

McMaster University Winter 2021

CIVENG 4L04: Design of Water Resources Systems

Project 1: Modeling Critical Creek in HEC-RAS

Lab Section 01, L01

Group 12

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Due: February 3, 2021; 8:30 am (EST)

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Part A: Create a New Project

Questions

1. To create a new project in HEC-RAS, from the **File** menu, the **New Project** option must be selected first. A window will open, where one may name and create a new folder in the same directory as their preferred hard drive location. Then, the user may click the **OK** button twice - first in the window where their new folder has been created and once they have provided a title/name for their project, as well as in the window that pops up afterwards, which will confirm adjusted settings.¹

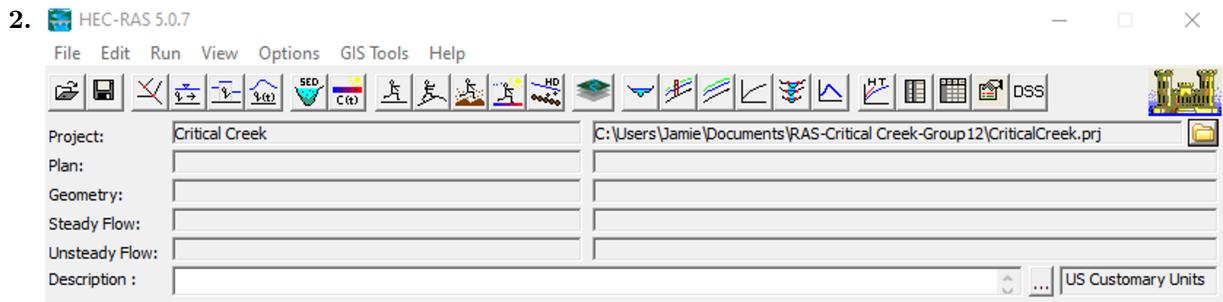


Figure 1: The main HEC-RAS window after creating the new project titled “Critical Creek.”

¹In the context of this lab, the user would ensure that the system units are *US Customary*.

Part B: Enter the Geometry Data

Questions

3. To import a geometry data file, the user must first access the **Geometry Data Editor** window by selecting the **Geometry Data** option under the **Edit** menu in the main HEC-RAS window. Once this window is open, select **File**, then **Import Geometry Data**, and choose the desired format option that subsequently appears (in this case, the user would select the **HEC-RAS Format** option). In the **Import #HEC-RAS Format data file** window, select the “Base Geometry Data” file, click **OK**, and in the **Import Geometry Data** window, choose the units for which to import the data file in,² as well as ensure to accept the settings by clicking the **Finished - Import Data** button.

4.

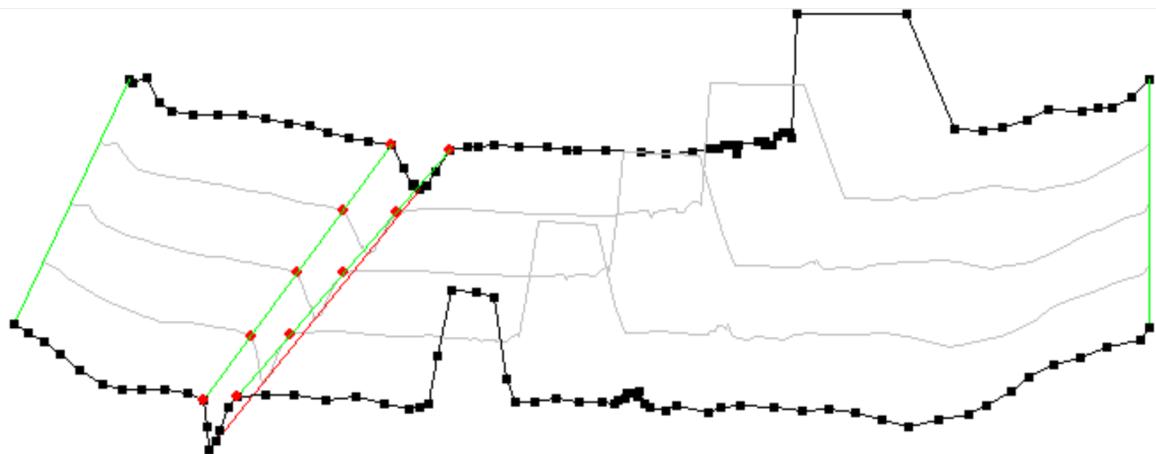


Figure 2: The interpolated cross sections between river station 11 and 10 using the **Between 2 X's**' tool.

5. HEC-RAS 5.0.7

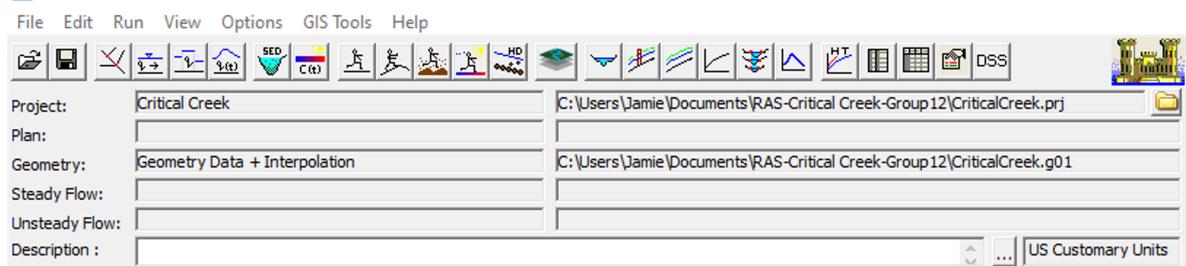


Figure 3: The main HEC-RAS window after importing the geometry data file.

²In the context of this lab, the user would ensure that both the project units and the “Base Geometry Data” file units are *US Customary*.

Part C: Steady Flow Data

Questions

6. To enter steady flow data, begin by clicking the **Edit** menu bar located on the main HEC-RAS window and then select the **Steady Flow Data** option. Next, in the window that appears, select the desired River Station, click the **Add A Flow Change Location** button, and enter the desired flow rate in the **PF1** column. Click on the **Reach Boundary Conditions** button to set desired boundary conditions Upstream and Downstream with the available external boundary condition type buttons and select **OK**. Be sure to save the steady flow data and enter a title; press **OK**.

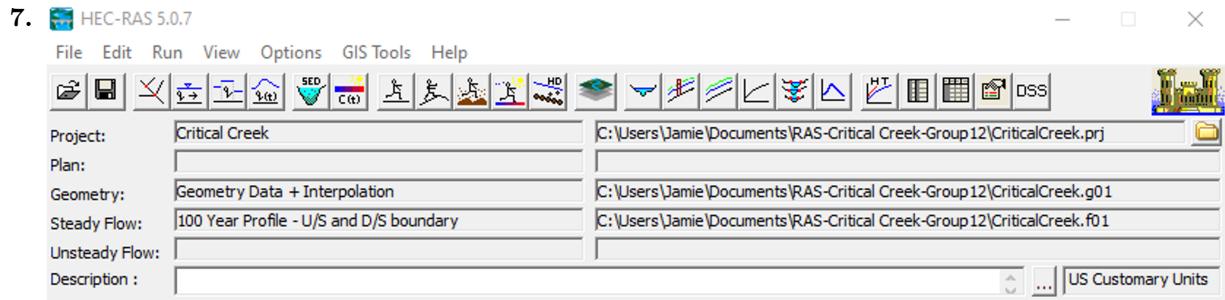


Figure 4: The main HEC-RAS window after saving the flow data file.

Part D: Simulation Plans

Questions

8. The three important factors to note when creating a simulation plan are to select: (1) a geometry file, (2) a steady flow file, and (3) a flow regime.

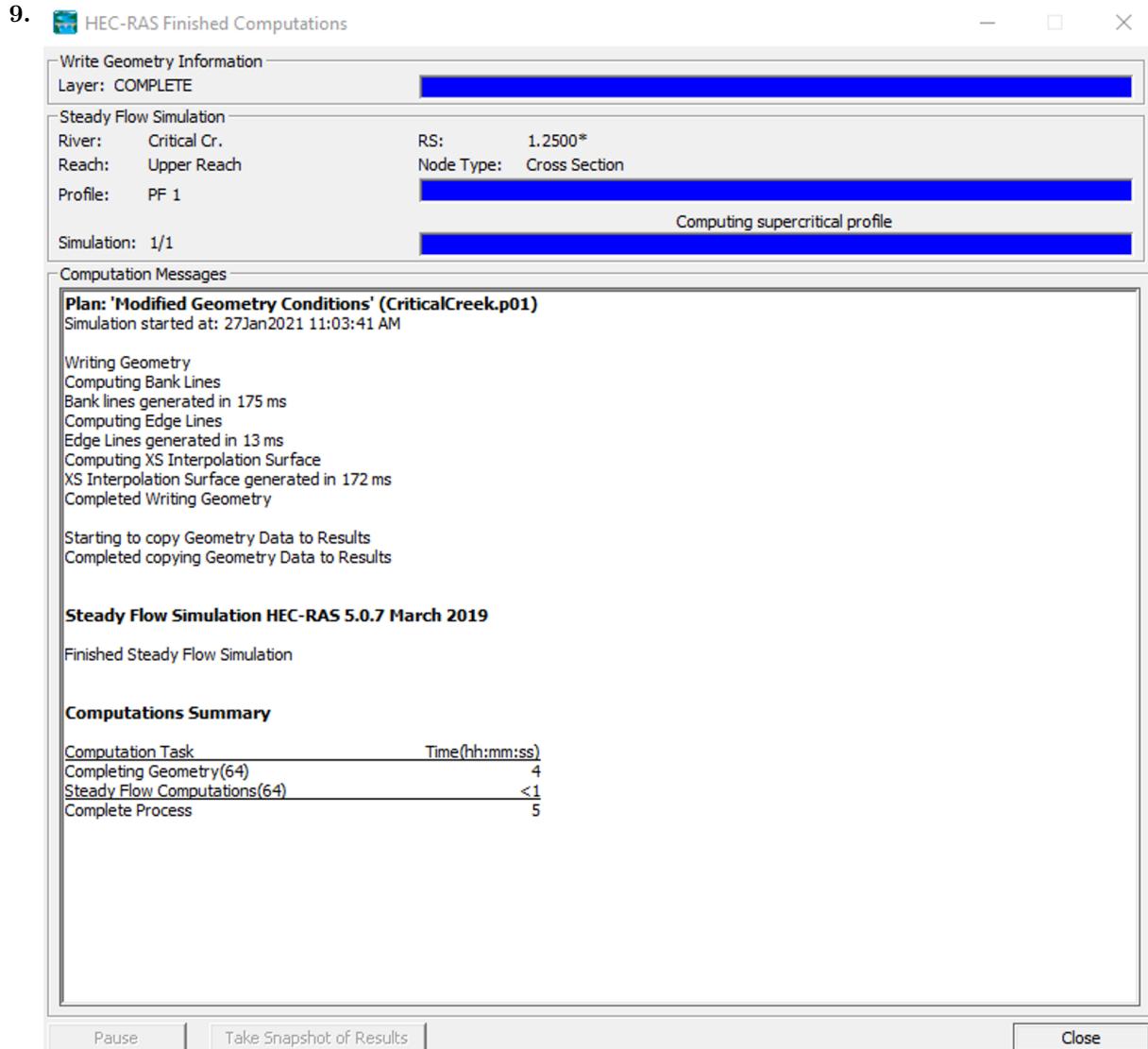


Figure 5: The steady flow analysis plan for evaluation.

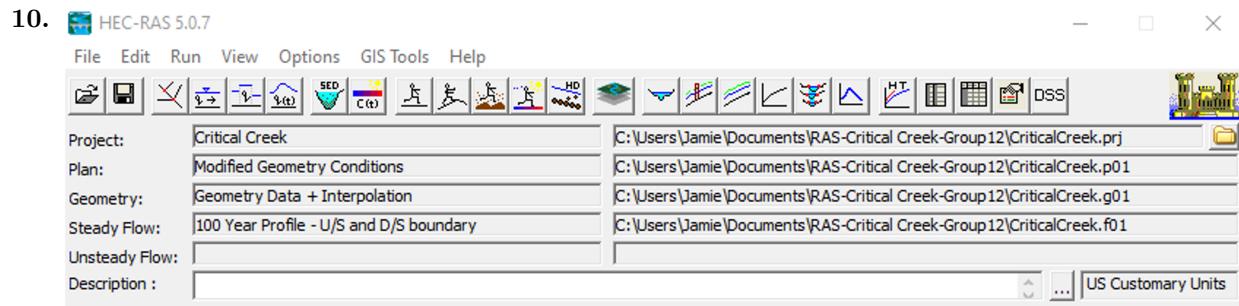


Figure 6: The main HEC-RAS window after creating the simulation plan.

Part E: Results and Comparison

Questions

11.

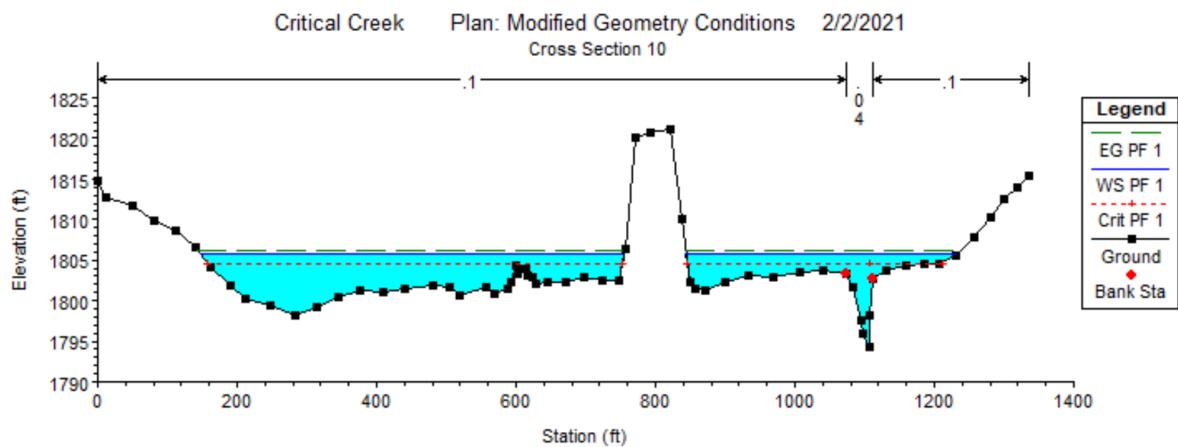


Figure 7: The cross section plot at river station 10 showing the water surface level.

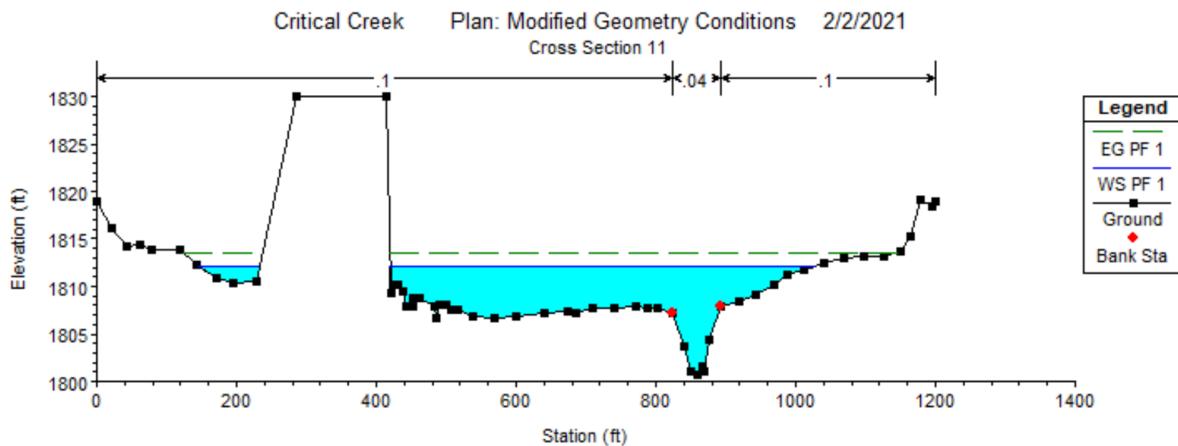


Figure 8: The cross section plot at river station 11 showing the water surface level.

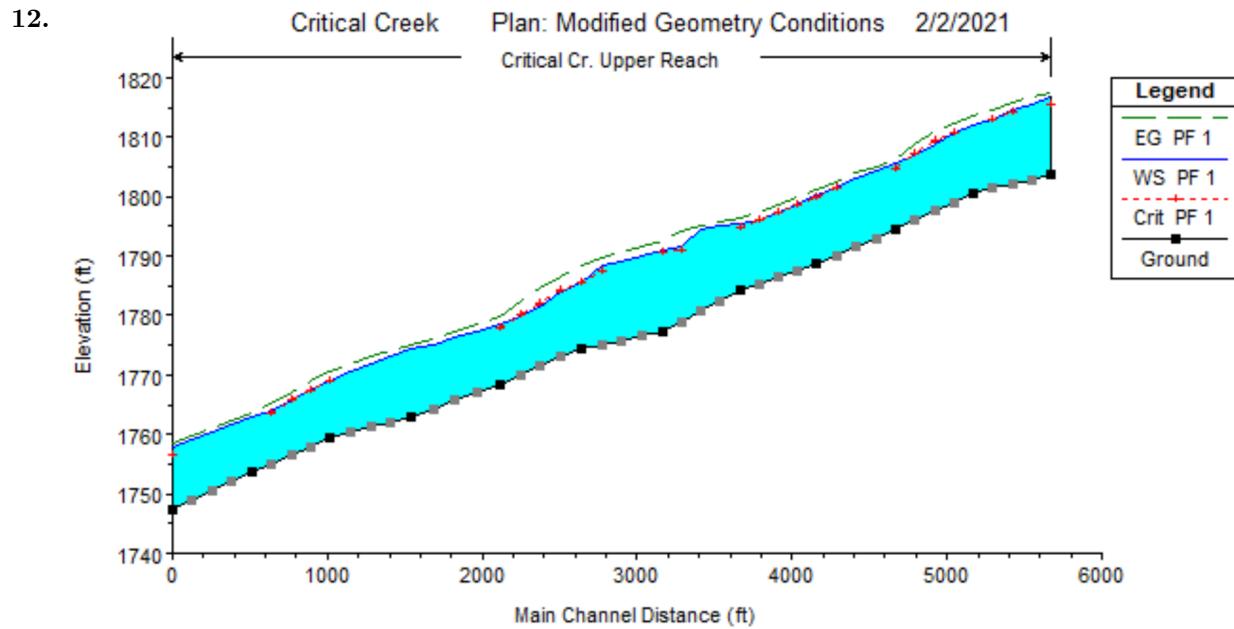


Figure 9: The profile plot of Critical Creek illustrating water surface level along the upper reach.

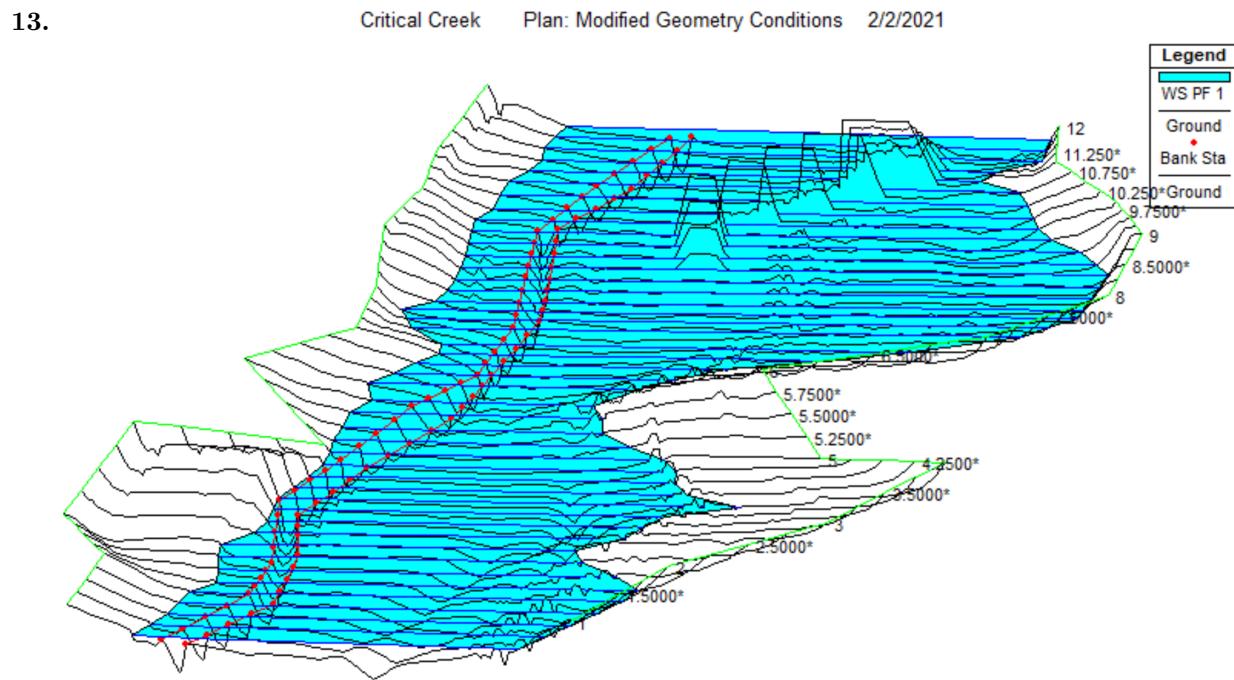


Figure 10: A perspective view of the upper reach showing water surface level.

14.

HEC-RAS Plan: ModifiedGeo River: Critical Cr. Reach: Upper Reach Profile: PF 1

Reach	River Sta	Profile	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude # Chl
Upper Reach	12	PF 1	14700.00	1803.60	1816.93	1815.45	1817.45	0.004519	9.97	4297.66	951.51	0.59
Upper Reach	11.750*	PF 1	14700.00	1802.88	1815.66		1816.70	0.006987	12.55	3349.96	845.58	0.75
Upper Reach	11.500*	PF 1	14700.00	1802.15	1814.50	1814.13	1815.77	0.007441	13.09	3115.26	813.13	0.78
Upper Reach	11.250*	PF 1	14700.00	1801.42	1812.93	1812.89	1814.68	0.009583	14.42	2618.35	708.35	0.89
Upper Reach	11	PF 1	14700.00	1800.70	1812.13		1813.54	0.007228	12.87	2826.03	696.06	0.78
Upper Reach	10.750*	PF 1	14700.00	1799.12	1810.80	1810.80	1812.48	0.009362	14.35	2742.09	831.01	0.88
Upper Reach	10.500*	PF 1	14700.00	1797.55	1808.93	1809.42	1811.01	0.014541	16.64	2611.77	888.34	1.07
Upper Reach	10.250*	PF 1	14700.00	1795.97	1806.85	1807.35	1808.83	0.020660	17.80	2567.24	927.05	1.22
Upper Reach	10	PF 1	14700.00	1794.40	1805.71	1804.62	1806.24	0.008947	11.23	3691.24	996.01	0.77
Upper Reach	9.7500*	PF 1	14700.00	1792.97	1804.42		1805.10	0.009012	12.17	3679.62	1027.15	0.80
Upper Reach	9.5000*	PF 1	14700.00	1791.55	1803.14		1803.95	0.009078	12.76	3719.49	1096.70	0.82
Upper Reach	9.2500*	PF 1	14700.00	1790.12	1801.47	1801.47	1802.62	0.011897	14.42	3408.27	1144.31	0.94
Upper Reach	9	PF 1	14700.00	1788.70	1800.24	1799.95	1801.09	0.009078	12.71	3858.77	1240.16	0.82
Upper Reach	8.7500*	PF 1	14700.00	1787.60	1798.75	1798.75	1799.85	0.010414	13.85	3615.91	1233.98	0.89
Upper Reach	8.5000*	PF 1	14700.00	1786.50	1797.51	1797.53	1798.62	0.009409	13.61	3693.06	1234.33	0.86
Upper Reach	8.2500*	PF 1	14700.00	1785.40	1796.09	1796.20	1797.39	0.010067	14.25	3555.05	1238.82	0.89
Upper Reach	8	PF 1	15200.00	1784.30	1795.58	1794.96	1796.29	0.005319	11.19	4612.65	1292.65	0.66
Upper Reach	7.7500*	PF 1	15200.00	1782.53	1794.99		1795.68	0.004623	11.12	4723.36	1230.80	0.62
Upper Reach	7.5000*	PF 1	15200.00	1780.75	1794.55		1795.15	0.003696	10.61	5013.08	1171.88	0.56
Upper Reach	7.2500*	PF 1	15200.00	1778.97	1791.75	1791.07	1794.17	0.014042	18.88	2776.32	889.78	1.07
Upper Reach	7	PF 1	15200.00	1777.20	1790.99	1790.58	1792.49	0.009644	16.17	2831.76	727.03	0.88
Upper Reach	6.7500*	PF 1	15200.00	1776.52	1790.09		1791.71	0.007902	15.01	2742.88	560.97	0.82
Upper Reach	6.5000*	PF 1	15200.00	1775.85	1789.03		1790.74	0.007331	14.30	2624.74	531.95	0.80
Upper Reach	6.2500*	PF 1	15200.00	1775.18	1788.34	1787.40	1789.85	0.005906	12.88	2686.92	520.06	0.72
Upper Reach	6	PF 1	15200.00	1774.50	1785.43	1785.43	1788.57	0.014542	17.02	1684.36	403.96	1.09
Upper Reach	5.7500*	PF 1	15200.00	1773.00	1783.88	1784.34	1786.62	0.012791	16.49	1955.62	476.48	1.03
Upper Reach	5.5000*	PF 1	15200.00	1771.50	1781.55	1782.21	1784.63	0.016785	18.06	1889.93	498.36	1.16
Upper Reach	5.2500*	PF 1	15200.00	1770.00	1779.92	1780.30	1782.29	0.014891	17.02	2241.64	578.16	1.09
Upper Reach	5	PF 1	15200.00	1768.50	1778.58	1777.89	1779.76	0.009428	13.56	2902.43	626.65	0.85
Upper Reach	4.7500*	PF 1	15200.00	1767.12	1777.39		1778.51	0.009391	13.57	2993.14	655.09	0.85
Upper Reach	4.5000*	PF 1	15200.00	1765.75	1776.22		1777.26	0.009274	13.48	3119.87	693.97	0.84
Upper Reach	4.2500*	PF 1	15200.00	1764.38	1775.16		1776.05	0.008625	13.01	3310.51	733.43	0.80
Upper Reach	4	PF 1	15200.00	1763.00	1774.26		1774.96	0.007368	12.06	3634.63	808.61	0.73
Upper Reach	3.7500*	PF 1	15200.00	1762.10	1773.16		1774.02	0.007761	12.72	3433.70	747.81	0.77
Upper Reach	3.5000*	PF 1	15200.00	1761.20	1772.01		1773.02	0.008216	13.25	3228.76	708.98	0.81
Upper Reach	3.2500*	PF 1	15200.00	1760.30	1770.62		1771.89	0.009856	14.26	2930.59	666.48	0.89
Upper Reach	3	PF 1	15200.00	1759.40	1769.06	1768.89	1770.52	0.012006	15.06	2781.10	680.81	0.98
Upper Reach	2.7500*	PF 1	15200.00	1757.95	1767.55	1767.31	1768.96	0.012147	14.98	2785.93	690.58	0.98
Upper Reach	2.5000*	PF 1	15200.00	1756.50	1765.72	1765.72	1767.23	0.014905	15.72	2670.79	729.10	1.07
Upper Reach	2.2500*	PF 1	15200.00	1755.05	1763.92	1763.58	1765.18	0.015404	14.95	2675.42	786.73	1.06
Upper Reach	2	PF 1	15200.00	1753.60	1762.87		1763.50	0.008992	11.33	3337.16	834.60	0.80
Upper Reach	1.7500*	PF 1	15200.00	1752.05	1761.63		1762.31	0.009904	11.79	3322.29	819.32	0.84
Upper Reach	1.5000*	PF 1	15200.00	1750.50	1760.40		1761.07	0.009895	11.69	3322.98	791.85	0.83
Upper Reach	1.2500*	PF 1	15200.00	1748.95	1759.17		1759.82	0.009890	11.59	3325.69	779.38	0.83
Upper Reach	1	PF 1	15200.00	1747.40	1757.93	1756.69	1758.57	0.010000	11.54	3316.93	768.92	0.83

Figure 11: Standard Table 1 for the ModifiedGeo Plan (i.e. no ice cover).

Part F: Ice Cover Modelling (Optional)

Questions

15.

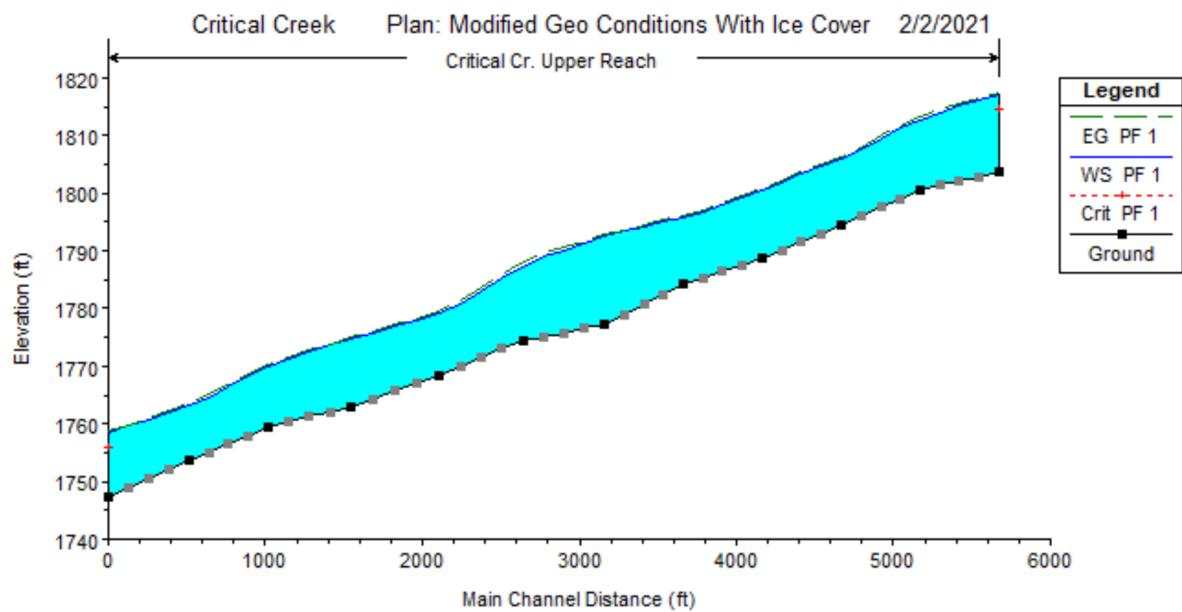


Figure 12: The profile plot of Critical Creek illustrating water surface level and ice cover thickness along the upper reach.

16.

HEC-RAS Plan: ModifiedGeoIce River: Critical Cr. Reach: Upper Reach Profile: PF 1

Reach	River Sta	Profile	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude # Chl
Upper Reach	12	PF 1	14700.00	1803.60	1817.20	1814.59	1817.40	0.005436	5.59	4466.08	956.63	0.36
Upper Reach	11.750*	PF 1	14700.00	1802.88	1816.28		1816.58	0.007722	6.85	3799.25	892.57	0.44
Upper Reach	11.500*	PF 1	14700.00	1802.15	1815.23		1815.57	0.008378	7.20	3612.86	841.74	0.46
Upper Reach	11.250*	PF 1	14700.00	1801.42	1814.06		1814.46	0.009360	7.58	3379.82	833.92	0.49
Upper Reach	11	PF 1	14700.00	1800.70	1812.81		1813.25	0.00955	7.71	3185.85	738.71	0.50
Upper Reach	10.750*	PF 1	14700.00	1799.12	1811.35		1811.84	0.012865	8.48	3097.92	867.40	0.57
Upper Reach	10.500*	PF 1	14700.00	1797.55	1809.60		1810.07	0.015629	8.75	3121.58	917.27	0.61
Upper Reach	10.250*	PF 1	14700.00	1795.97	1807.46		1807.90	0.019212	8.59	3056.77	950.67	0.65
Upper Reach	10	PF 1	14700.00	1794.40	1805.94		1806.18	0.009751	5.72	3848.75	1001.46	0.45
Upper Reach	9.7500*	PF 1	14700.00	1792.97	1804.69		1804.94	0.010027	6.28	3885.36	1037.31	0.47
Upper Reach	9.5000*	PF 1	14700.00	1791.55	1803.38		1803.64	0.010862	6.81	3896.03	1105.23	0.50
Upper Reach	9.2500*	PF 1	14700.00	1790.12	1801.92		1802.20	0.012122	7.23	3835.79	1158.77	0.53
Upper Reach	9	PF 1	14700.00	1788.70	1800.54		1800.78	0.010398	6.68	4144.11	1245.43	0.49
Upper Reach	8.7500*	PF 1	14700.00	1787.60	1799.23		1799.48	0.010396	6.93	4124.81	1242.59	0.49
Upper Reach	8.5000*	PF 1	14700.00	1786.50	1797.95		1798.21	0.010117	7.06	4144.17	1242.45	0.49
Upper Reach	8.2500*	PF 1	14700.00	1785.40	1796.80		1797.04	0.008741	6.83	4339.56	1256.40	0.46
Upper Reach	8	PF 1	15200.00	1784.30	1795.92		1796.11	0.006305	6.14	4958.82	1300.76	0.40
Upper Reach	7.7500*	PF 1	15200.00	1782.53	1795.11		1795.33	0.006472	6.61	4791.37	1234.57	0.41
Upper Reach	7.5000*	PF 1	15200.00	1780.75	1794.28		1794.53	0.006658	7.07	4626.58	1161.60	0.42
Upper Reach	7.2500*	PF 1	15200.00	1778.97	1793.43		1793.70	0.006952	7.55	4460.22	1092.87	0.43
Upper Reach	7	PF 1	15200.00	1777.20	1792.49		1792.80	0.007840	8.28	4219.06	1039.33	0.46
Upper Reach	6.7500*	PF 1	15200.00	1776.52	1791.27		1791.73	0.009204	8.84	3436.28	736.62	0.50
Upper Reach	6.5000*	PF 1	15200.00	1775.85	1790.18		1790.66	0.008016	8.07	3159.85	600.33	0.47
Upper Reach	6.2500*	PF 1	15200.00	1775.18	1789.01		1789.58	0.009205	8.34	2921.11	537.86	0.50
Upper Reach	6	PF 1	15200.00	1774.50	1787.17		1788.06	0.015910	9.94	2347.64	495.71	0.64
Upper Reach	5.7500*	PF 1	15200.00	1773.00	1785.14		1785.93	0.015273	9.66	2452.66	517.79	0.63
Upper Reach	5.5000*	PF 1	15200.00	1771.50	1783.01		1783.76	0.016806	9.85	2543.26	578.68	0.65
Upper Reach	5.2500*	PF 1	15200.00	1770.00	1780.82		1781.46	0.016659	9.35	2675.84	614.20	0.64
Upper Reach	5	PF 1	15200.00	1768.50	1779.29		1779.67	0.009853	7.16	3256.49	639.82	0.49
Upper Reach	4.7500*	PF 1	15200.00	1767.12	1778.04		1778.41	0.009812	7.16	3343.82	673.67	0.48
Upper Reach	4.5000*	PF 1	15200.00	1765.75	1776.83		1777.17	0.009439	7.02	3470.70	716.66	0.47
Upper Reach	4.2500*	PF 1	15200.00	1764.38	1775.68		1775.99	0.008976	6.91	3628.96	773.37	0.46
Upper Reach	4	PF 1	15200.00	1763.00	1774.65		1774.91	0.007813	6.52	3884.40	859.48	0.43
Upper Reach	3.7500*	PF 1	15200.00	1762.10	1773.64		1773.93	0.008350	6.76	3725.16	786.55	0.45
Upper Reach	3.5000*	PF 1	15200.00	1761.20	1772.52		1772.85	0.009414	7.20	3511.93	727.92	0.48
Upper Reach	3.2500*	PF 1	15200.00	1760.30	1771.21		1771.61	0.011054	7.63	3245.19	690.15	0.52
Upper Reach	3	PF 1	15200.00	1759.40	1769.81		1770.21	0.011861	7.58	3206.05	694.49	0.54
Upper Reach	2.7500*	PF 1	15200.00	1757.95	1768.22		1768.63	0.012825	7.73	3167.08	733.12	0.55
Upper Reach	2.5000*	PF 1	15200.00	1756.50	1766.46		1766.88	0.014565	7.81	3143.37	845.45	0.58
Upper Reach	2.2500*	PF 1	15200.00	1755.05	1764.66		1765.05	0.013585	7.00	3201.26	868.50	0.55
Upper Reach	2	PF 1	15200.00	1753.60	1763.29		1763.58	0.009251	5.84	3603.04	850.19	0.45
Upper Reach	1.7500*	PF 1	15200.00	1752.05	1762.09		1762.39	0.009873	5.97	3614.84	830.19	0.46
Upper Reach	1.5000*	PF 1	15200.00	1750.50	1760.86		1761.15	0.009900	5.89	3598.46	801.58	0.46
Upper Reach	1.2500*	PF 1	15200.00	1748.95	1759.62		1759.91	0.009096	5.81	3590.24	765.90	0.46
Upper Reach	1	PF 1	15200.00	1747.40	1758.37	1755.84	1758.66	0.010099	5.74	3572.07	773.65	0.46

Figure 13: Standard Table 1 for the ModifiedGeoIce Plan (i.e. with ice cover).

Comparing the water surface elevations obtained with ice cover (see Figure 13) and without ice cover (see Figure 11), the water surface elevation values were slightly higher *with* ice cover. Moreover, the differences observed in the water surface elevation values were less than a foot. This result makes sense as the less dense ice would float above the water, with part of it being submerged (hence why the water surface elevation values were only slightly higher between the two plans and why they varied by less than 2ft - the thickness of the ice cover).