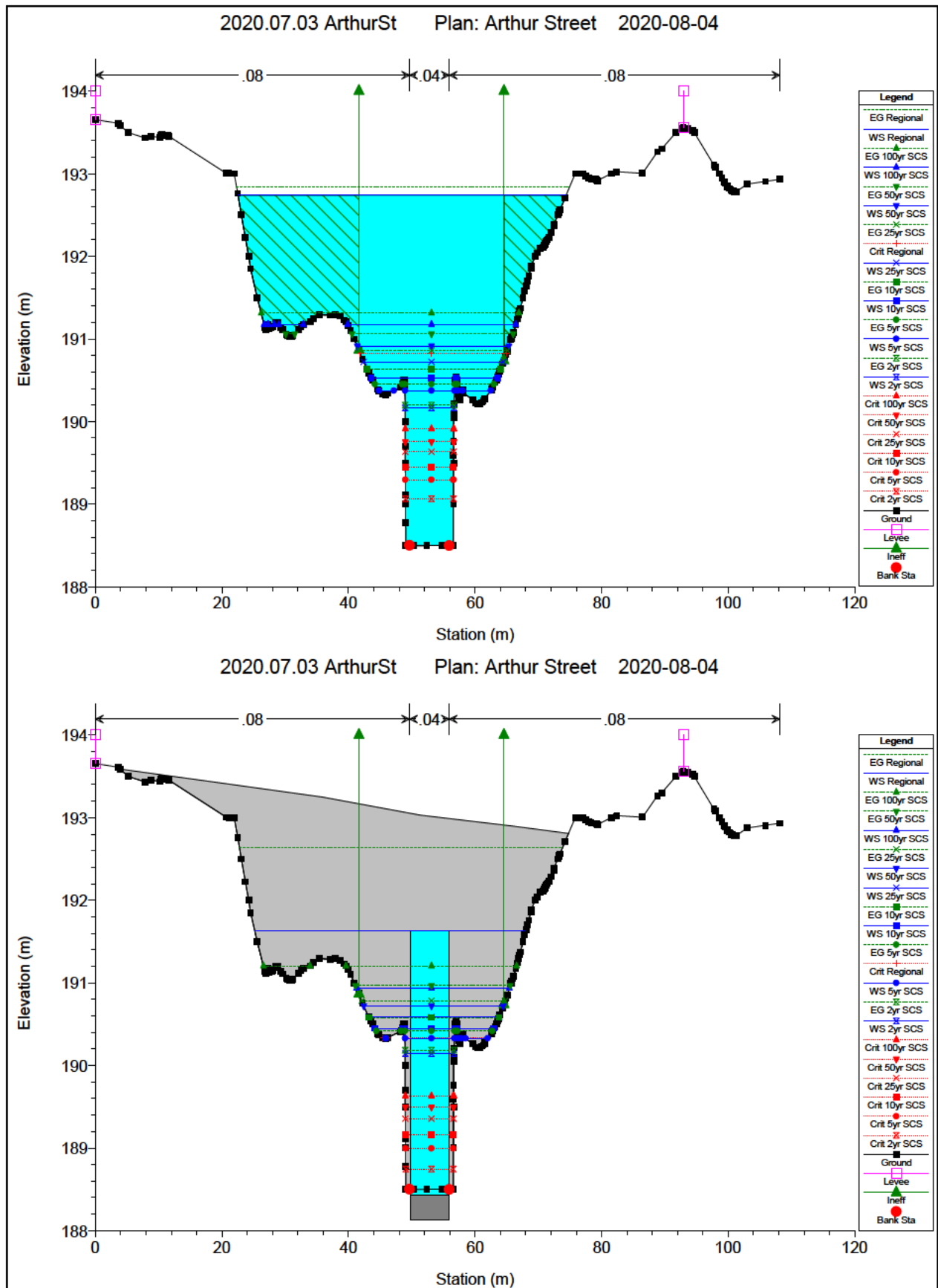


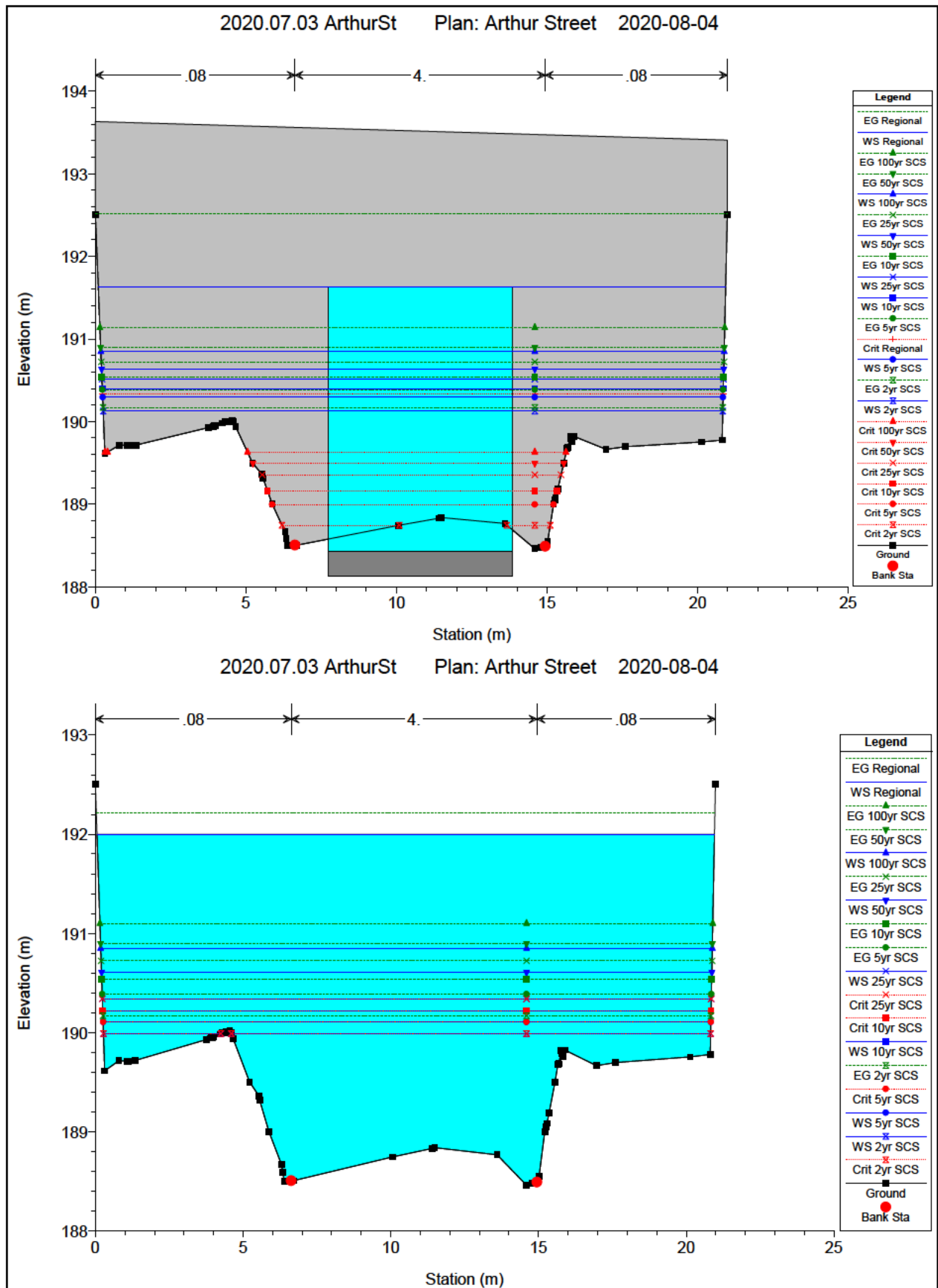


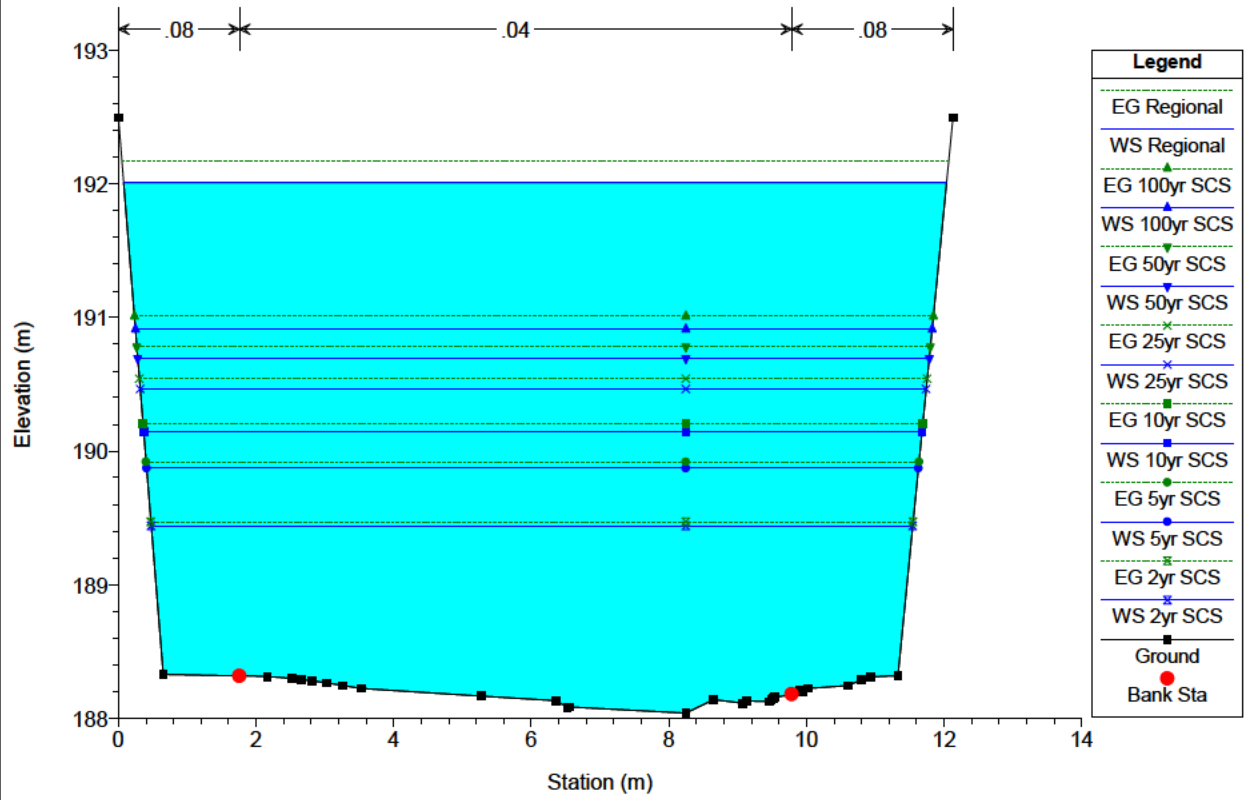












HEC-RAS Plan: 03 River: CREEK Reach: CREEK

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
CREEK	464	Regional	62.42	190.50	192.89	192.14	192.94	0 001092	1.46	97.14	80 96	0.30
CREEK	464	100yr SCS	35 09	190.50	191.68	191 68	192.02	0 010747	2.84	19.08	39 57	0.84
CREEK	464	50yr SCS	30.49	190.50	191.58	191 58	191.92	0 012065	2.83	15.07	36 59	0.88
CREEK	464	25yr SCS	25 88	190.50	191.39	191 39	191.79	0 017220	2.98	10.77	14.76	1.02
CREEK	464	10yr SCS	19 92	190.50	191.25	191 25	191.60	0 018653	2.75	8.76	13 84	1.03
CREEK	464	5yr SCS	15.41	190.50	191.14	191.14	191.43	0 020019	2.55	7.20	13.14	1.03
CREEK	464	2yr SCS	9 22	190.50	190.96	190 96	191.17	0 022992	2.17	4.93	12 07	1.05
CREEK	457	Regional	62.42	190.06	192.89	191 96	192.93	0 000747	1.29	110.99	83 23	0.25
CREEK	457	100yr SCS	35 09	190.06	191.51	191 39	191.86	0 009594	2.82	17.18	45 01	0.80
CREEK	457	50yr SCS	30.49	190.06	191.30	191 30	191.72	0 014140	3.03	13.02	17 51	0.95
CREEK	457	25yr SCS	25 88	190.06	191.20	191 20	191.58	0 014847	2.90	11.26	16.42	0.95
CREEK	457	10yr SCS	19 92	190.06	191.08	191 06	191.40	0 014100	2.59	9.43	15.41	0.91
CREEK	457	5yr SCS	15.41	190.06	191.00	190 93	191.24	0 012481	2.27	8.15	14 64	0.84
CREEK	457	2yr SCS	9 22	190.06	190.83	190.74	190.98	0 011119	1.80	5.84	12.43	0.76
CREEK	436	Regional	62.42	189.99	192.90	191 24	192.91	0 000323	0.73	158.49	100 92	0.14
CREEK	436	100yr SCS	35 09	189.99	191.59	190 93	191.67	0 003061	1.51	42.41	71 54	0.38
CREEK	436	50yr SCS	30.49	189.99	191.42	190 86	191.49	0 003191	1.43	32.63	37 99	0.38
CREEK	436	25yr SCS	25 88	189.99	191.28	190.79	191.35	0 003462	1.39	27.68	34.43	0.39
CREEK	436	10yr SCS	19 92	189.99	191.13	190 69	191.19	0 003417	1.27	22.71	31 21	0.38
CREEK	436	5yr SCS	15.41	189.99	191.01	190 60	191.06	0 003163	1.13	19.23	28 97	0.36
CREEK	436	2yr SCS	9 22	189.99	190.81	190.45	190.84	0 002845	0.92	13.60	25.14	0.33
CREEK	397	Regional	62.42	189.95	192.88	191 50	192.90	0 000309	0.90	158.16	91 14	0.17
CREEK	397	100yr SCS	35 09	189.95	191.34	190 93	191.51	0 004811	2.14	31.74	58.45	0.58
CREEK	397	50yr SCS	30.49	189.95	191.13	190 86	191.31	0 006168	2.16	23.32	32 67	0.64
CREEK	397	25yr SCS	25 88	189.95	190.95	190.77	191.14	0 007933	2.20	18.20	26 31	0.71
CREEK	397	10yr SCS	19 92	189.95	190.74	190 65	190.95	0 011507	2.26	13.00	23.19	0.82
CREEK	397	5yr SCS	15.41	189.95	190.57	190 56	190.80	0 017103	2.33	9.29	20.72	0.96
CREEK	397	2yr SCS	9 22	189.95	190.41	190.41	190.59	0 020385	2.05	5.99	18 04	0.99
CREEK	367	Regional	62.42	189.50	192.88		192.89	0 000140	0.65	205.95	94 64	0.11
CREEK	367	100yr SCS	35 09	189.50	191.39		191.42	0 000817	1.04	71.27	85 67	0.25
CREEK	367	50yr SCS	30.49	189.50	191.15		191.19	0 001316	1.19	50.74	84 07	0.31
CREEK	367	25yr SCS	25 88	189.50	190.95		191.00	0 001698	1.23	35.95	53 68	0.34
CREEK	367	10yr SCS	19 92	189.50	190.72		190.78	0 002089	1.21	25.36	40.79	0.37
CREEK	367	5yr SCS	15.41	189.50	190.54		190.59	0 002412	1.15	18.82	31.47	0.38
CREEK	367	2yr SCS	9 22	189.50	190.29		190.32	0 002589	0.95	12.75	21.16	0.38
CREEK	336	Regional	62.42	189.48	192.88	190.46	192.88	0 000103	0.46	208.88	80 35	0.08
CREEK	336	100yr SCS	35 09	189.48	191.38	190.14	191.39	0 000372	0.59	93.77	73.71	0.14
CREEK	336	50yr SCS	30.49	189.48	191.14	190 08	191.16	0 000518	0.64	76.14	72 58	0.16
CREEK	336	25yr SCS	25 88	189.48	190.94	190 00	190.96	0 000667	0.66	61.79	69 96	0.18
CREEK	336	10yr SCS	19 92	189.48	190.71	189 94	190.72	0 000853	0.67	46.12	63 60	0.19
CREEK	336	5yr SCS	15.41	189.48	190.51	189 86	190.53	0 001093	0.67	34.27	58 31	0.21
CREEK	336	2yr SCS	9 22	189.48	190.24	189.76	190.25	0 001398	0.62	20.17	44 04	0.23
CREEK	303	Regional	62.42	188.99	192.87	190.14	192.88	0 000109	0.63	160.28	62 32	0.10
CREEK	303	100yr SCS	35 09	188.99	191.36	189 83	191.38	0 000251	0.68	75.70	50 39	0.14
CREEK	303	50yr SCS	30.49	188.99	191.12	189.76	191.14	0 000297	0.69	63.71	48 51	0.15
CREEK	303	25yr SCS	25 88	188.99	190.92	189.70	190.94	0 000323	0.67	54.18	46 93	0.16
CREEK	303	10yr SCS	19 92	188.99	190.69	189 61	190.71	0 000328	0.61	43.47	45.10	0.16
CREEK	303	5yr SCS	15.41	188.99	190.50	189 53	190.51	0 000319	0.56	34.99	37.72	0.15
CREEK	303	2yr SCS	9 22	188.99	190.23	189.40	190.24	0 000242	0.42	25.90	28 89	0.13
CREEK	269	Regional	62.42	188.63	192.86	189.76	192.88	0 000154	0.75	152.99	57 62	0.12
CREEK	269	100yr SCS	35 09	188.63	191.36	189.42	191.37	0 000300	0.74	77.73	42.47	0.16
CREEK	269	50yr SCS	30.49	188.63	191.11	189 35	191.13	0 000332	0.72	67.71	39 99	0.16
CREEK	269	25yr SCS	25 88	188.63	190.91	189 28	190.93	0 000336	0.68	59.94	37 97	0.16
CREEK	269	10yr SCS	19 92	188.63	190.68	189.18	190.69	0 000308	0.59	51.42	35 58	0.15
CREEK	269	5yr SCS	15.41	188.63	190.49	189 09	190.50	0 000275	0.51	44.82	33 59	0.14
CREEK	269	2yr SCS	9 22	188.63	190.22	188 97	190.23	0 000187	0.37	36.19	30 86	0.11
CREEK	240	Regional	62.42	188.57	192.86	189 89	192.87	0 000137	0.75	177.95	70.43	0.12
CREEK	240	100yr SCS	35 09	188.57	191.35	189 56	191.36	0 000274	0.79	86.28	49 21	0.16
CREEK	240	50yr SCS	30.49	188.57	191.10	189.49	191.12	0 000300	0.77	74.71	45 63	0.16
CREEK	240	25yr SCS	25 88	188.57	190.90	189.42	190.92	0 000302	0.73	65.85	43.15	0.16
CREEK	240	10yr SCS	19 92	188.57	190.67	189 32	190.68	0 000274	0.64	56.19	40 51	0.15
CREEK	240	5yr SCS	15.41	188.57	190.48	189 24	190.49	0 000241	0.57	48.70	38 33	0.14
CREEK	240	2yr SCS	9 22	188.57	190.22	189 09	190.22	0 000160	0.41	38.93	35.45	0.11
CREEK	193	Regional	62.42	188.06	192.84		192.86	0 000166	0.89	162.70	69 50	0.13
CREEK	193	100yr SCS	35 09	188.06	191.32		191.35	0 000330	0.96	74.82	46 38	0.17
CREEK	193	50yr SCS	30.49	188.06	191.07		191.10	0 000360	0.95	63.84	42.76	0.18
CREEK	193	25yr SCS	25 88	188.06	190.87		190.90	0 000356	0.90	55.65	39 62	0.18

HEC-RAS Plan: 03 River: CREEK Reach: CREEK (Continued)

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
CREEK	193	10yr SCS	19.92	188.06	190.65		190.67	0.000312	0.79	47.03	36.34	0.16
CREEK	193	5yr SCS	15.41	188.06	190.46		190.48	0.000262	0.69	40.55	33.36	0.15
CREEK	193	2yr SCS	9.22	188.06	190.21		190.22	0.000152	0.48	32.66	28.44	0.11
CREEK	167	Regional	62.42	188.46	192.83		192.86	0.000207	0.96	132.70	59.42	0.15
CREEK	167	100yr SCS	35.09	188.46	191.30		191.34	0.000381	0.97	62.02	37.00	0.19
CREEK	167	50yr SCS	30.49	188.46	191.06		191.09	0.000416	0.96	53.21	34.47	0.19
CREEK	167	25yr SCS	25.88	188.46	190.86		190.89	0.000413	0.90	46.59	32.41	0.19
CREEK	167	10yr SCS	19.92	188.46	190.64		190.66	0.000362	0.79	39.59	30.07	0.17
CREEK	167	5yr SCS	15.41	188.46	190.45		190.47	0.000307	0.69	34.25	28.13	0.16
CREEK	167	2yr SCS	9.22	188.46	190.20		190.21	0.000186	0.49	27.52	25.23	0.12
CREEK	134	Regional	62.42	188.50	192.82		192.85	0.000226	1.00	128.81	51.87	0.15
CREEK	134	100yr SCS	35.09	188.50	191.29		191.33	0.000418	1.01	63.51	36.88	0.19
CREEK	134	50yr SCS	30.49	188.50	191.04		191.08	0.000467	1.01	54.54	35.37	0.20
CREEK	134	25yr SCS	25.88	188.50	190.84		190.88	0.000475	0.96	47.61	34.18	0.20
CREEK	134	10yr SCS	19.92	188.50	190.62		190.65	0.000430	0.86	40.13	32.72	0.19
CREEK	134	5yr SCS	15.41	188.50	190.44		190.46	0.000373	0.75	34.32	30.71	0.17
CREEK	134	2yr SCS	9.22	188.50	190.19		190.20	0.000233	0.54	27.07	27.81	0.13
CREEK	129	Regional	62.42	188.50	192.74	190.82	192.84	0.000623	1.63	67.82	51.86	0.25
CREEK	129	100yr SCS	35.09	188.50	191.17	189.91	191.31	0.001364	1.78	31.90	32.02	0.35
CREEK	129	50yr SCS	30.49	188.50	190.91	189.75	191.06	0.001596	1.80	25.97	23.95	0.37
CREEK	129	25yr SCS	25.88	188.50	190.72	189.63	190.86	0.001632	1.72	21.61	22.03	0.37
CREEK	129	10yr SCS	19.92	188.50	190.53	189.45	190.64	0.001402	1.50	17.49	19.77	0.34
CREEK	129	5yr SCS	15.41	188.50	190.37	189.30	190.45	0.001105	1.26	14.77	15.36	0.29
CREEK	129	2yr SCS	9.22	188.50	190.16	189.06	190.20	0.000590	0.85	12.61	7.73	0.21
CREEK	116.5	Culvert										
CREEK	104	Regional	62.42	188.46	192.00		192.21	0.014632	0.07	56.76	20.90	0.01
CREEK	104	100yr SCS	35.09	188.46	190.85		191.10	0.035946	0.08	32.82	20.70	0.02
CREEK	104	50yr SCS	30.49	188.46	190.61		190.90	0.054082	0.09	27.85	20.66	0.02
CREEK	104	25yr SCS	25.88	188.46	190.34	190.34	190.72	0.107142	0.11	22.30	20.62	0.03
CREEK	104	10yr SCS	19.92	188.46	190.21	190.21	190.54	0.116175	0.11	19.74	20.59	0.03
CREEK	104	5yr SCS	15.41	188.46	190.11	190.11	190.39	0.131591	0.11	17.52	20.57	0.03
CREEK	104	2yr SCS	9.22	188.46	189.99	189.99	190.17	0.088322	0.09	15.10	20.20	0.02
CREEK	100	Regional	62.42	188.04	192.01		192.17	0.000910	1.85	43.18	11.96	0.30
CREEK	100	100yr SCS	35.09	188.04	190.91		191.01	0.000878	1.45	30.21	11.58	0.28
CREEK	100	50yr SCS	30.49	188.04	190.70		190.78	0.000869	1.37	27.72	11.50	0.27
CREEK	100	25yr SCS	25.88	188.04	190.47		190.54	0.000858	1.27	25.08	11.42	0.27
CREEK	100	10yr SCS	19.92	188.04	190.14		190.20	0.000839	1.14	21.40	11.31	0.26
CREEK	100	5yr SCS	15.41	188.04	189.87		189.92	0.000818	1.02	18.34	11.22	0.25
CREEK	100	2yr SCS	9.22	188.04	189.44		189.47	0.000770	0.81	13.54	11.07	0.23
CREEK	5	Regional	62.42	188.04	191.91		192.08	0.000998	1.90	41.92	11.92	0.31
CREEK	5	100yr SCS	35.09	188.04	190.81		190.92	0.000995	1.50	29.03	11.54	0.30
CREEK	5	50yr SCS	30.49	188.04	190.59		190.69	0.000994	1.42	26.56	11.47	0.29
CREEK	5	25yr SCS	25.88	188.04	190.37		190.45	0.000994	1.33	23.94	11.39	0.29
CREEK	5	10yr SCS	19.92	188.04	190.04		190.11	0.000993	1.20	20.29	11.28	0.28
CREEK	5	5yr SCS	15.41	188.04	189.77		189.83	0.000992	1.08	17.26	11.18	0.27
CREEK	5	2yr SCS	9.22	188.04	189.35		189.38	0.000989	0.88	12.52	11.04	0.26
CREEK	4	Regional	62.42	188.04	191.91		192.08	0.000999	1.90	41.91	11.92	0.31
CREEK	4	100yr SCS	35.09	188.04	190.81		190.91	0.000996	1.51	29.02	11.54	0.30
CREEK	4	50yr SCS	30.49	188.04	190.59		190.69	0.000996	1.42	26.55	11.47	0.29
CREEK	4	25yr SCS	25.88	188.04	190.36		190.45	0.000996	1.33	23.93	11.39	0.29
CREEK	4	10yr SCS	19.92	188.04	190.04		190.11	0.000995	1.20	20.28	11.28	0.28
CREEK	4	5yr SCS	15.41	188.04	189.77		189.83	0.000994	1.08	17.25	11.18	0.27
CREEK	4	2yr SCS	9.22	188.04	189.35		189.38	0.000992	0.88	12.50	11.04	0.26
CREEK	3	Regional	62.42	188.04	191.91		192.08	0.001000	1.90	41.90	11.92	0.31
CREEK	3	100yr SCS	35.09	188.04	190.81		190.91	0.000998	1.51	29.01	11.54	0.30
CREEK	3	50yr SCS	30.49	188.04	190.59		190.69	0.000997	1.42	26.54	11.47	0.29
CREEK	3	25yr SCS	25.88	188.04	190.36		190.45	0.000997	1.33	23.91	11.39	0.29
CREEK	3	10yr SCS	19.92	188.04	190.04		190.11	0.000997	1.20	20.27	11.28	0.28
CREEK	3	5yr SCS	15.41	188.04	189.77		189.83	0.000997	1.08	17.24	11.18	0.27
CREEK	3	2yr SCS	9.22	188.04	189.34		189.38	0.000995	0.88	12.49	11.04	0.26
CREEK	2	Regional	62.42	188.04	191.90		192.07	0.001001	1.90	41.88	11.92	0.31
CREEK	2	100yr SCS	35.09	188.04	190.81		190.91	0.000999	1.51	29.00	11.54	0.30
CREEK	2	50yr SCS	30.49	188.04	190.59		190.69	0.000999	1.42	26.52	11.47	0.29
CREEK	2	25yr SCS	25.88	188.04	190.36		190.44	0.000999	1.33	23.90	11.39	0.29
CREEK	2	10yr SCS	19.92	188.04	190.04		190.11	0.000999	1.20	20.26	11.28	0.28
CREEK	2	5yr SCS	15.41	188.04	189.77		189.83	0.000999	1.08	17.23	11.18	0.27

HEC-RAS Plan: 03 River: CREEK Reach: CREEK (Continued)

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
CREEK	2	2yr SCS	9.22	188.04	189.34		189.38	0.000998	0.88	12.48	11.04	0.26
CREEK	1	Regional	62.42	188.04	191.90	189.82	192.07	0.001002	1.90	41.87	11.92	0.31
CREEK	1	100yr SCS	35.09	188.04	190.81	189.29	190.91	0.001000	1.51	28.98	11.54	0.30
CREEK	1	50yr SCS	30.49	188.04	190.59	189.19	190.69	0.001000	1.42	26.51	11.47	0.29
CREEK	1	25yr SCS	25.88	188.04	190.36	189.09	190.44	0.001001	1.33	23.89	11.39	0.29
CREEK	1	10yr SCS	19.92	188.04	190.04	188.94	190.11	0.001000	1.20	20.25	11.28	0.28
CREEK	1	5yr SCS	15.41	188.04	189.77	188.83	189.82	0.001001	1.08	17.22	11.18	0.27
CREEK	1	2yr SCS	9.22	188.04	189.34	188.64	189.38	0.001001	0.88	12.47	11.04	0.26

LIST OF FIGURES

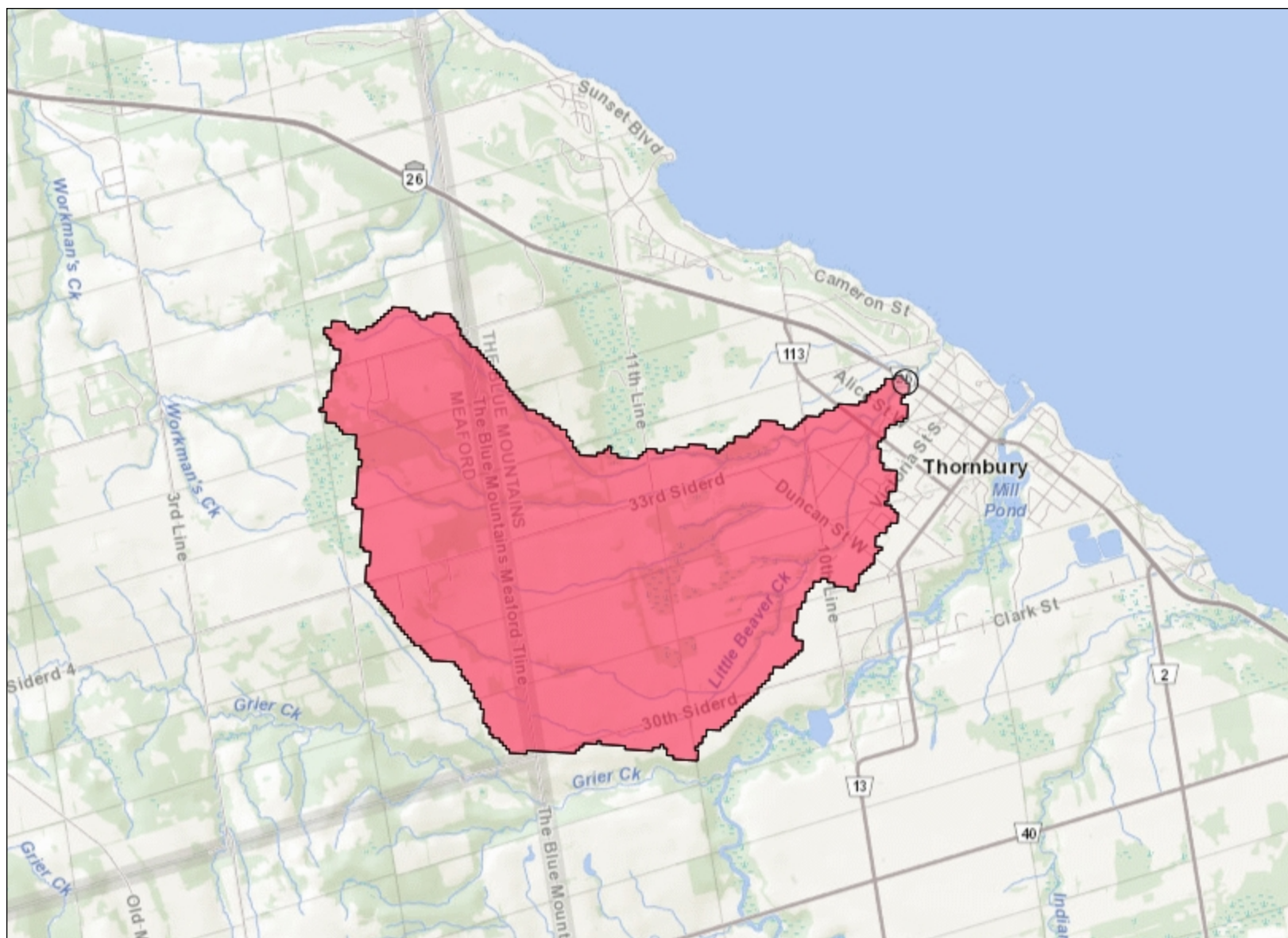
- Figure 1:** Site Location Plan
- Figure 2:** Little Beaver Creek Watershed Delineation
- Figure 3:** Existing Constraints



Legend	Project	 = SUBJECT LANDS 125 ARTHUR ST TOWN OF THE BLUE MOUNTAINS						 CROZIER CONSULTING ENGINEERS THE HARBOUREDGE BUILDING, 40 HURON STREET, SUITE 301, COLLINGWOOD, ON L9Y 4R3 705 446-3510 T 705 446-3520 F WWW.CFCROZIER.CA INFO@CFCROZIER.CA					
	Drawing	SITE LOCATION PLAN						Drawn ByJ.E. Design ByJ.E. Project598-5414 ScaleN.T.S. Date08/06/2020 Check ByR.A. DrawingFIG. 1					

Figure 2: Little Beaver Creek Watershed Delineation

Notes:



Legend

- Assessment Parcel
- Secondary Watershed
- Tertiary Watersheds
- Great Lakes - St. Lawrence Basin
- Hudson - James Bay Basin
- Nelson River Basin
- ✖ Diversions
- Y Waterbody Outlet
- ▲ Conservation Authority Dam
- ▲ Provincial Dam
- ▲ Federal Dam
- ▲ OPG Dam
- ▲ Other Dam
- ⊙ HYDAT Gauge
- ⊙ HYDAT Gauge (RHBN)

Land Cover Compilation

- Other
- Cloud/Shadow
- Clear Open Water
- Turbid Water
- Shoreline
- Mudflats
- Marsh
- Swamp
- Fen
- Bog
- Heath
- Sparse Treed
- Treed Upland
- Deciduous Treed
- Mixed Treed
- Coniferous Treed
- Plantations - Treed Cultivated
- Hedge Rows
- Disturbance
- Open Cliff and Talus
- Alvar
- Sand Barren and Dune
- Open Tallgrass Prairie
- Tallgrass Savannah
- Tallgrass Woodland
- Sand/Gravel/Mine
- Tailings/Extraction
- Bedrock
- Community/Infrastructure
- Agriculture and Undifferentiated Rural Land Use

2.6 0 km 1.31 2.6

Scale: 1 : 51,461

Projection: Web Mercator



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