**Hydraulic Analysis for Interstate 90
over Bear Trap Creek
M.P. 282.62, BIN 5510130
NYSTA D214386**

Prepared for:
New York State Thruway Authority

Prepared by:
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May 1, 2017

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Executive Summary

The New York State Thruway Authority has proposed the replacement of the bridge (BIN 5510130) which carries Interstate 90 over Bear Trap Creek at M.P. 282.62 in the Town of Salina, Onondaga County. The replacement will be progressed as a "design-build" project and therefore the structure selected by the design-build team is not yet known. If different than assumed in this analysis and report, the design-build designers should perform their own hydraulic analysis.

In general, the current structure over Bear Trap Creek is hydraulically sufficient and the structure provides approximately 3 feet of freeboard for the 50-year design storm. As required by the USACE Section 404 Nationwide Permit General Condition #9 that requires a bridge replacement to be 1.25 times bank full channel width, the hydraulic opening of the replacement structure will be increased by approximately 51% and the approximate low chord will be set to match the existing low chord elevation.

The net effect of the increased hydraulic opening on stream flow characteristics is a slight decrease in water surface elevations in the vicinity of the structure and a slight decrease in flow velocities through the structure.

Bear Trap Creek is part of the FEMA Onondaga County Flood Insurance Study, dated November 4, 2016. As part of this study, a detailed hydraulic model was created for Bear Trap Creek. The FEMA model was obtained and used the basis for this hydraulic analysis. With regards to FEMA Floodway/Floodplain regulations, this project will meet the Base Flood (100-year) elevation "No Rise" requirement.

1.0 INTRODUCTION

New York State Thruway Authority has proposed the replacement of the bridge (BIN 5510130) which carries Interstate 90 over Bear Trap Creek in the Town of Salina. Refer to Figure 1 General Location Map, and Figure 2 Project Location Map. Interstate 90 is a full access controlled four-lane divided highway that is part the Eisenhower Interstate System. This section of Interstate 90 is owned and maintained by the New York State Thruway Authority and is oriented in an east-west direction.

In accordance with 6NYCRR Part 502, "Floodplain Management Criteria for State Projects", this report summarizes the hydraulic effects of the existing structure and proposed replacement structure on the flow characteristics of Bear Trap Creek. Included in this report is information concerning the magnitude and frequency of the design storm event (hydrologic data) and corresponding stream flow water surface elevation and stream flow velocity computations (hydraulic data). The 50-year (design) and 100-year storms were considered when assessing flood levels and velocities, while the 500-year storm event was considered when evaluating scour susceptibility.

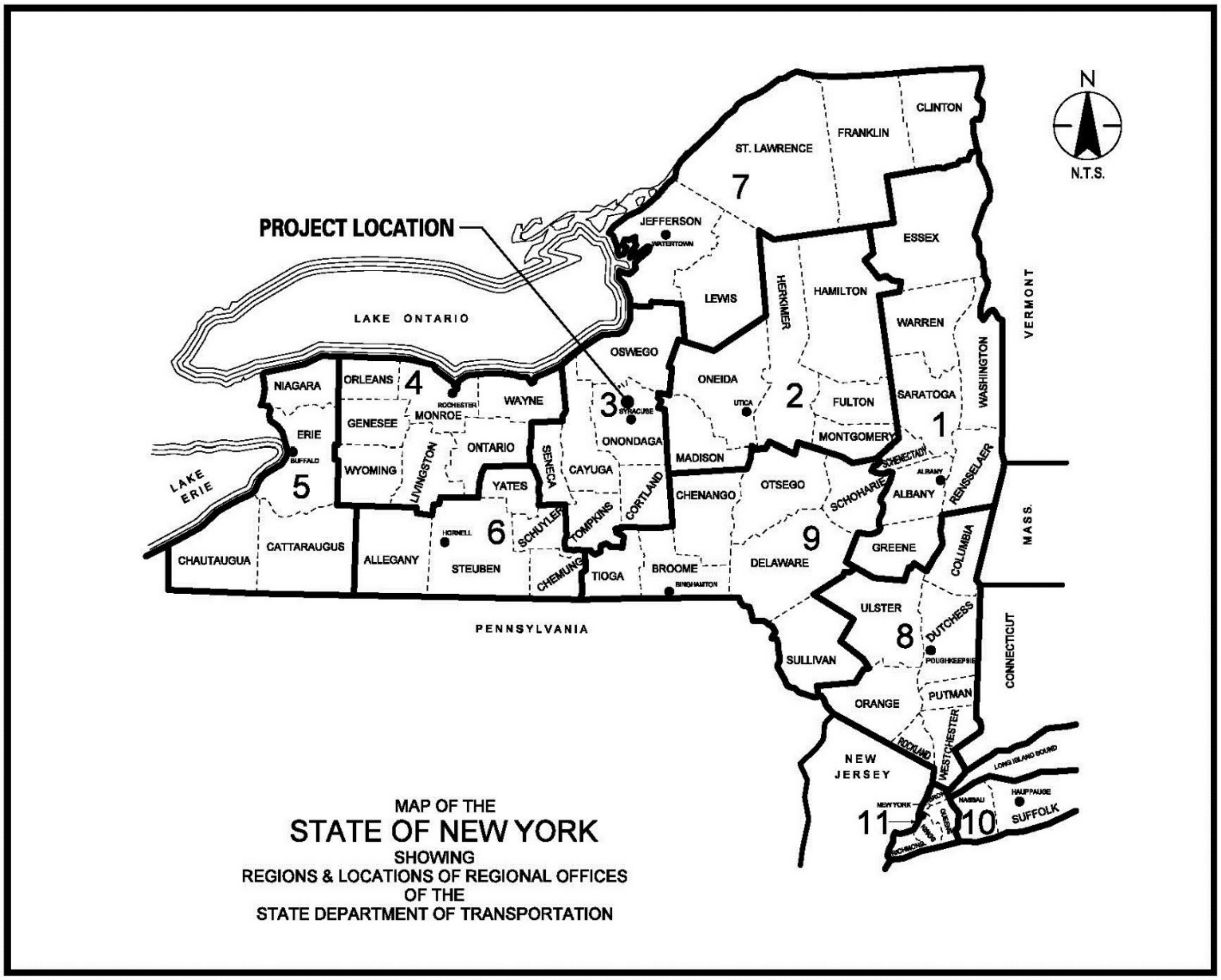

FIGURE 1 - GENERAL LOCATION MAP

NEW YORK STATE THRUWAY AUTHORITY

Interstate 90 over Bear Trap Creek Bridge Replacement

M.P. 282.62; BIN 5510130

Town of Salina

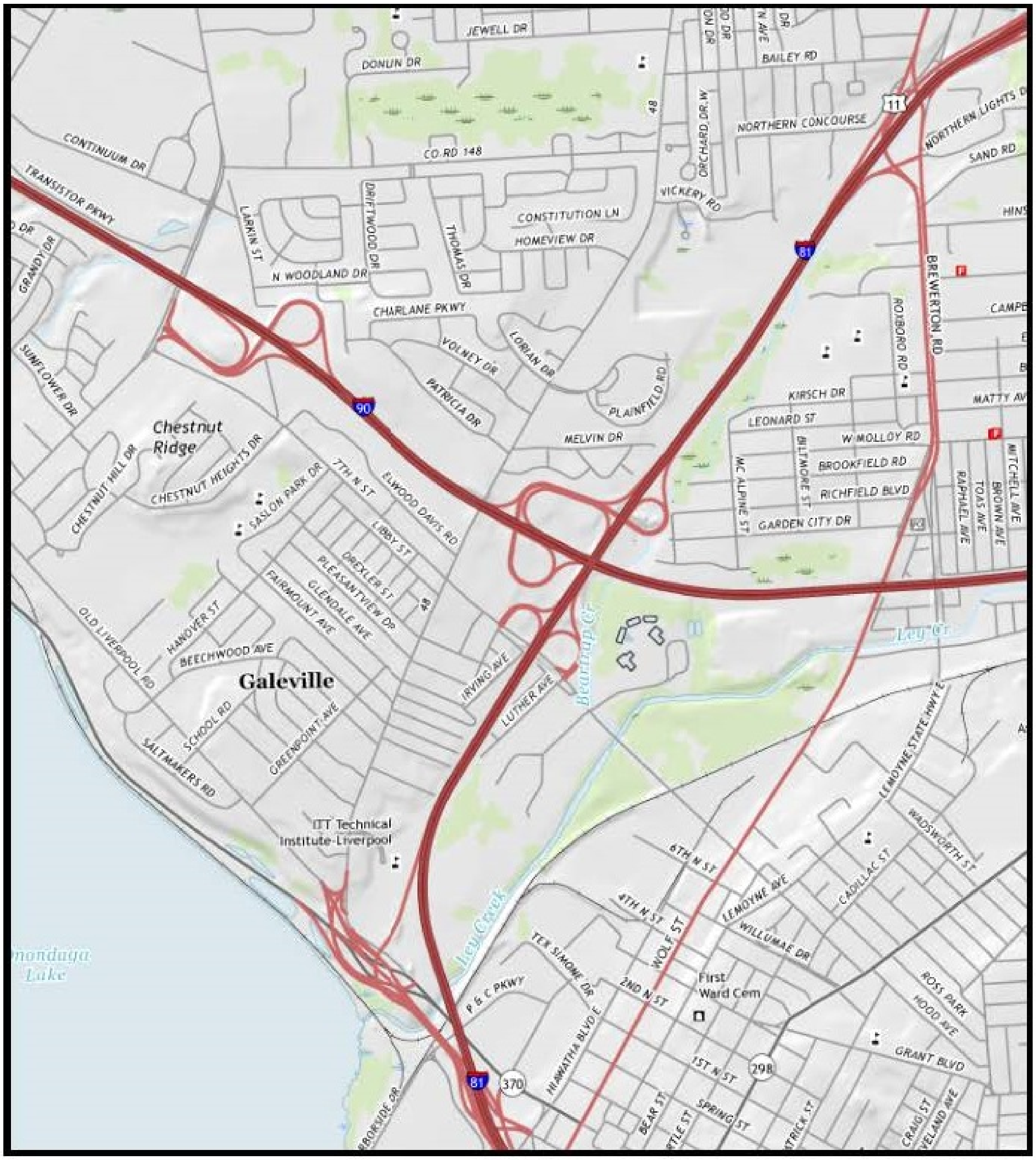

FIGURE 2 - PROJECT LOCATION MAP

NEW YORK STATE THRUWAY AUTHORITY

Interstate 90 over Bear Trap Creek Bridge Replacement

M.P. 282.62; BIN 5510130

Town of Salina

2.0 EXISTING CONDITIONS

Bear Trap Creek flows generally from north to south and originates at a wetland area near E. Taft Road on the west side of I-81. Interstate 90 crosses Bear Trap Creek approximately 2.9 miles downstream from its origin and continues south to Ley Creek, approximately 0.5 miles further downstream.

The total watershed area upstream of the project is 3.77 mi^2. The creek has an average channel slope of 0.00176 feet per feet (0.17%) in the vicinity of the structure and normal flows are confined to a well-defined channel, which consist of silty sand. Over-bank areas typically consist of developed residential areas, wetlands, dense brush, and some woodlands. Just upstream of I-90, Bear Trap Creek flows under Interchange 36 ramps via large diameter culverts.

Record information indicates that BIN 5510130 over Bear Trap Creek was originally constructed in 1946. The existing structure is a twin cell 4-sided reinforced cast-in-place concrete box structure. Both cells have a length of 168' and a span of 12'-6". Photos 1 and 2 show the structure and the channel configuration near the project.

Photo 1: BIN 5510130 over Bear Trap Creek upstream fascia.

Photo 2: Bear Trap Creek channel looking downstream.

Deficient bridge conditions have prompted the New York State Thruway Authority to initiate this bridge replacement project. To comply with federal and state regulations and standards for floodway encroachment, a hydraulic analysis is required. The analysis must compare the effects of the existing and proposed bridge structure on the 100-year (Base Flood) elevations.

The purpose of this report is to demonstrate that the assumed proposed bridge section will not increase the 100-year Base Flood elevations of Bear Trap Creek and/or significantly affect the stream flow velocities adjacent to the structure. This report also analyzes existing and proposed water surface elevations resulting from a 50-year (Design) storm.

A scour susceptibility analysis, using the 500- year storm event as a basis must also be documented.

3.0 HYDROLOGY

3.1 WATERSHED

The watershed upstream of the Interstate 90 bridge is in a developed area north of the City of Syracuse that is a part of the Onondaga Lake watershed (refer to Figure 3). The creek flows south and discharges into Ley Creek which ultimately discharges into Onondaga Lake. The headwaters of the watershed are at elevation 400' and along the tributary route, the watershed falls approximately 25' to the project location. The elevation of the project site is approximately 375'. The majority of the overbank area along Bear Trap Creek within the watershed is a mix of woodlands, wetland, dense brush, and developed areas. In the vicinity of the project site the overbanks include, dense brush and some woodlands.

3.2 HYDROLOGIC ANALYSIS

Bear Trap Creek has been studied in detail by FEMA as part of the Town of Salina Flood Insurance Study (FIS) dated February 16, 1982. The creek was also included as part of the Onondaga County FIS dated November 4, 2016. FEMA-calculated flowrates that were included in the FIS were used for this hydraulic analysis.

The following table summarizes the computed flowrates of the 50-year design storm, 100-year Base Flood storm event, and 500-year storm events. See Figure 2 for the project watershed boundary.

Table 1: Watershed Summary

Watershed Name	Contributing Watershed (mi^2)	Design Q50 (cfs)	Base Flood Q_{100} (cfs)	Base Flood Q_{500} (cfs)*
Bear Trap Creek	3.77	680	780	1,020

*Used for scour analysis.

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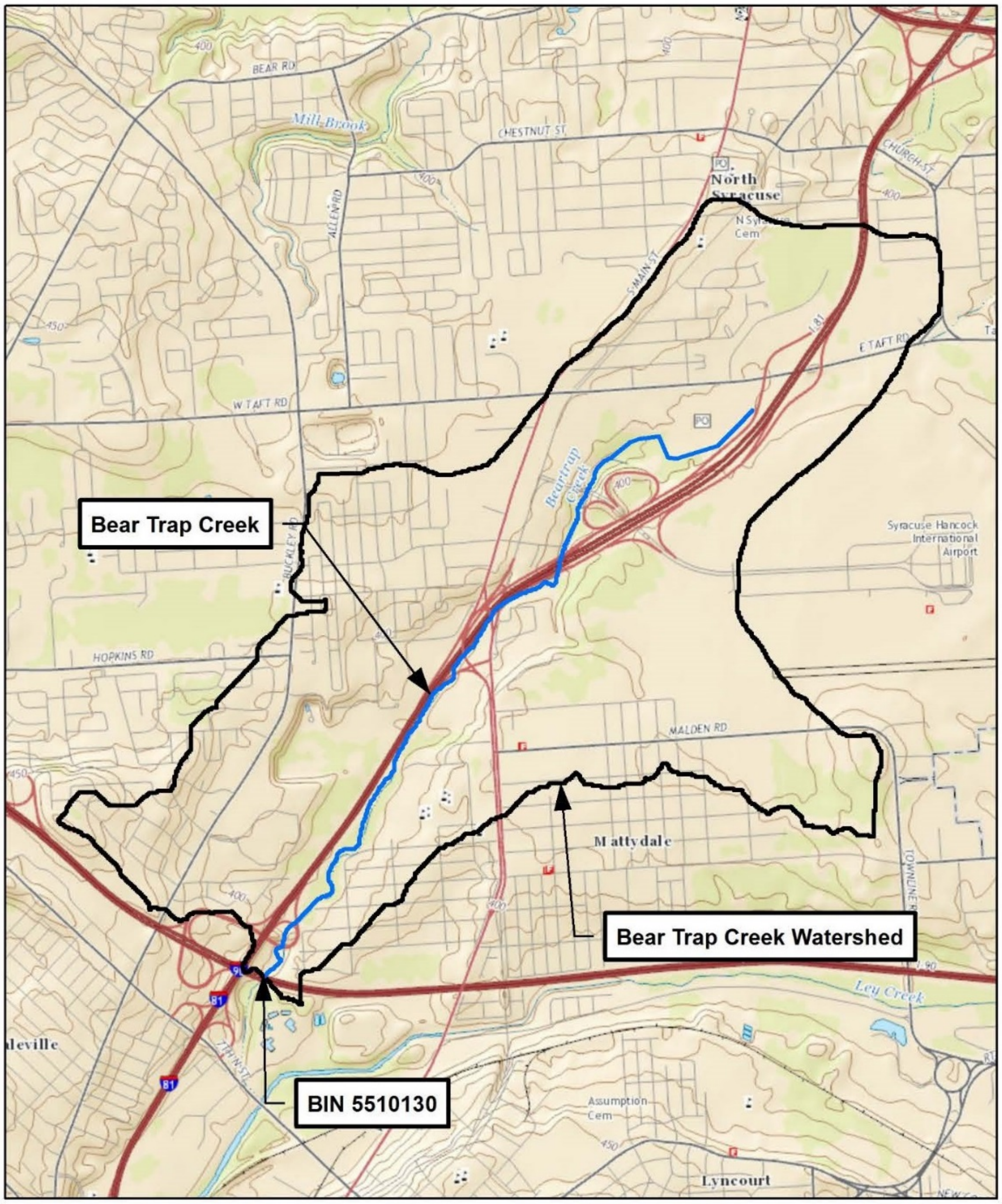

FIGURE 3 – WATERSHED FOR BEAR TRAP CREEK AT I-90 BIN 5510130

NEW YORK STATE THRUWAY AUTHORITY
Interstate 90 over Bear Trap Creek Bridge Replacement
M.P. 282.62; BIN 5510130
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4.0 HYDRAULICS

4.1 STREAM DESCRIPTION

Bear Trap Creek, near the project area, is characterized by a well-defined channel, with a relatively flat and well vegetated overbank (floodplain) area. The channel bottom has a relatively flat profile and corresponding low velocities under normal flow conditions. The overbank areas typically comprise a combination of brush, grass, trees, and open space. The channel bottom generally consists of a silty sand bottom. During a 50-Year design storm event the stream flow velocity at the existing bridge is estimated to be 2.24 ft/s.

Although the existing bridge creates a slight constriction of Bear Trap Creek, there was no evidence of scour. Due to the limited channel slope, the channel has accumulated silt within both cells of the structure.

Photo 3: Bear Trap Creek channel bed.

4.2 HYDRAULIC ANALYSIS

The HEC-RAS 5.0 software package, produced by the Army Corp of Engineers Hydraulic Engineering Center, was used as the basis to model the creek flow characteristics for both the existing and assumed proposed bridge conditions.

As previously discussed, Bear Trap Creek was studied by FEMA for the Town of Salina FIS, dated February 16, 1982. The original model was completed using HEC-2; the input and results from that model were obtained from NYSDEC. This original model was used to create the data for Bear Trap Creek that is now part of the Onondaga County FIS, dated November 4, 2016.

Along with the HEC-2 model data, channel cross sections and geometric data on BIN 5510130 were collected via instrument survey in January, 2017. Roughness coefficients were chosen based on record data included within the FEMA HEC-2 file. Cover types were assigned "n" values as shown in Table 2.

Table 2: Manning's "n" Values

Type of Cover	Manning's "n" Value
Concrete	0.013
Channel	0.02 – 0.035
Overbank	0.055 – 0.070

As part of the hydraulic analysis for this project, several models were created. A Duplicate Effective model was created using the original FEMA-developed HEC-2 data to create an existing model within the newer HEC-RAS software. That model was then used to create the Corrected Effective model that incorporated additional cross sectional data, and adjustments to the modeling procedures (to include adjustments in ineffective flows and manning's n values). That corrected effective model is considered herein to be the existing conditions model. A post project model was also created that incorporates the proposed structure.

The existing two-cell bridge was modeled using instrument survey data and is reflected in Figure 4. The summary output files (including channel cross sections, a channel profile, and data tables) for the "existing condition" hydraulic analysis is included in Appendix A.

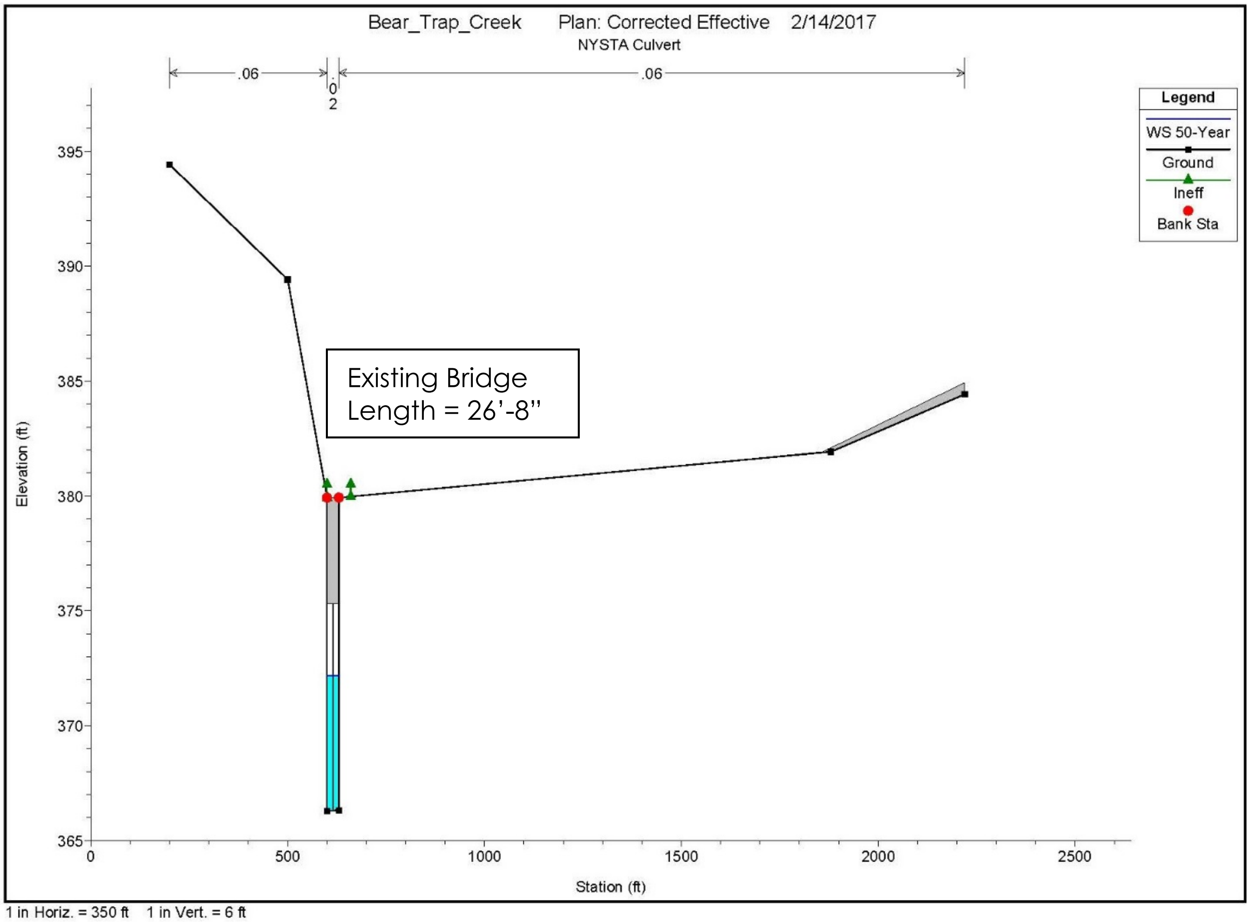


Figure 4: Existing BIN 5510130 Single Span Bridge Section (Looking Downstream)

This analysis assumes the replacement of the existing structure will be a new single span that will consist of a conventional bridge structure founded on concrete abutments bearing on pile foundations, with a clear span of 56'. A single span structure was chosen to provide a less obstructed hydraulic opening there by limiting the possibility of debris accumulating on the inlet end of the structure. The span has been increased to better align with the stream and to conform to USACE Section 404 Nationwide Permit General Condition #9, which requires a replacement structure span length to be 1.25 times the bank full channel width. As part of the project improvements, the low chord elevation should be set to provide a minimum of 2 feet of freeboard at the lowest point of the proposed structure. The ultimate bridge type will be selected by the Design-Build Team. If different than the structure assumed here, the hydraulic analysis will need to be updated.

It is also assumed that the footings that will support the proposed abutments will be founded on piles. To reduce the potential scour problems at the wingwalls, medium (minimum) stone fill should be placed along the banks to a minimum elevation 1-ft above the 50-year design storm flood elevation.

The assumed new bridge geometry (used in the proposed model) was developed to incorporate the above modifications. The assumed proposed bridge section is reflected in Figure 5. The summary output files for the anticipated conditions are included in Appendix B.

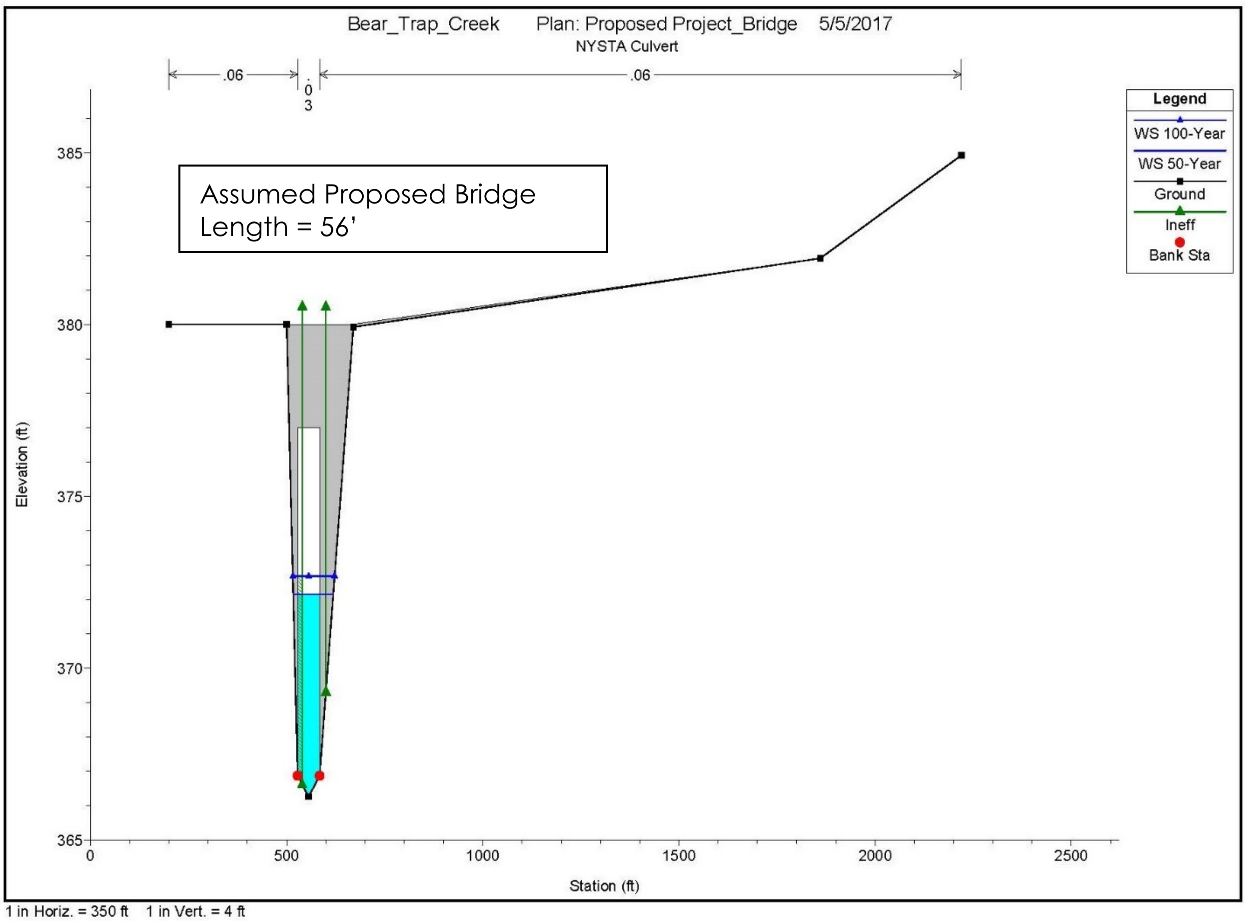


Figure 5: Proposed BIN 5510130 Single Span Bridge Section (Looking Downsteram)

4.3 MODEL RESULTS

Table 3 summarizes the hydraulic analysis and compare existing and assumed proposed conditions for the Interstate 90 bridge replacement over Bear Trap Creek.

Table 3: Hydraulic Model Results BIN 5510130

		50-Year Design Storm		100-Year Design Storm	
		Existing Bridge	Assumed Proposed Bridge	Existing Bridge	Assumed Proposed Bridge
Hydraulic Opening	Sq-Ft	225	459	225	459
Upstream Water Surface Elevation	Ft	372.25	372.23	372.75	372.74
Low Chord Elevation	Ft	375.31	377.0	375.31	377.0
Minimum Freeboard	Ft	3.06	4.77	2.56	4.26
Discharge/Flowrate	cfs	680	680	780	780
Average Velocity	cfs	4.08	2.73	4.31	2.87

4.4 SCOUR SUSCEPTIBILITY

The assumed proposed structure is assumed to be founded on abutments bearing on piles. A scour analysis was completed to determine scour depths of the natural earthen channel bottom. The projected scour depth for BIN 5510130 for the 100-year storm event is 11.93 feet and the depth for the 500-year storm is 12.02 feet. The scour analysis and depths are based on a single span conventional bridge structure with concrete abutments, and an earthen channel bottom with no bedrock.

The bottom of the channel at BIN 5510130 consists of a silty sand bottom that is generally susceptible to scour. Based on the scour analysis it is recommended that proposed piles supporting the new foundation be driven bellow the bottom elevation of the possible scour hole caused by the 500-year storm. Also, the inlet and outlet ends of the new structure should have a Medium Stone Fill (minimum) apron as well as stone fill on the effected channel banks to an elevation that is 1-ft above the 50-year design storm on the channel banks.

5.0 CONCLUSION

Based on the results of the analysis of the assumed replacement structure, the 50-year and 100-year water surface elevations will remain effectively unchanged (-0.02 feet and -0.01 feet respectively) at BIN 5510130. The 50 and 100-year stream flow velocities will decrease through the structure, as illustrated in Table 3. Based on assumed structure depth of 3 feet, the new bridge structure will provide 4.77' of freeboard for the 50-year design storm.

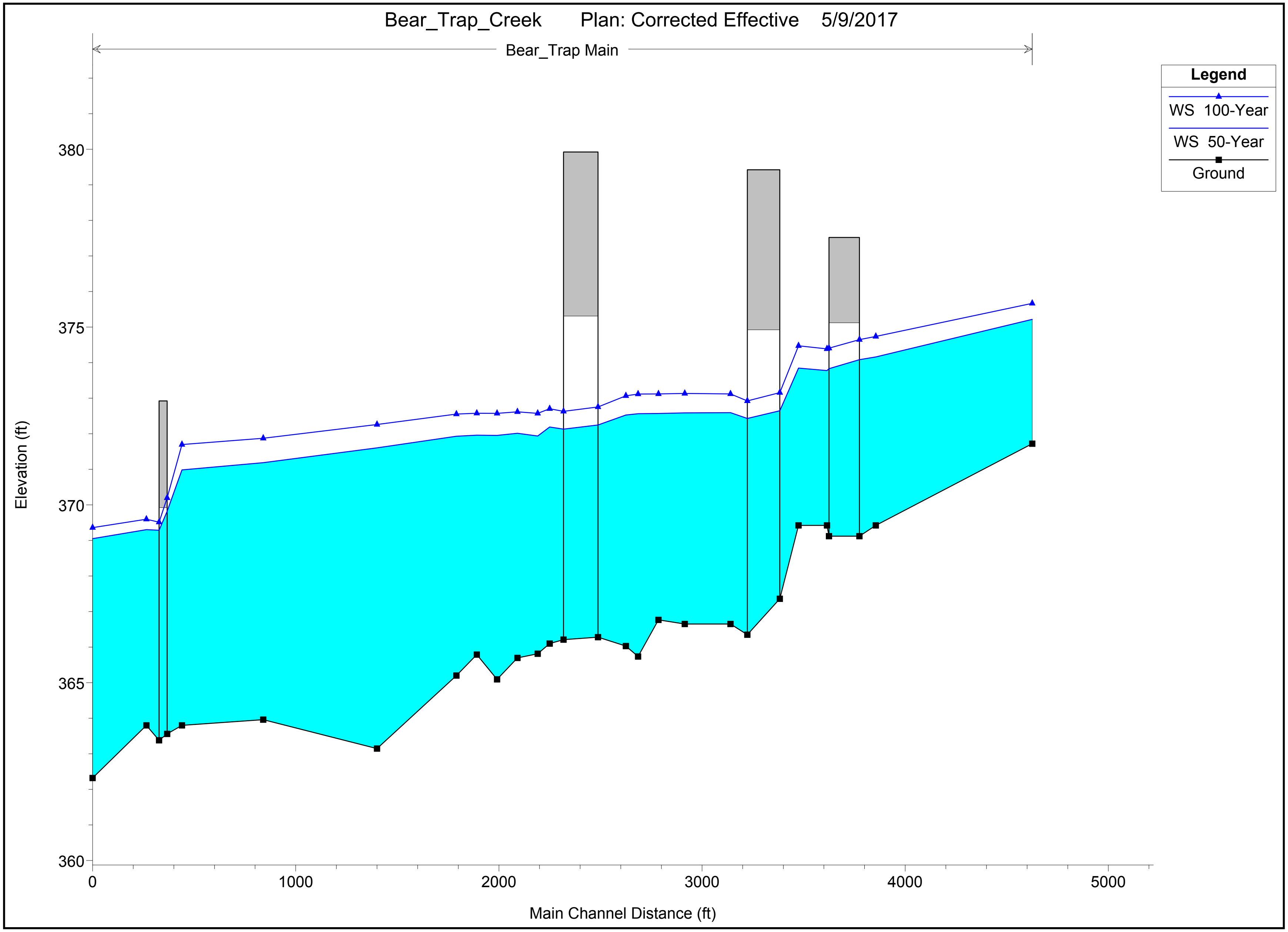
Scour protection will be provided for the substructures by founding them on piles. Erosion and scour protection for the embankments as well as the inlet and outlet channel should be provided using Medium Stone Fill (minimum) as described in section 4.4 of this report.

The construction of the assumed bridge will not adversely affect the hydraulics of Bear Trap Creek for either the 50-year or 100-year storm events.

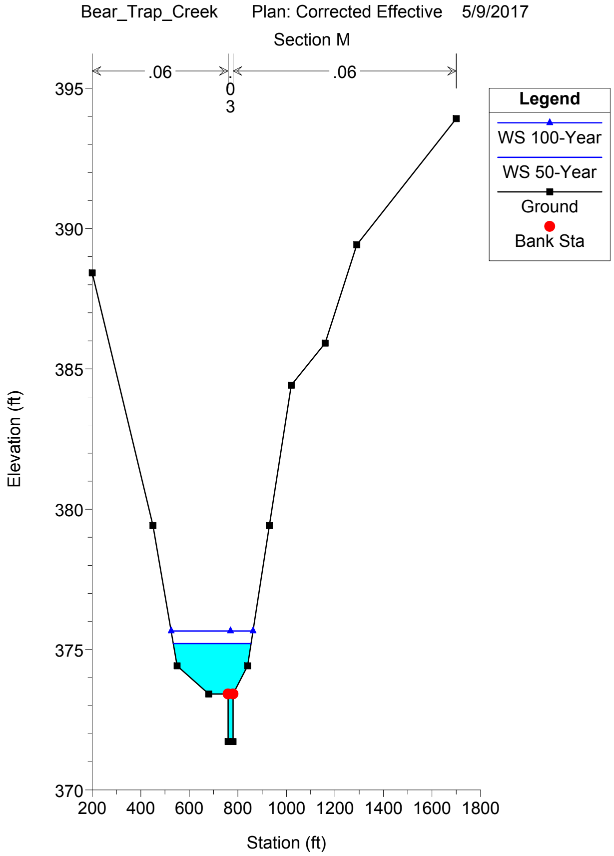
Appendix A : EXISTING CONDITION HEC-RAS MODEL

HEC-RAS Plan: Cor. Effective River: Bear_Trap Reach: Main

Reach	River Sta	Profile	E.G. Elev	W.S. Elev	Crit W.S.	Frctn Loss	C & E Loss	Top Width	Q Left	Q Channel	Q Right	Vel Chnl
			(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(cfs)	(cfs)	(cfs)	(ft/s)
Main	4795	50-Year	375.30	375.22		0.70	0.03	320.21	348.71	252.80	78.49	3.62
Main	4795	100-Year	375.72	375.66		0.53	0.04	337.27	430.48	245.12	104.41	3.11
Main	4005	50-Year	374.57	374.16	372.27	0.07	0.00	181.75		680.00		5.14
Main	4005	100-Year	375.16	374.73	372.51	0.07	0.01	224.18		780.00		5.22
Main	3875 BR U	50-Year	374.50	374.08	371.85	0.19	0.01	26.50		680.00		5.17
Main	3875 BR U	100-Year	375.09	374.65	372.12	0.19	0.01	26.50		780.00		5.33
Main	3875 BR D	50-Year	374.29	373.83	371.85	0.01	0.01	26.50		680.00		5.45
Main	3875 BR D	100-Year	374.89	374.40	372.12	0.01	0.00	26.50		780.00		5.57
Main	3765	50-Year	374.27	373.78	372.27	0.08	0.15	101.65		680.00		5.64
Main	3765	100-Year	374.88	374.39	372.51	0.06	0.15	120.23		780.00		5.61
Main	3625	50-Year	374.04	373.84	371.81	0.08	0.26	236.83		680.00		3.56
Main	3625	100-Year	374.66	374.47	371.98	0.07	0.29	285.28		780.00		3.50
Main	3525 BR U	50-Year	373.70	372.64	371.31	0.44	0.23	16.00		680.00		8.24
Main	3525 BR U	100-Year	374.30	373.16	371.68	0.47	0.24	16.00		780.00		8.60
Main	3525 BR D	50-Year	373.03	372.43	369.88	0.05	0.21	18.00		680.00		6.22
Main	3525 BR D	100-Year	373.60	372.92	370.24	0.04	0.24	18.00		780.00		6.59
Main	3290	50-Year	372.77	372.59	369.53	0.05	0.04	140.45		680.00		3.40
Main	3290	100-Year	373.31	373.12	369.78	0.04	0.05	164.80		780.00		3.53
Main	3065	50-Year	372.68	372.58		0.03	0.00	295.74	144.00	491.03	44.97	2.99
Main	3065	100-Year	373.22	373.13		0.02	0.00	341.69	198.76	519.18	62.06	2.88
Main	2835.272	50-Year	372.63	372.56		0.01	0.00	241.46	150.67	254.84	274.49	3.21
Main	2835.272	100-Year	373.17	373.11		0.01	0.00	249.65	188.24	268.21	323.55	3.09
Main	2775	50-Year	372.61	372.53	369.24	0.05	0.05	208.08		680.00		2.34
Main	2775	100-Year	373.15	373.06	369.42	0.05	0.06	241.26		780.00		2.42
Main	2650 BR U	50-Year	372.50	372.25	368.93	0.11	0.00	28.00		680.00		4.08
Main	2650 BR U	100-Year	373.04	372.75	369.19	0.12	0.00	28.00		780.00		4.31
Main	2650 BR D	50-Year	372.39	372.13	368.89	0.03	0.09	28.00		680.00		4.13
Main	2650 BR D	100-Year	372.92	372.63	369.15	0.03	0.10	28.00		780.00		4.37
Main	2400	50-Year	372.27	372.19	368.65	0.04	0.05	151.64		680.00		2.27
Main	2400	100-Year	372.79	372.70	368.85	0.03	0.02	170.64		780.00		2.37
Main	2340.5	50-Year	372.18	371.94		0.06	0.06	169.65	116.45	426.06	137.49	4.92
Main	2340.5	100-Year	372.73	372.57		0.05	0.04	171.97	129.49	412.66	237.85	4.28
Main	990	50-Year	371.37	371.18		0.24	0.02	51.16	7.58	668.69	3.73	3.53
Main	990	100-Year	372.07	371.87		0.22	0.02	59.42	17.31	754.16	8.53	3.59
Main	590	50-Year	371.12	370.98	366.80	0.10	0.25	122.78		680.00		2.94
Main	590	100-Year	371.83	371.69	367.06	0.10	0.32	160.50		780.00		3.01
Main	550 BR U	50-Year	370.77	369.82	367.80	0.37	0.04	14.00		680.00		7.84
Main	550 BR U	100-Year	371.41	370.20	368.22	0.55	0.03			780.00		8.85
Main	550 BR D	50-Year	370.36	369.28	367.63	0.32	0.34	14.00		680.00		8.34
Main	550 BR D	100-Year	370.83	369.51	368.05	0.35	0.43	14.00		780.00		9.21
Main	415	50-Year	369.71	369.30	367.76	0.38	0.13	40.18		680.00		5.11
Main	415	100-Year	370.04	369.60	368.03	0.38	0.14	41.71		780.00		5.38
Main	150	50-Year	369.20	369.05	365.87			159.69	10.65	663.77	5.58	3.18
Main	150	100-Year	369.52	369.36	366.13			207.97	27.27	738.43	14.30	3.31



1 in Horiz. = 700 ft 1 in Vert. = 4 ft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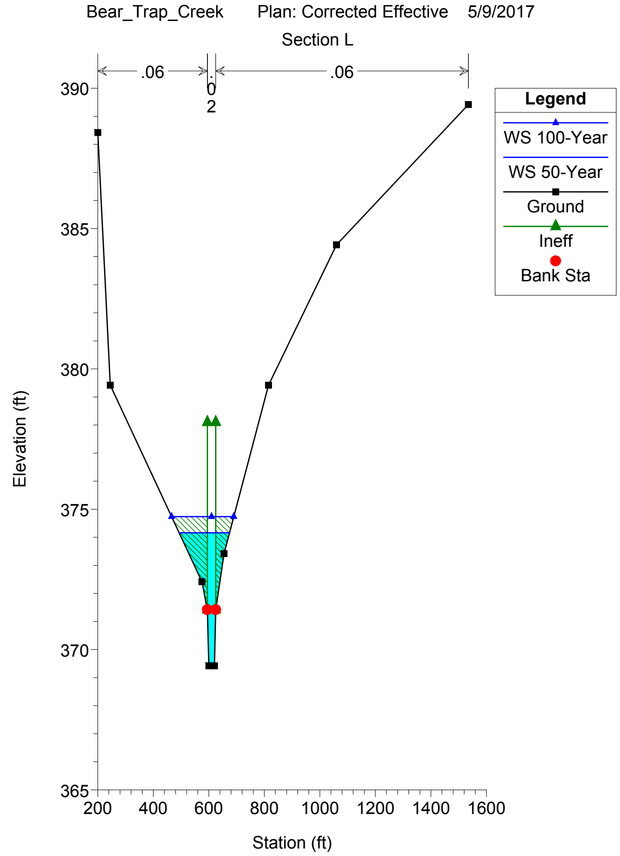
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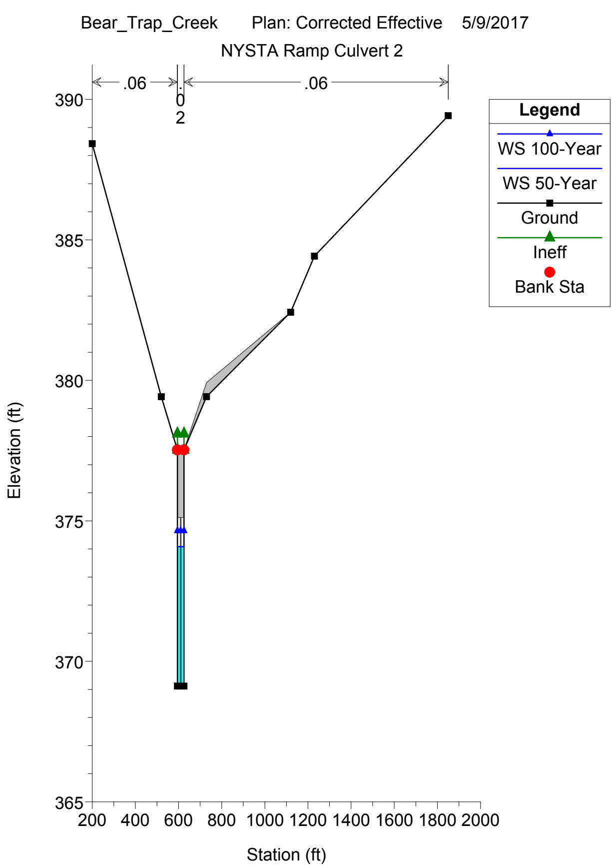
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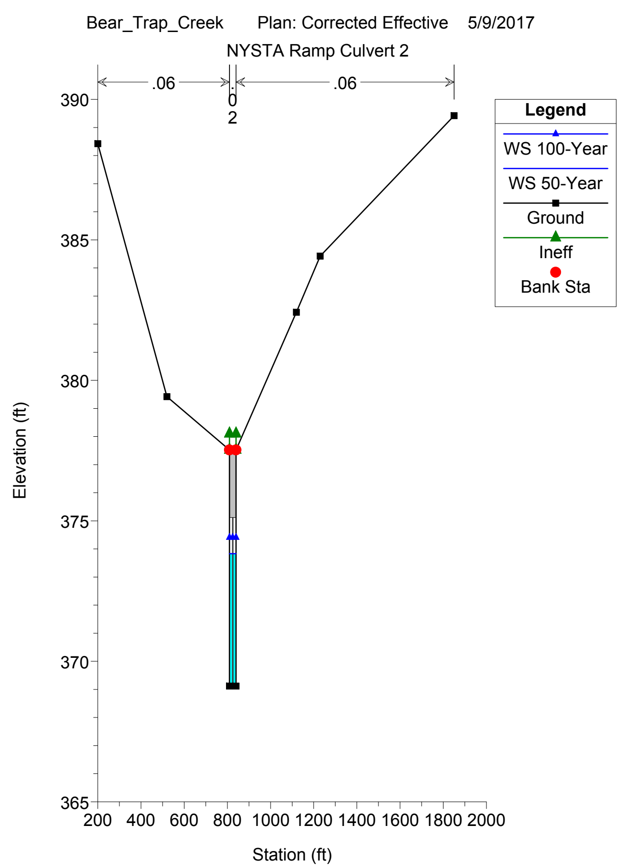
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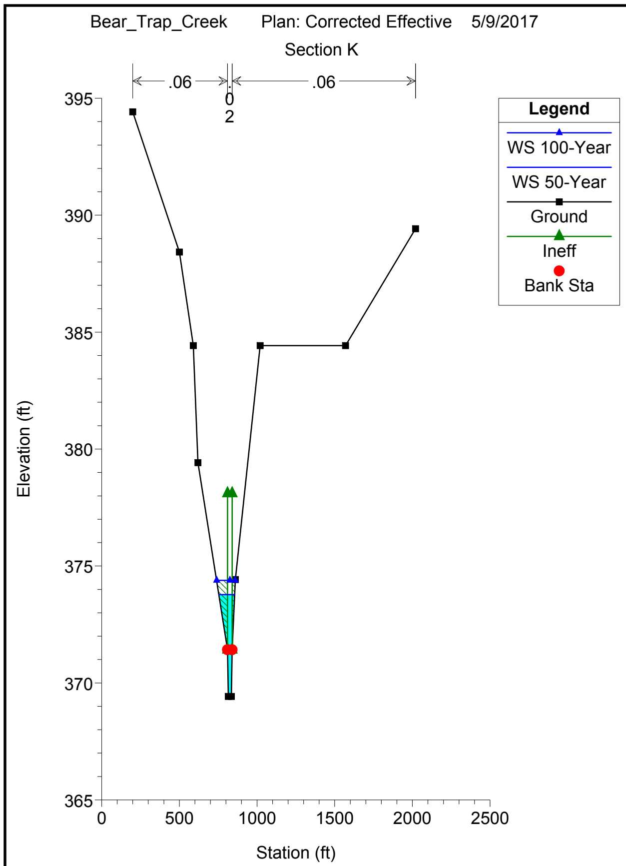
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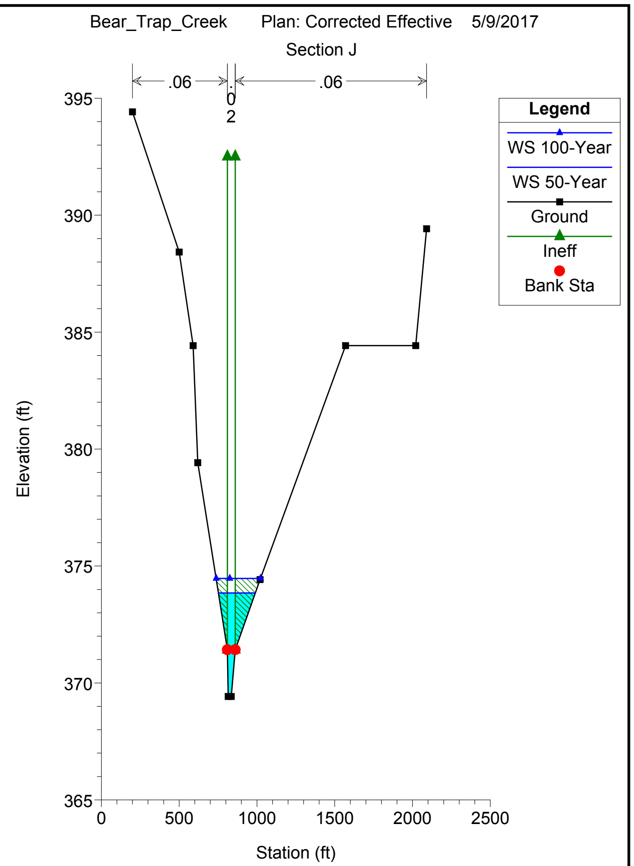
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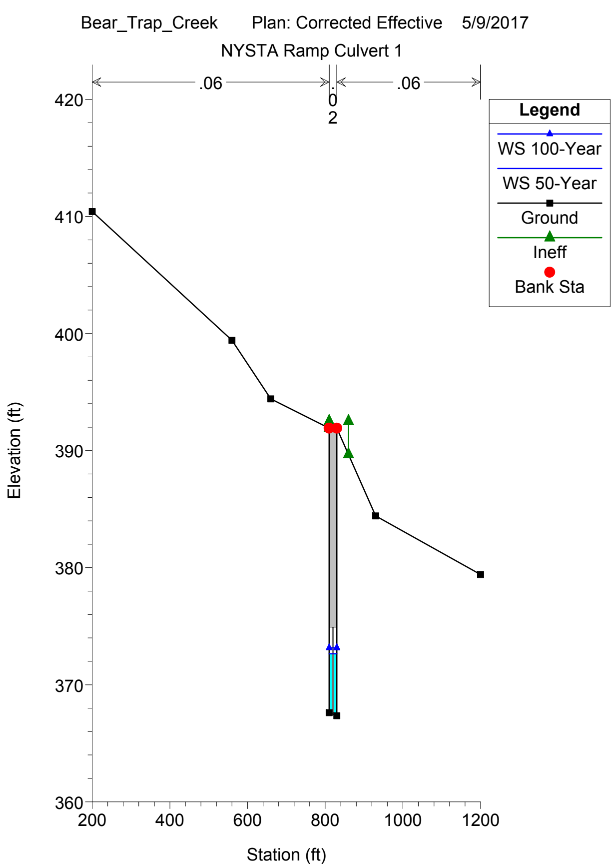
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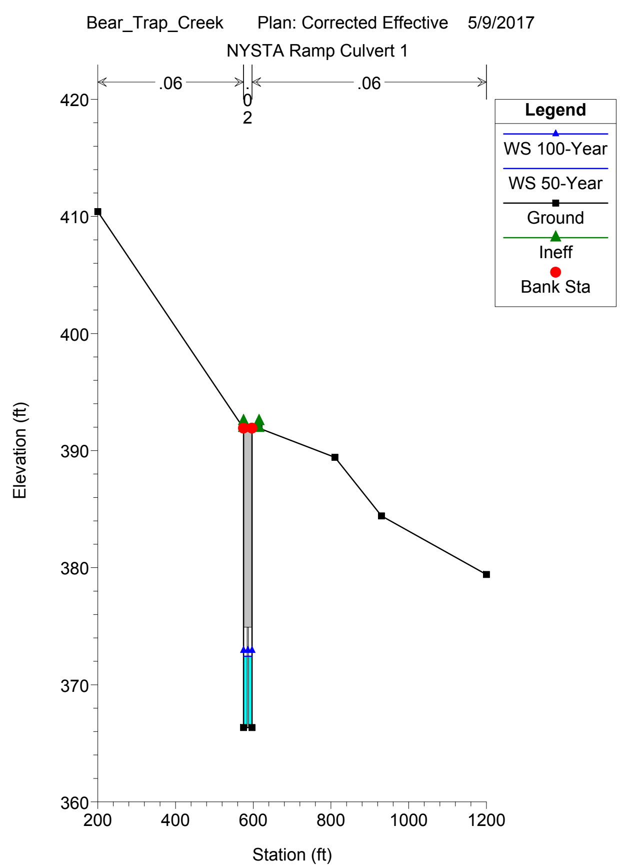
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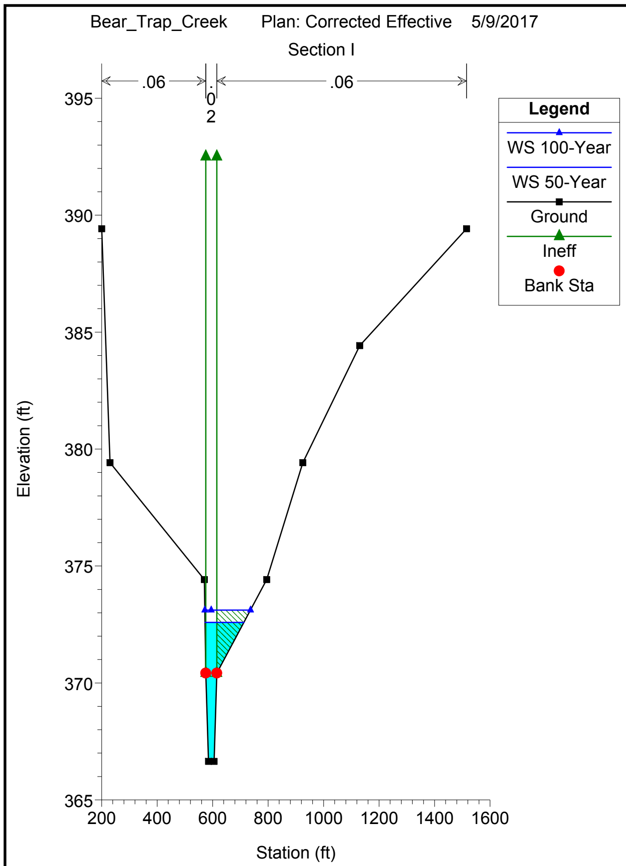
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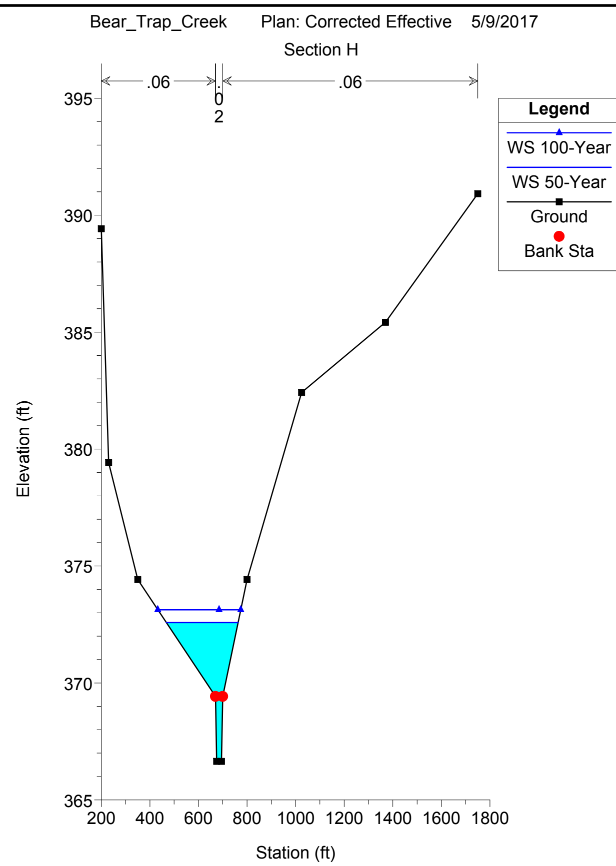
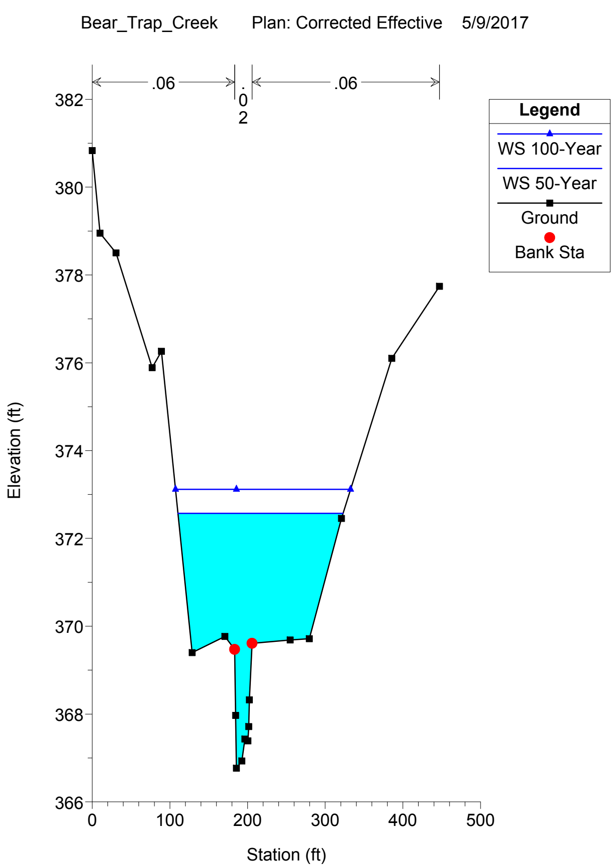

Bear_Trap_Creek Plan: Corrected Effective 5/9/2017
Section H
.06
0
2
.06
Legend
WS 100-Year
WS 50-Year
Ground
Bank Sta
Elevation (ft)
Station (ft)
395
390
385
380
375
370
365
200 400 600 800 1000 1200 1400 1600 1800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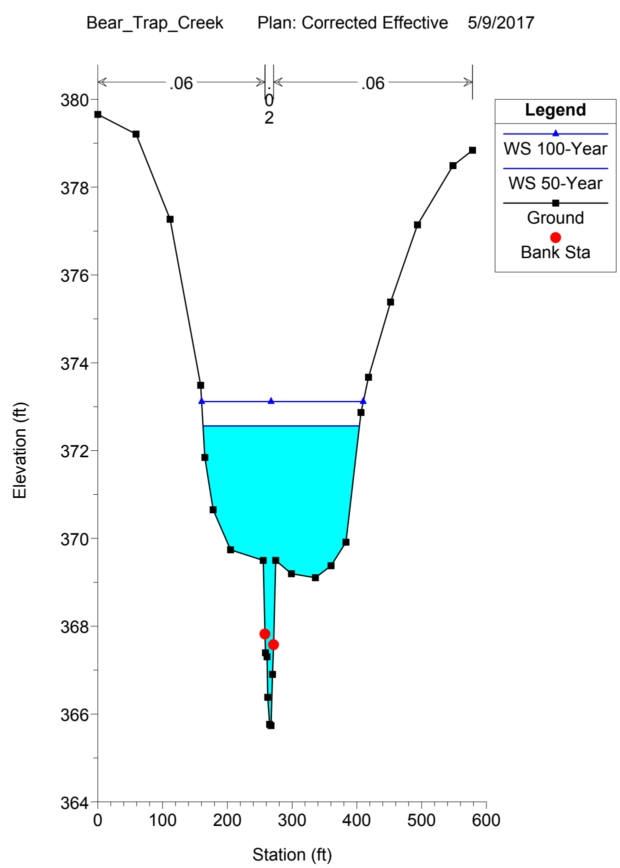
Legend
WS 100-Year
WS 50-Year
Ground
Bank Sta
Elevation (ft)
Station (ft)
382
380
378
376
374
372
370
368
366
0 100 200 300 400 500


Bear_Trap_Creek Plan: Corrected Effective 5/9/2017
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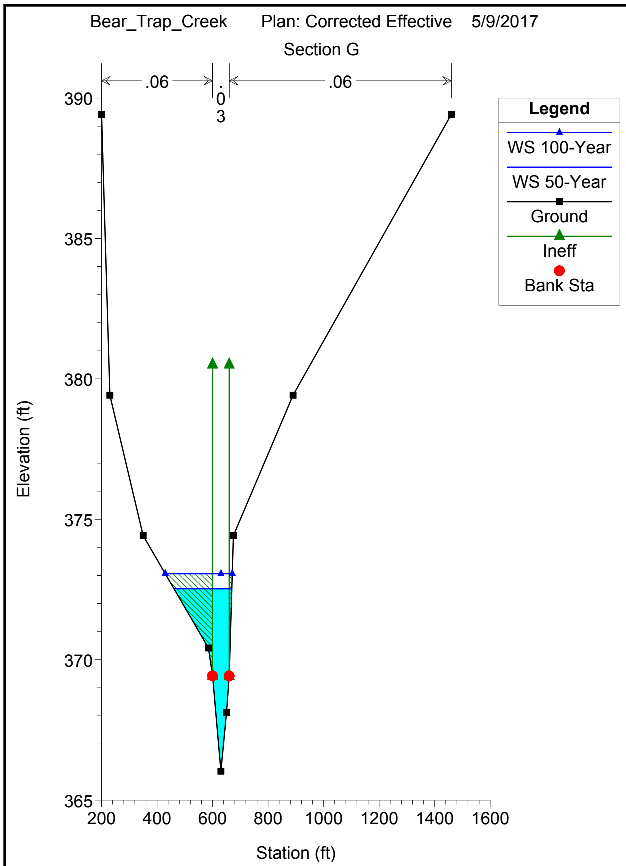
2
.06
Legend
WS 100-Year
WS 50-Year
Ground
Bank Sta
Elevation (ft)
Station (ft)
380
378
376
374
372
370
368
366
364
0 100 200 300 400 500 600


Bear_Trap_Creek Plan: Corrected Effective 5/9/2017
Section G
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Legend
WS 100-Year
WS 50-Year
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
390
385
380
375
370
365
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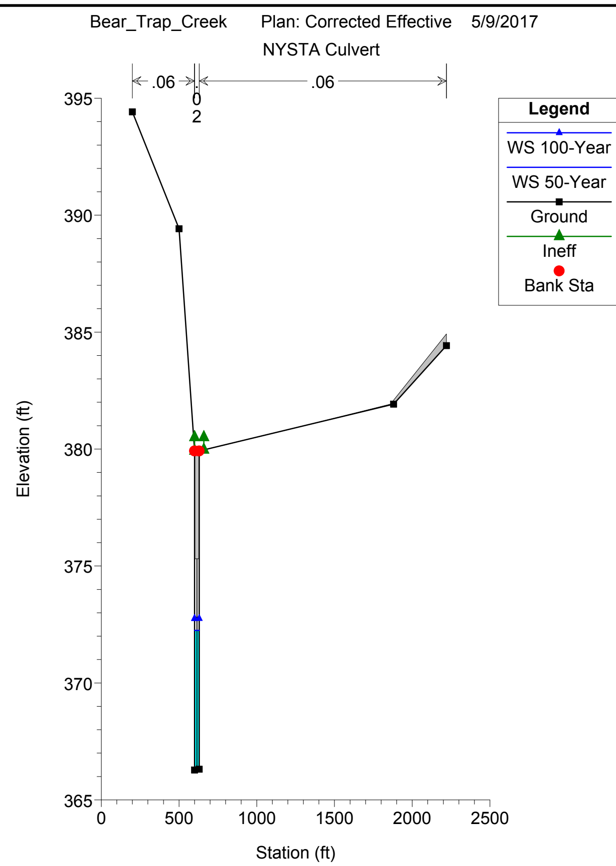
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NYSTA Culvert
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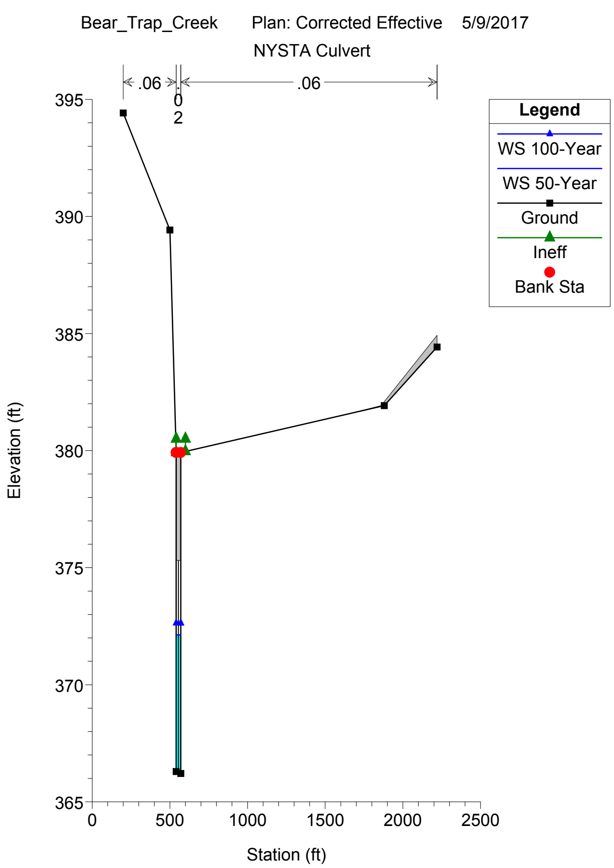
.06
0
2
Legend
WS 100-Year
WS 50-Year
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
395
390
385
380
375
370
365
0 500 1000 1500 2000 2500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NYSTA Culvert
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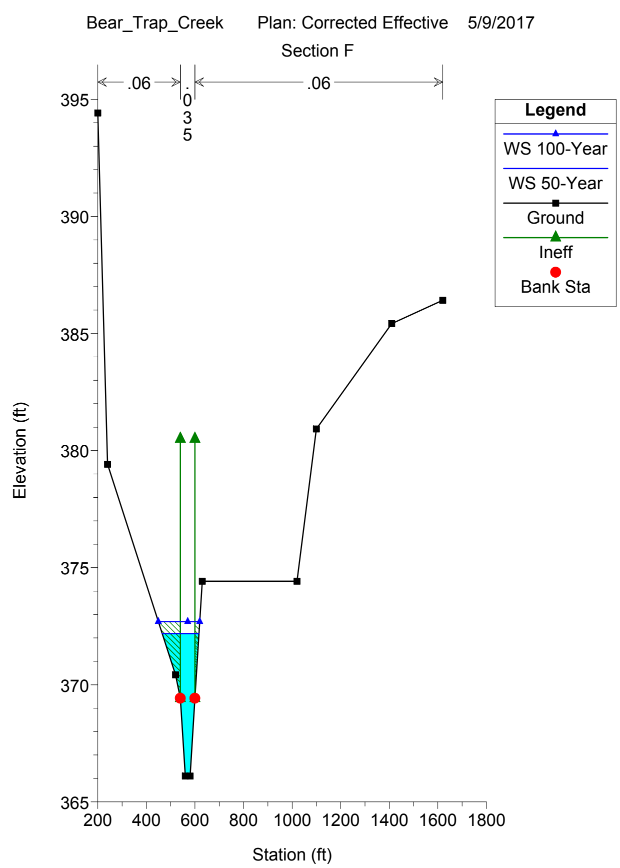
.06
0
2
Legend
WS 100-Year
WS 50-Year
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
395
390
385
380
375
370
365
0 500 1000 1500 2000 2500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Section F
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.06
0
3
5
Legend
WS 100-Year
WS 50-Year
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
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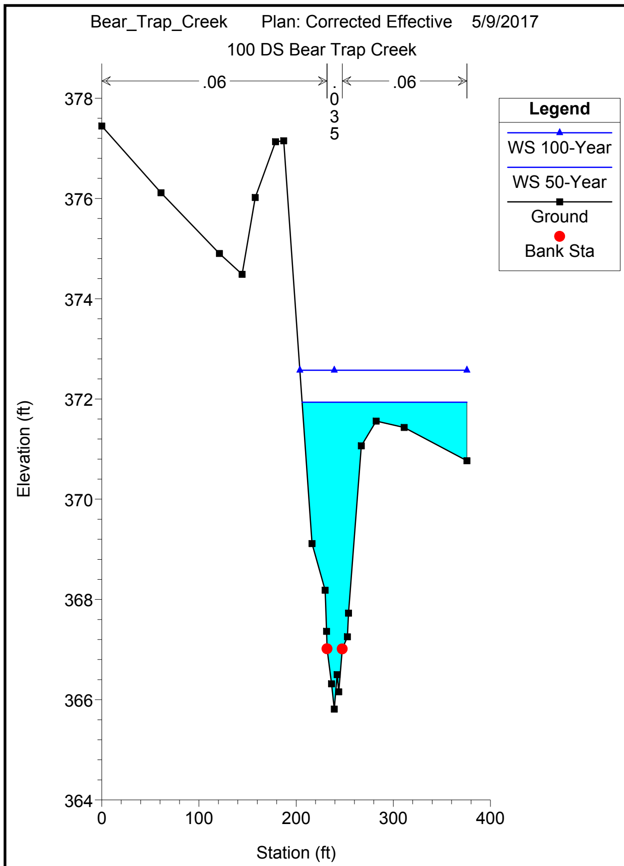
390
385
380
375
370
365
200 400 600 800 1000 1200 1400 1600 1800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100 DS Bear Trap Creek
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.035
.06
Legend
WS 100-Year
WS 50-Year
Ground
Bank Sta
Elevation (ft)
Station (ft)
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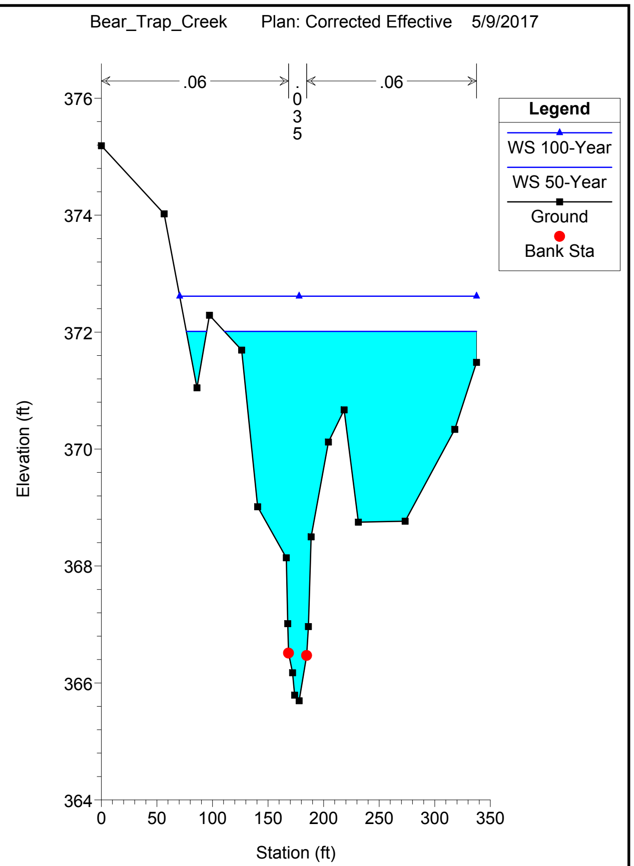
366
368
370
372
374
376
378
0
100
200
300
400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.035
.06
Legend
WS 100-Year
WS 50-Year
Ground
Bank Sta
Elevation (ft)
Station (ft)
364
366
368
370
372
374
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0
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100
150
200
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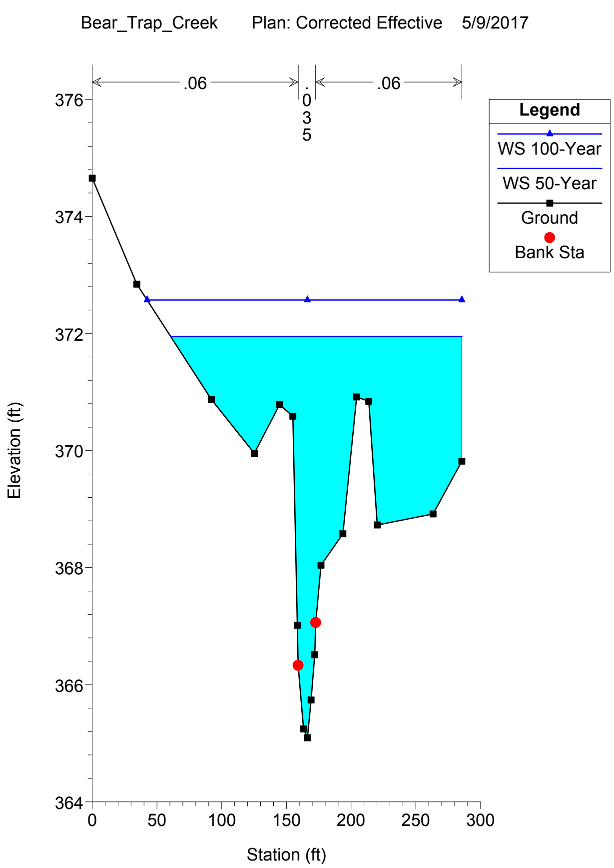
300
350


Bear_Trap_Creek Plan: Corrected Effective 5/9/2017
.06
.035
.06
Legend
WS 100-Year
WS 50-Year
Ground
Bank Sta
Elevation (ft)
Station (ft)
364
366
368
370
372
374
376
0
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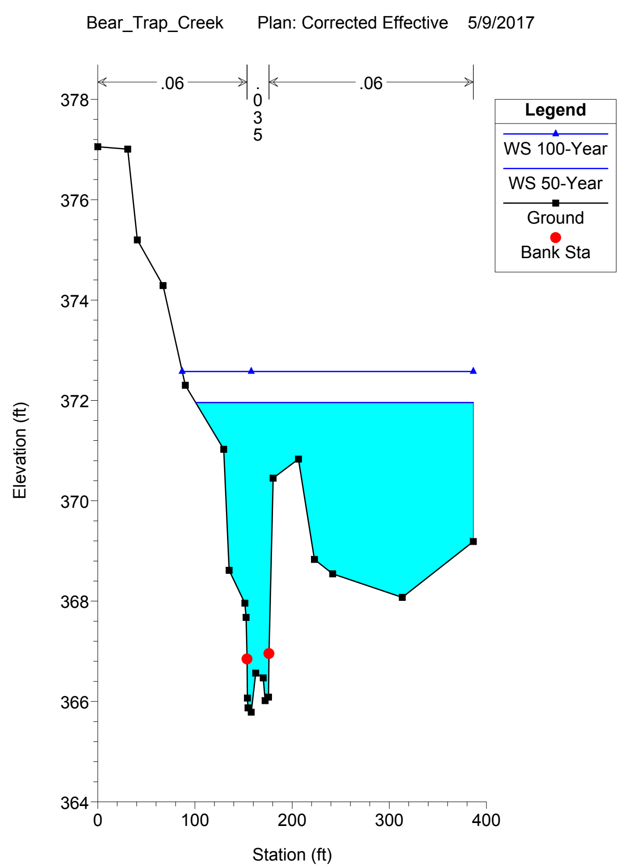
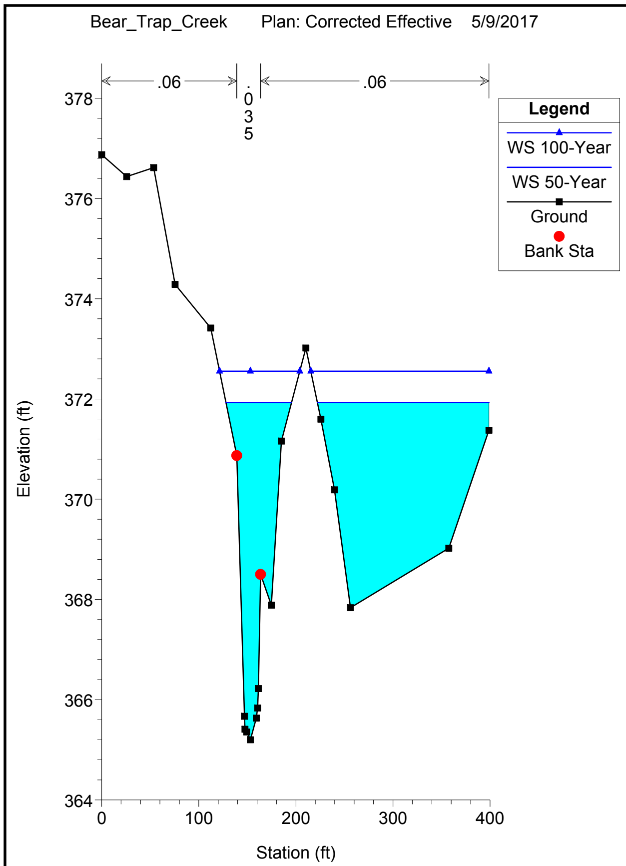
100
150
200
250
300


Bear_Trap_Creek Plan: Corrected Effective 5/9/2017
.06
.035
.06
Legend
WS 100-Year
WS 50-Year
Ground
Bank Sta
Elevation (ft)
Station (ft)
364
366
368
370
372
374
376
378
0
100
200
300
400


Bear_Trap_Creek Plan: Corrected Effective 5/9/2017
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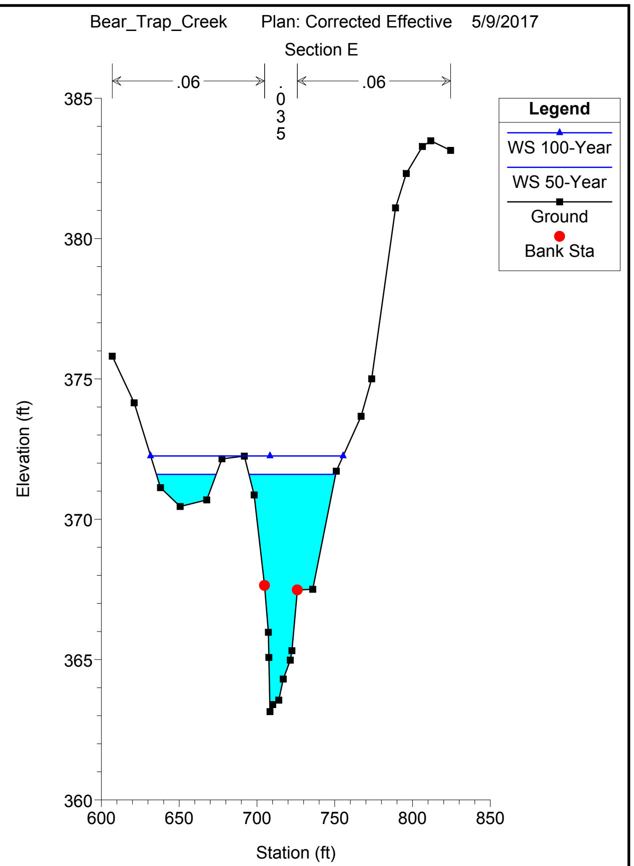
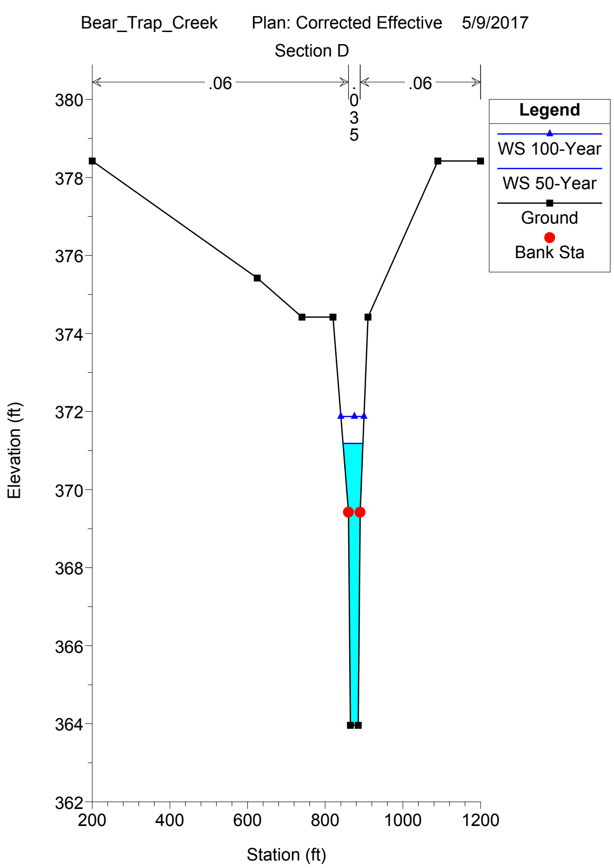
.035
.06
Legend
WS 100-Year
WS 50-Year
Ground
Bank Sta
Elevation (ft)
Station (ft)
378
376
374
372
370
368
366
364
0
100
200
300
400


Bear_Trap_Creek Plan: Corrected Effective 5/9/2017
Section E
.06
.035
.06
Legend
WS 100-Year
WS 50-Year
Ground
Bank Sta
Elevation (ft)
Station (ft)
385
380
375
370
365
360
600
650
700
750
800
850


Bear_Trap_Creek Plan: Corrected Effective 5/9/2017
Section D
.06
.035
.06
Legend
WS 100-Year
WS 50-Year
Ground
Bank Sta
Elevation (ft)
Station (ft)
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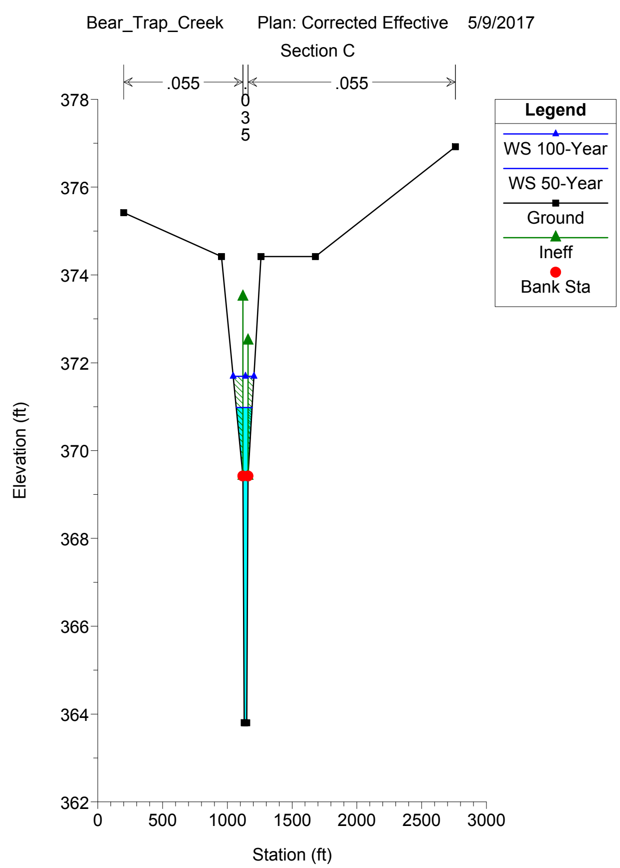
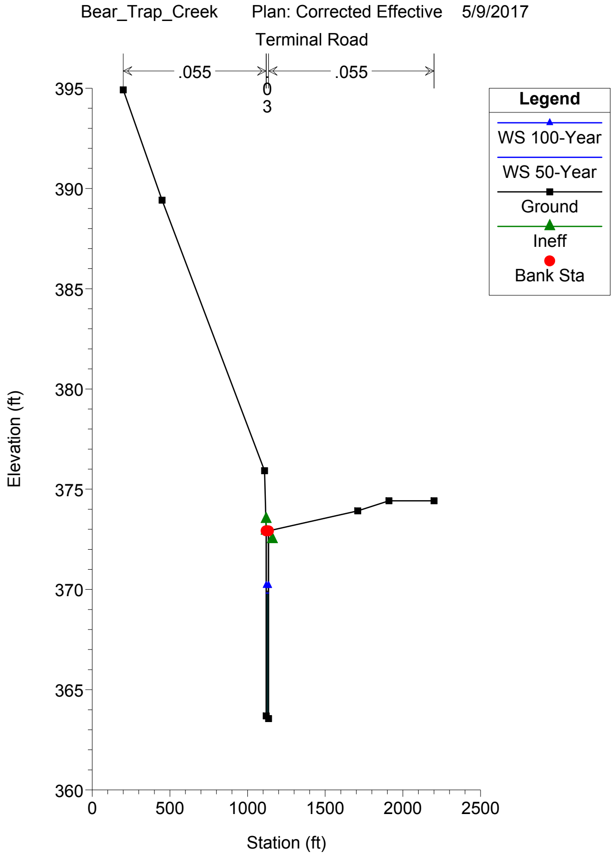
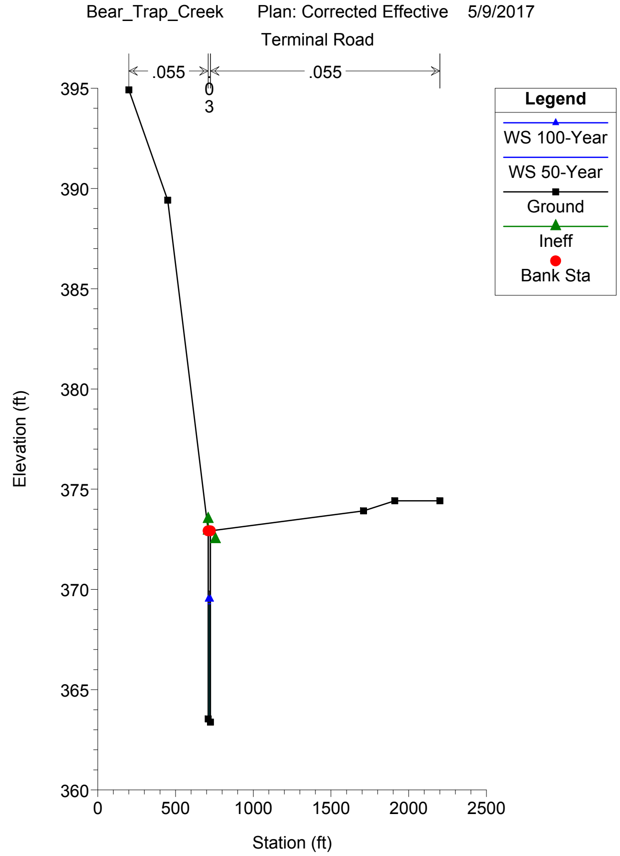
378
376
374
372
370
368
366
364
362
200
400
600
800
1000
1200

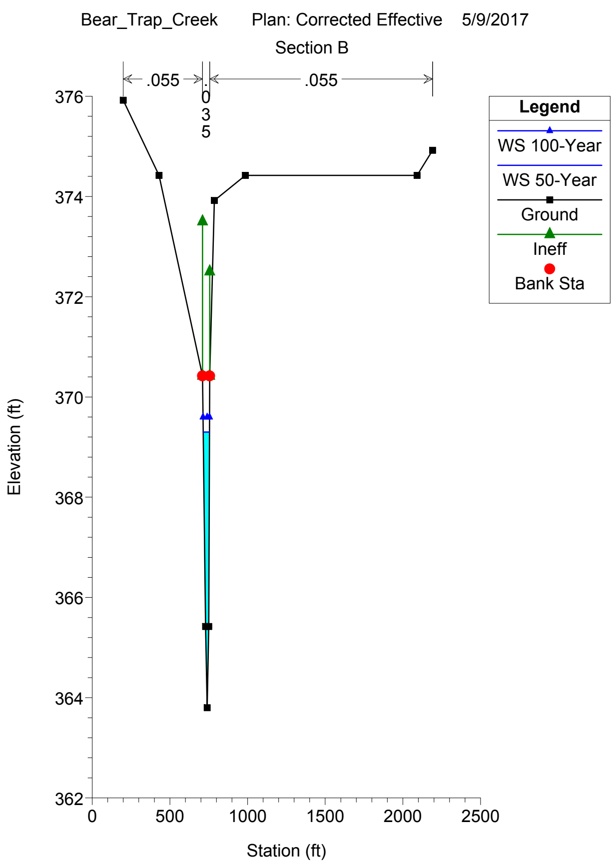

Bear_Trap_Creek Plan: Corrected Effective 5/9/2017
Section C
.055
.035
.055
Legend
WS 100-Year
WS 50-Year
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
378
376
374
372
370
368
366
364
362
0
500
1000
1500
2000
2500
3000



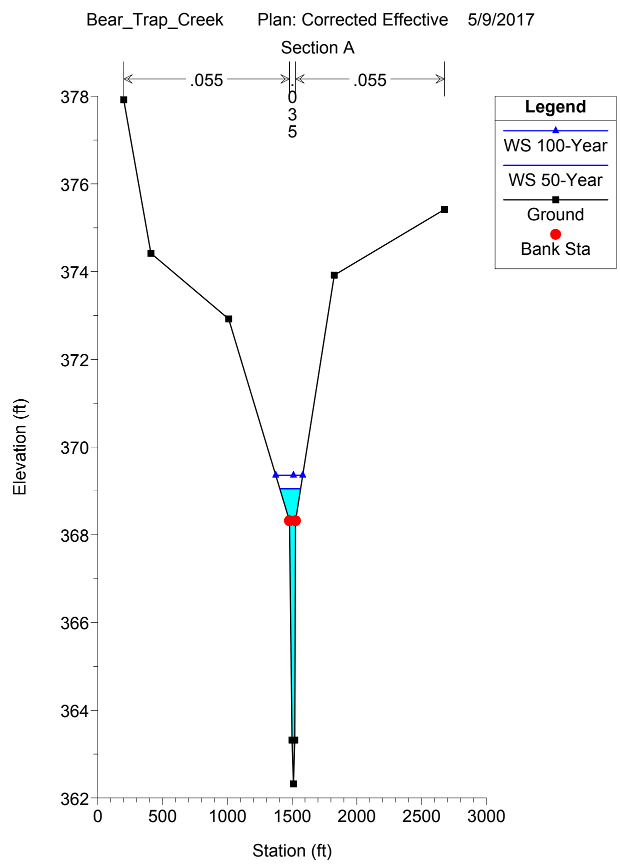
Bear_Trap_Creek Plan: Corrected Effective 5/9/2017
Terminal Road
.055
0
3
.055
Legend
WS 100-Year
WS 50-Year
Ground
Ineff
Bank Sta
Elevation (ft)
395
390
385
380
375
370
365
360
0
500
1000
1500
2000
2500
Station (ft)



Bear_Trap_Creek Plan: Corrected Effective 5/9/2017
Terminal Road
.055
0
3
.055
Legend
WS 100-Year
WS 50-Year
Ground
Ineff
Bank Sta
Elevation (ft)
395
390
385
380
375
370
365
360
0
500
1000
1500
2000
2500
Station (ft)



Bear_Trap_Creek Plan: Corrected Effective 5/9/2017
Section B
.055
0
3
5
.055
Legend
WS 100-Year
WS 50-Year
Ground
Ineff
Bank Sta
Elevation (ft)
376
374
372
370
368
366
364
362
0
500
1000
1500
2000
2500
Station (ft)

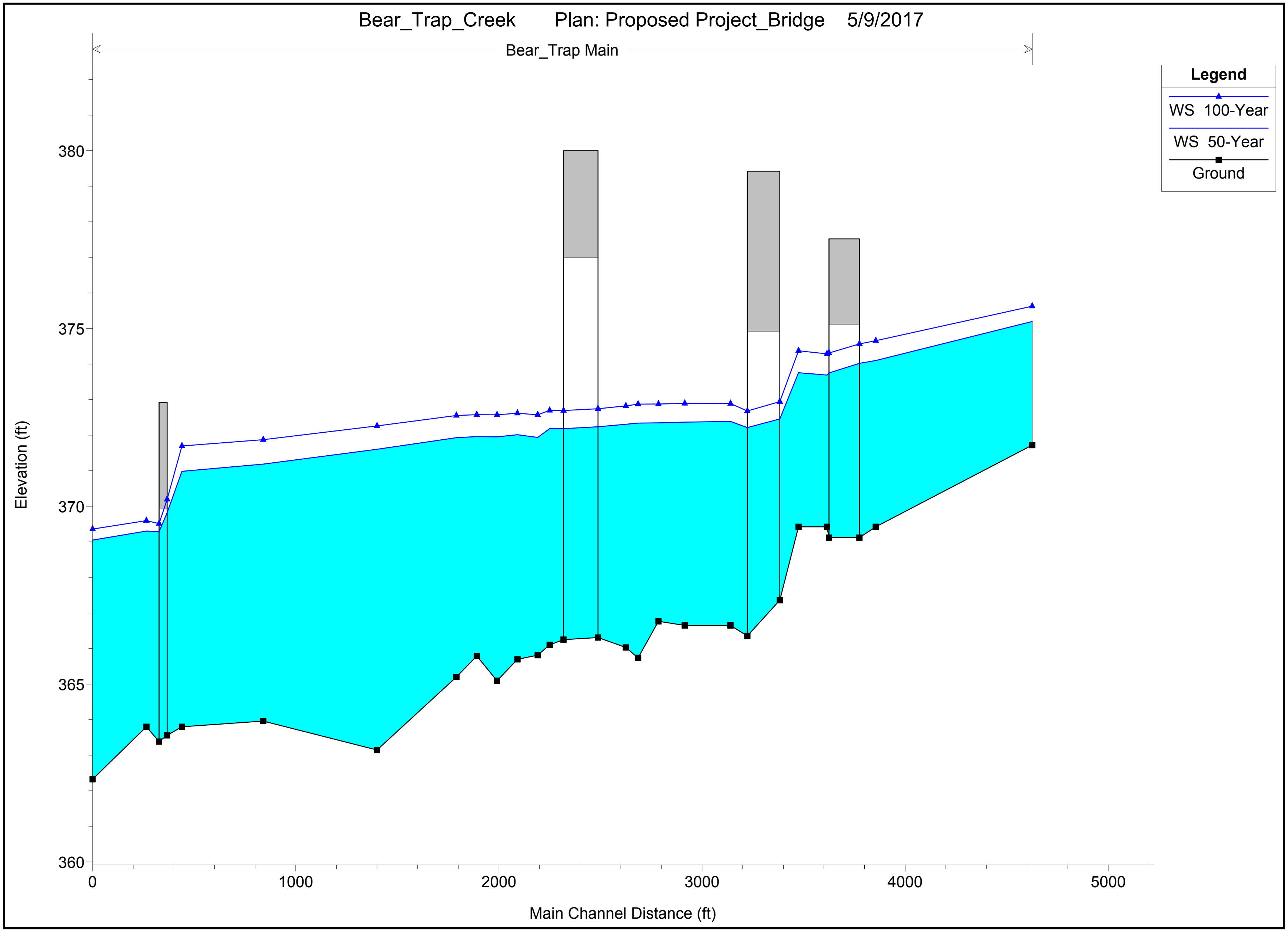


Bear_Trap_Creek Plan: Corrected Effective 5/9/2017
Section A
.055
0
3
5
.055
Legend
WS 100-Year
WS 50-Year
Ground
Bank Sta
Elevation (ft)
378
376
374
372
370
368
366
364
362
0
500
1000
1500
2000
2500
3000
Station (ft)

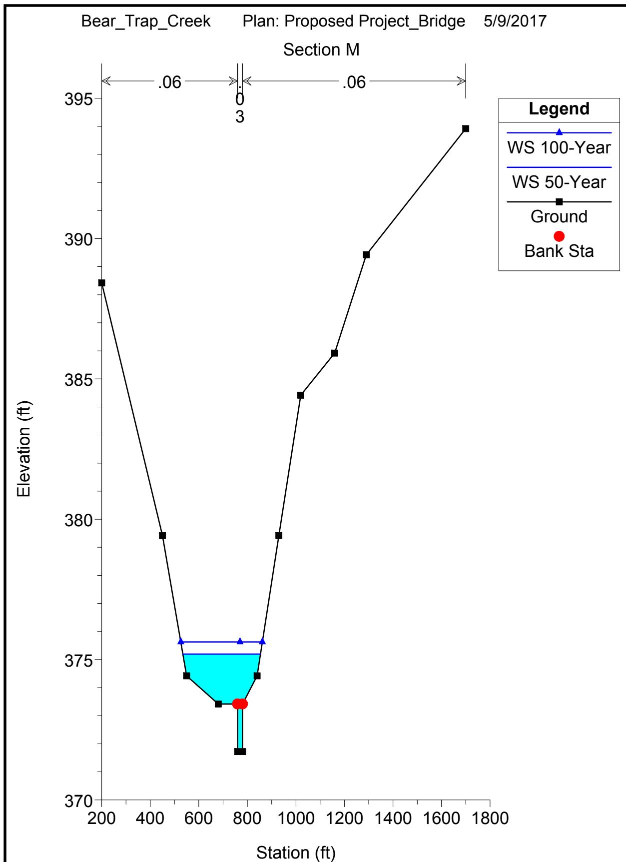
Appendix B: PROPOSED CONDITION HEC-RAS MODEL

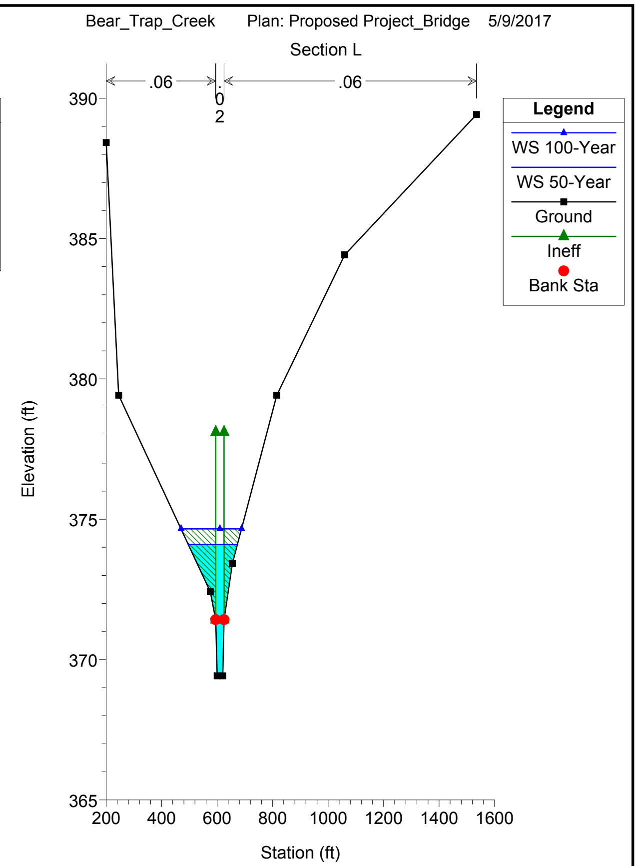
HEC-RAS Plan: Pr. Bridge River: Bear_Trap Reach: Main

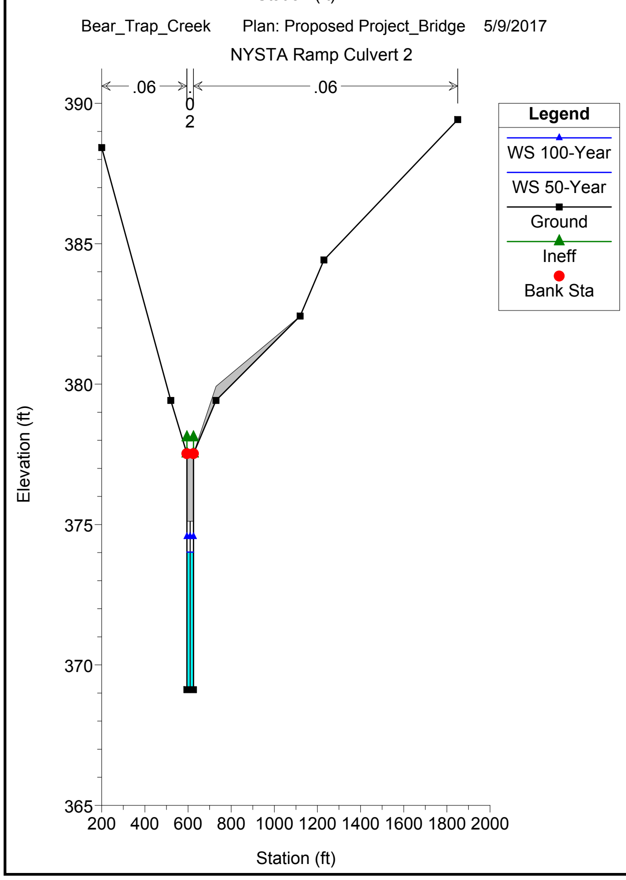
Reach	River Sta	Profile	E.G. Elev	W.S. Elev	Crit W.S.	Frctn Loss	C & E Loss	Top Width	Q Left	Q Channel	Q Right	Vel Chnl
			(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(cfs)	(cfs)	(cfs)	(ft/s)
Main	4795	50-Year	375.28	375.19		0.73	0.03	319.39	347.05	255.18	77.77	3.67
Main	4795	100-Year	375.69	375.63		0.56	0.04	335.85	428.47	248.17	103.37	3.18
Main	4005	50-Year	374.52	374.10	372.27	0.07	0.00	177.11		680.00		5.22
Main	4005	100-Year	375.09	374.66	372.51	0.07	0.01	218.37		780.00		5.30
Main	3875 BR U	50-Year	374.44	374.02	371.85	0.20	0.02	26.50		680.00		5.24
Main	3875 BR U	100-Year	375.02	374.56	372.12	0.20	0.01	26.50		780.00		5.41
Main	3875 BR D	50-Year	374.23	373.75	371.85	0.01	0.01	26.50		680.00		5.54
Main	3875 BR D	100-Year	374.81	374.31	372.12	0.01	0.00	26.50		780.00		5.67
Main	3765	50-Year	374.20	373.69	372.27	0.09	0.15	98.95		680.00		5.76
Main	3765	100-Year	374.80	374.28	372.51	0.07	0.16	117.13		780.00		5.74
Main	3625	50-Year	373.96	373.76	371.81	0.09	0.28	230.01		680.00		3.64
Main	3625	100-Year	374.57	374.37	371.98	0.08	0.31	277.46		780.00		3.59
Main	3525 BR U	50-Year	373.59	372.45	371.31	0.49	0.25	16.00		680.00		8.55
Main	3525 BR U	100-Year	374.18	372.94	371.68	0.52	0.26	16.00		780.00		8.93
Main	3525 BR D	50-Year	372.86	372.21	369.88	0.05	0.22	18.00		680.00		6.45
Main	3525 BR D	100-Year	373.41	372.68	370.24	0.05	0.26	18.00		780.00		6.85
Main	3290	50-Year	372.58	372.38	369.53	0.06	0.04	130.84		680.00		3.55
Main	3290	100-Year	373.10	372.89	369.78	0.05	0.05	154.12		780.00		3.68
Main	3065	50-Year	372.49	372.36		0.03	0.01	277.36	131.56	507.36	41.08	3.22
Main	3065	100-Year	373.00	372.89		0.03	0.00	321.60	184.47	537.93	57.60	3.10
Main	2835.272	50-Year	372.42	372.34		0.02	0.00	238.78	144.24	265.70	270.06	3.47
Main	2835.272	100-Year	372.94	372.87		0.01	0.00	245.16	181.65	277.54	320.81	3.32
Main	2775	50-Year	372.40	372.30	369.24	0.04	0.01	194.37		680.00		2.45
Main	2775	100-Year	372.92	372.82	369.42	0.04	0.01	226.24		780.00		2.53
Main	2650 BR U	50-Year	372.35	372.23	368.51	0.05	0.00	56.00		680.00		2.73
Main	2650 BR U	100-Year	372.87	372.74	368.71	0.05	0.00	56.00		780.00		2.87
Main	2650 BR D	50-Year	372.30	372.18	368.45	0.02	0.02	56.01		680.00	0.00	2.72
Main	2650 BR D	100-Year	372.82	372.69	368.64	0.02	0.02	56.01		780.00	0.00	2.87
Main	2400	50-Year	372.26	372.18	368.65	0.03	0.05	151.37		680.00		2.28
Main	2400	100-Year	372.78	372.70	368.85	0.03	0.02	170.43		780.00		2.37
Main	2340.5	50-Year	372.18	371.94		0.06	0.06	169.65	116.45	426.06	137.49	4.92
Main	2340.5	100-Year	372.73	372.57		0.05	0.04	171.97	129.49	412.66	237.85	4.28
Main	990	50-Year	371.37	371.18		0.24	0.02	51.16	7.58	668.69	3.73	3.53
Main	990	100-Year	372.07	371.87		0.22	0.02	59.42	17.31	754.16	8.53	3.59
Main	590	50-Year	371.12	370.98	366.80	0.10	0.25	122.78		680.00		2.94
Main	590	100-Year	371.83	371.69	367.06	0.10	0.32	160.50		780.00		3.01
Main	550 BR U	50-Year	370.77	369.82	367.80	0.37	0.04	14.00		680.00		7.84
Main	550 BR U	100-Year	371.41	370.20	368.22	0.55	0.03			780.00		8.85
Main	550 BR D	50-Year	370.36	369.28	367.63	0.32	0.34	14.00		680.00		8.34
Main	550 BR D	100-Year	370.83	369.51	368.05	0.35	0.43	14.00		780.00		9.21
Main	415	50-Year	369.71	369.30	367.76	0.38	0.13	40.18		680.00		5.11
Main	415	100-Year	370.04	369.60	368.03	0.38	0.14	41.71		780.00		5.38
Main	150	50-Year	369.20	369.05	365.87			159.69	10.65	663.77	5.58	3.18
Main	150	100-Year	369.52	369.36	366.13			207.97	27.27	738.43	14.30	3.31



1 in Horiz. = 700 ft 1 in Vert. = 4 ft


Bear_Trap_Creek Plan: Proposed Project_Bridge 5/9/2017
Section M
.06
0
3
.06
Legend
WS 100-Year
WS 50-Year
Ground
Bank Sta
Elevation (ft)
Station (ft)
370
375
380
385
390
395
200
400
600
800
1000
1200
1400
1600
1800


Bear_Trap_Creek Plan: Proposed Project_Bridge 5/9/2017
Section L
.06
0
2
.06
Legend
WS 100-Year
WS 50-Year
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
365
370
375
380
385
390
200
400
600
800
1000
1200
1400
1600


Bear_Trap_Creek Plan: Proposed Project_Bridge 5/9/2017
NYSTA Ramp Culvert 2
.06
0
2
.06
Legend
WS 100-Year
WS 50-Year
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
365
370
375
380
385
390
200
400
600
800
1000
1200
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1600
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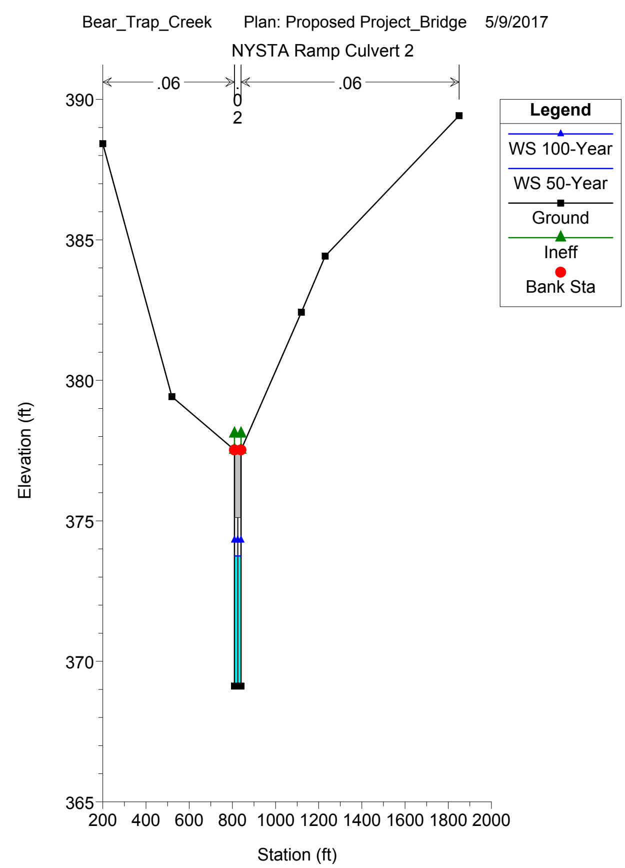
Bear_Trap_Creek Plan: Proposed Project_Bridge 5/9/2017
NYSTA Ramp Culvert 2
.06
0
2
.06
Legend
WS 100-Year
WS 50-Year
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
365
370
375
380
385
390
200
400
600
800
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1200
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1600
1800
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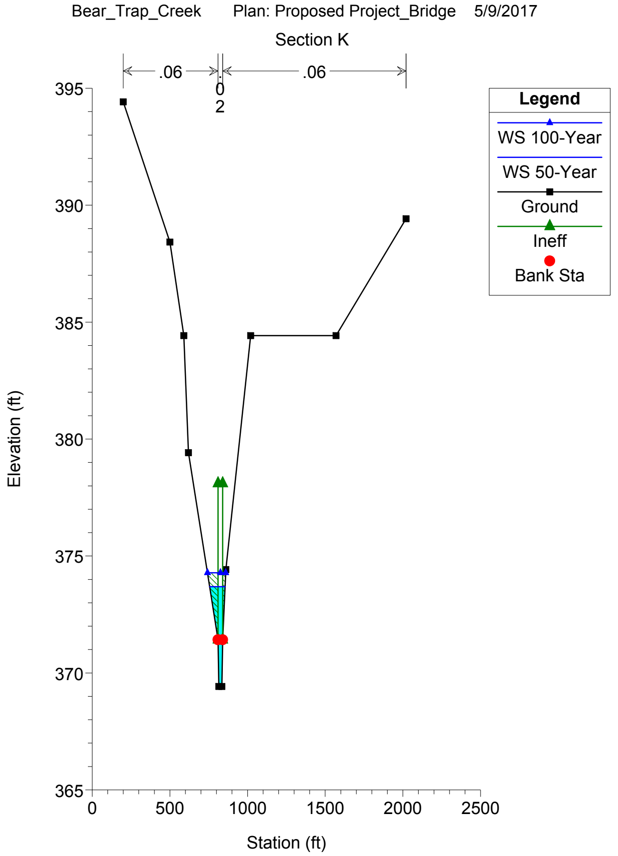
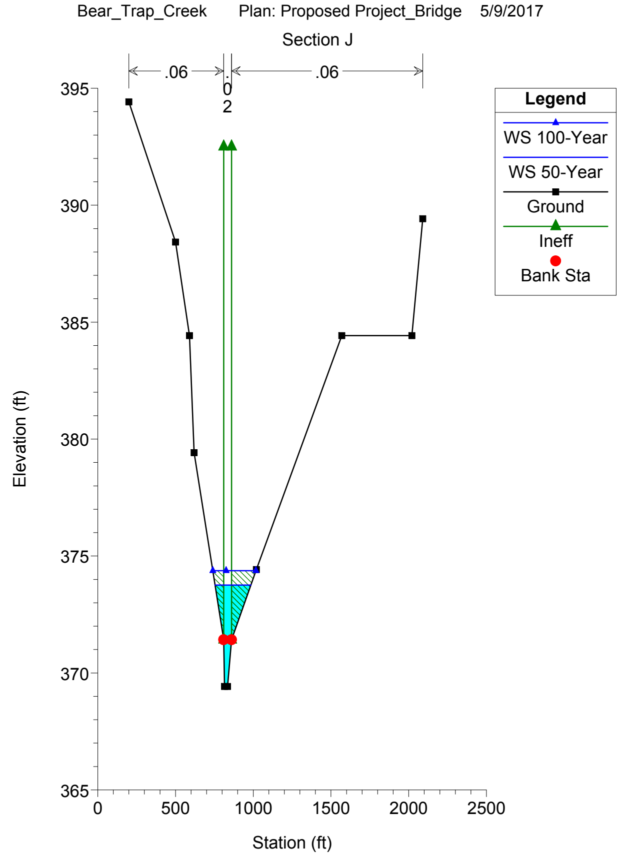


Bear_Trap_Creek Plan: Proposed Project_Bridge 5/9/2017
Section K
.06
0
2
.06
Legend
WS 100-Year
WS 50-Year
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
395
390
385
380
375
370
365
0
500
1000
1500
2000
2500



Bear_Trap_Creek Plan: Proposed Project_Bridge 5/9/2017
Section J
.06
0
2
.06
Legend
WS 100-Year
WS 50-Year
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
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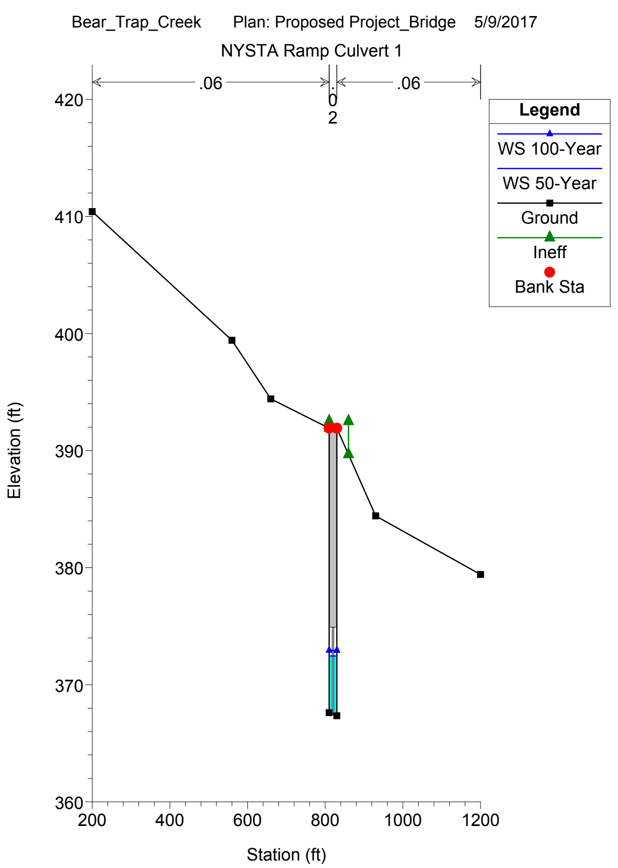
380
375
370
365
0
500
1000
1500
2000
2500



Bear_Trap_Creek Plan: Proposed Project_Bridge 5/9/2017
NYSTA Ramp Culvert 1
.06
0
2
.06
Legend
WS 100-Year
WS 50-Year
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
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410
400
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380
370
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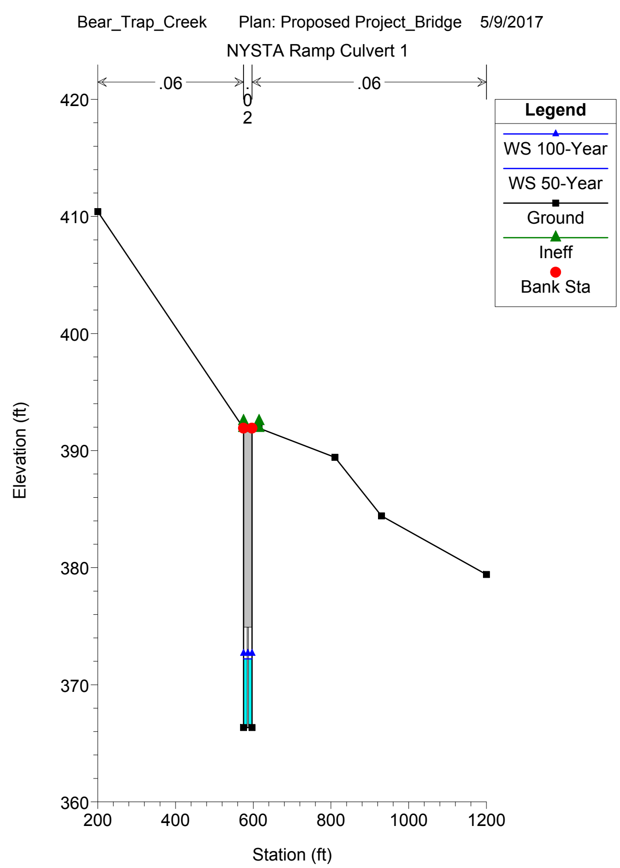
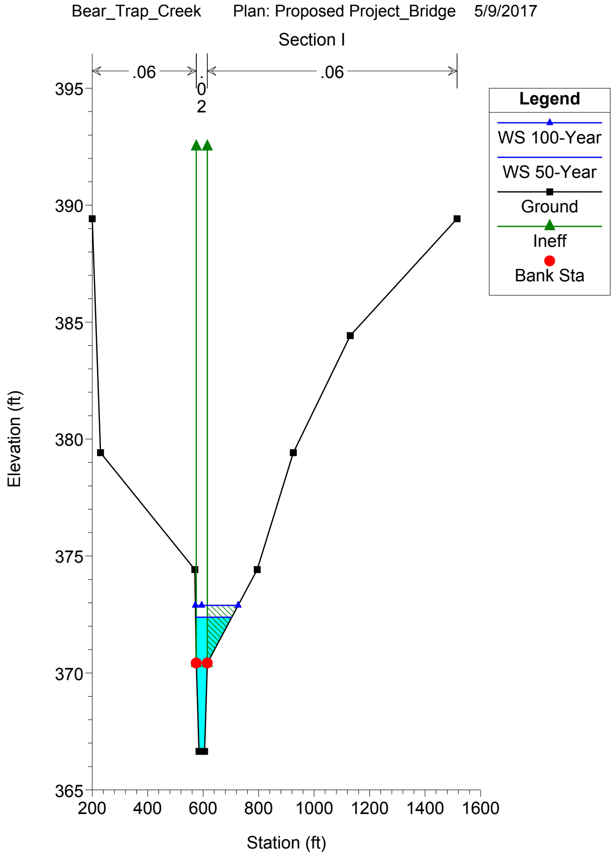
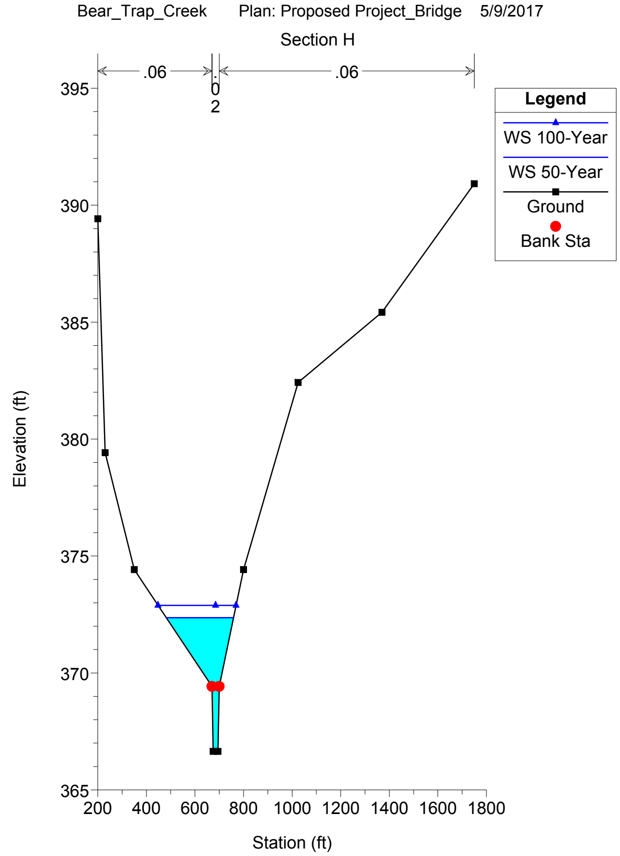
800
1000
1200



Bear_Trap_Creek Plan: Proposed Project_Bridge 5/9/2017
NYSTA Ramp Culvert 1
.06
0
2
.06
Legend
WS 100-Year
WS 50-Year
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
420
410
400
390
380
370
360
200
400
600
800
1000
1200


Bear_Trap_Creek Plan: Proposed Project_Bridge 5/9/2017
Section I
.06
.02
.06
Legend
WS 100-Year
WS 50-Year
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
395
390
385
380
375
370
365
200 400 600 800 1000 1200 1400 1600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Section H
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.02
.06
Legend
WS 100-Year
WS 50-Year
Ground
Bank Sta
Elevation (ft)
Station (ft)
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375
370
365
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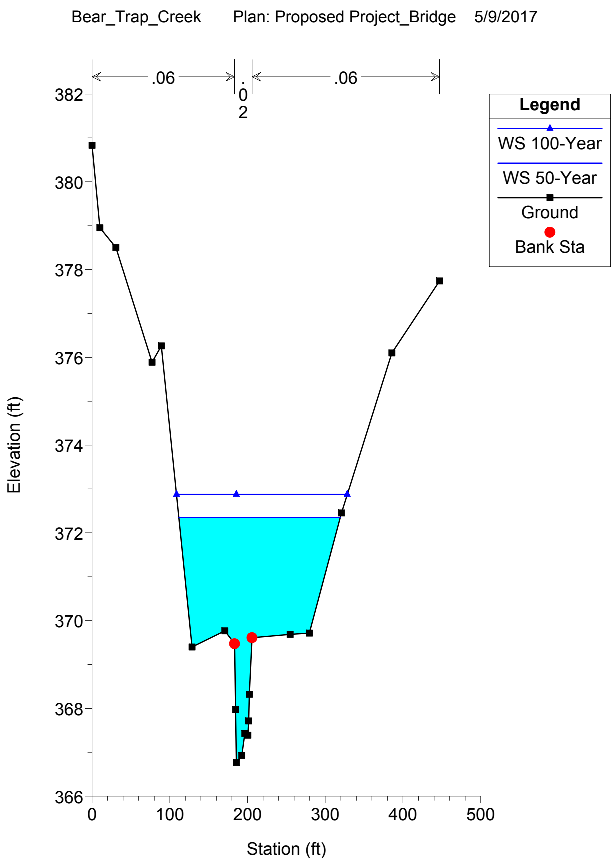
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.06
.02
.06
Legend
WS 100-Year
WS 50-Year
Ground
Bank Sta
Elevation (ft)
Station (ft)
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376
374
372
370
368
366
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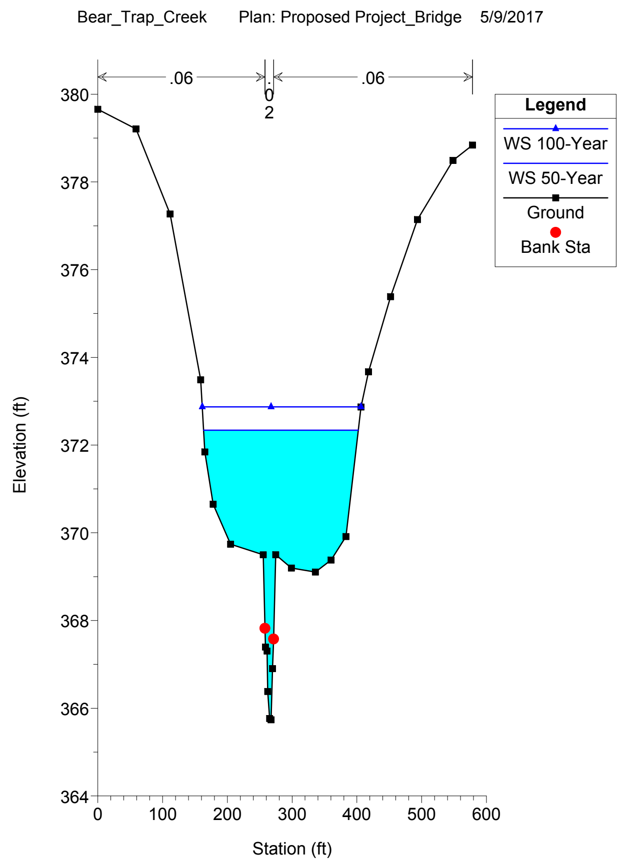
Bear_Trap_Creek Plan: Proposed Project_Bridge 5/9/2017
.06
.02
.06
Legend
WS 100-Year
WS 50-Year
Ground
Bank Sta
Elevation (ft)
Station (ft)
380
378
376
374
372
370
368
366
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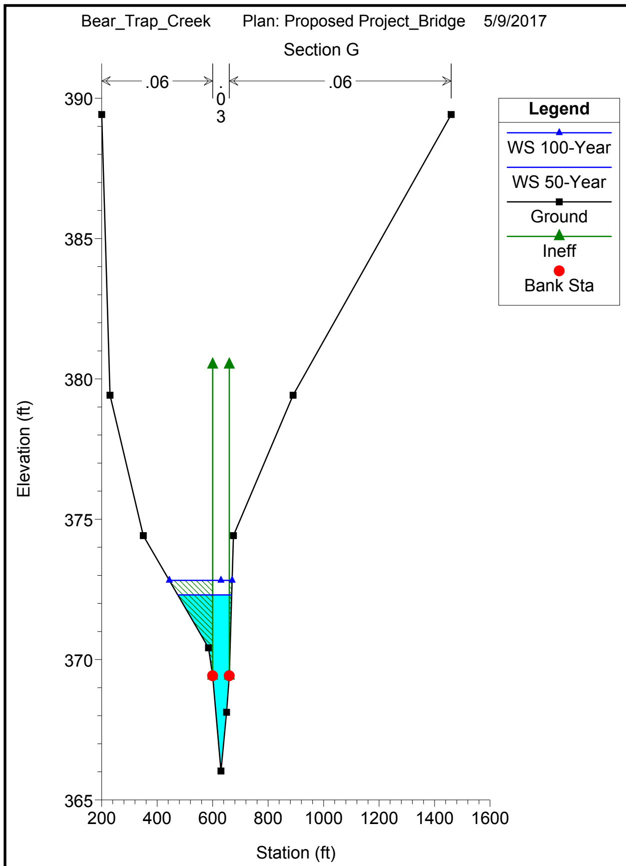
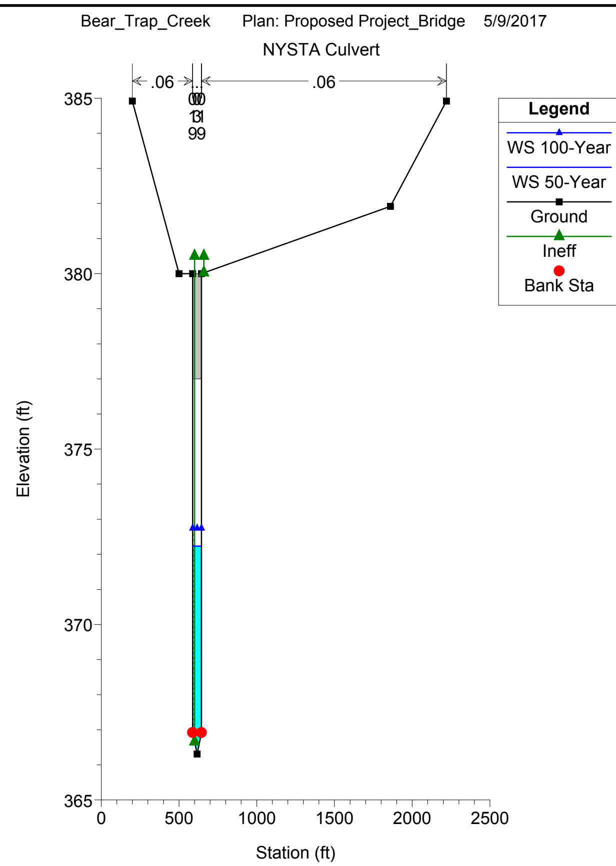
0 100 200 300 400 500 600


Bear_Trap_Creek Plan: Proposed Project_Bridge 5/9/2017
Section G
.06
0
3
.06
Legend
WS 100-Year
WS 50-Year
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
365
370
375
380
385
390
200
400
600
800
1000
1200
1400
1600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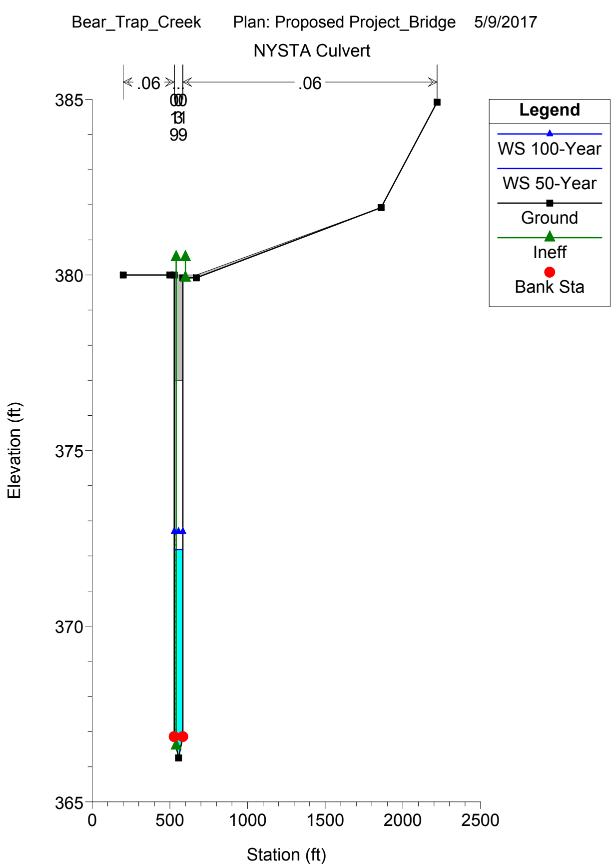
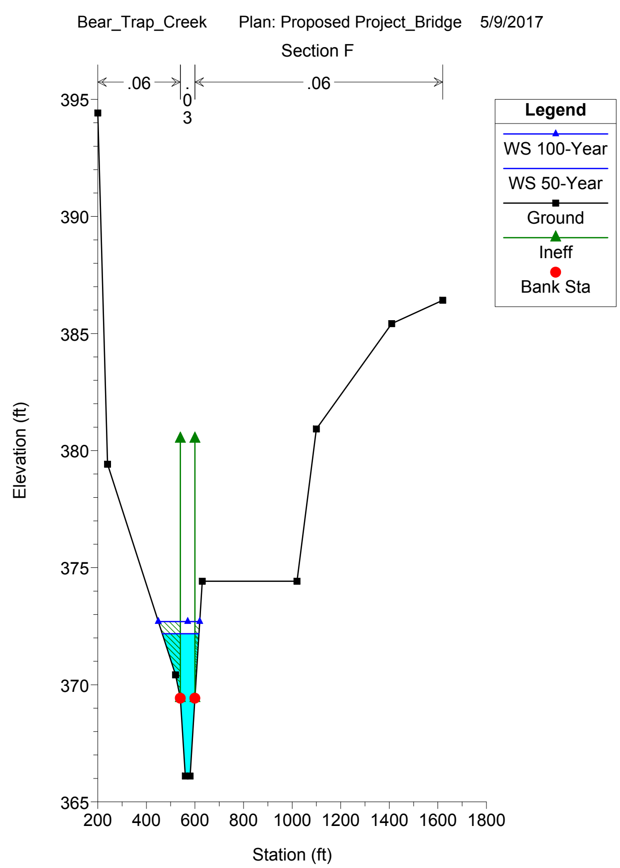
NYSTA Culvert
.06
.06
Legend
WS 100-Year
WS 50-Year
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
365
370
375
380
385
0
500
1000
1500
2000
2500


Bear_Trap_Creek Plan: Proposed Project_Bridge 5/9/2017
NYSTA Culvert
.06
.06
Legend
WS 100-Year
WS 50-Year
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
365
370
375
380
385
0
500
1000
1500
2000
2500


Bear_Trap_Creek Plan: Proposed Project_Bridge 5/9/2017
Section F
.06
0
3
.06
Legend
WS 100-Year
WS 50-Year
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
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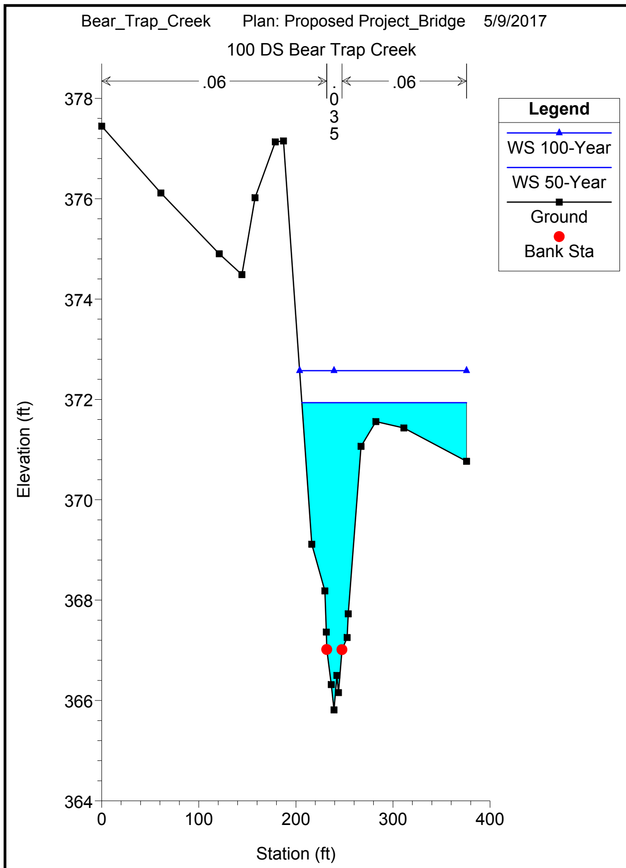
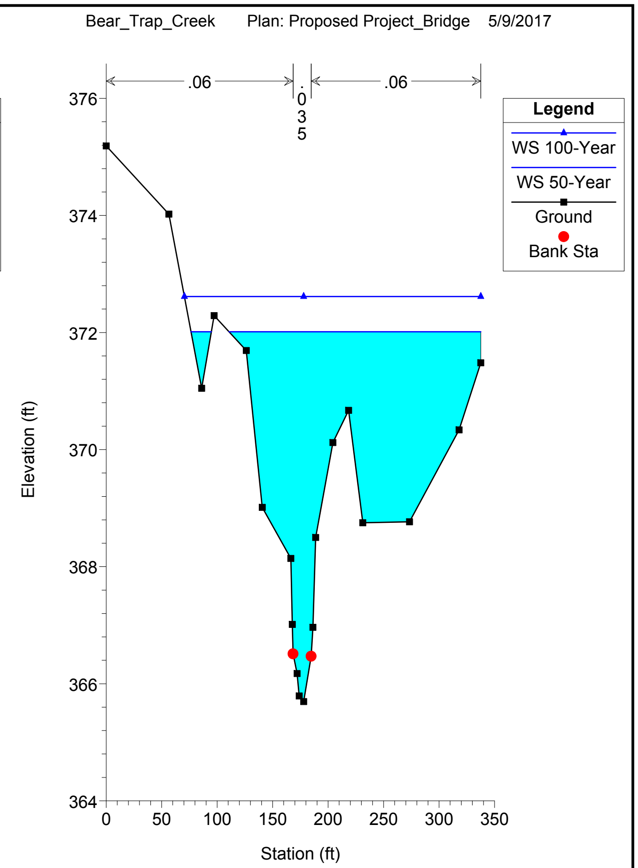
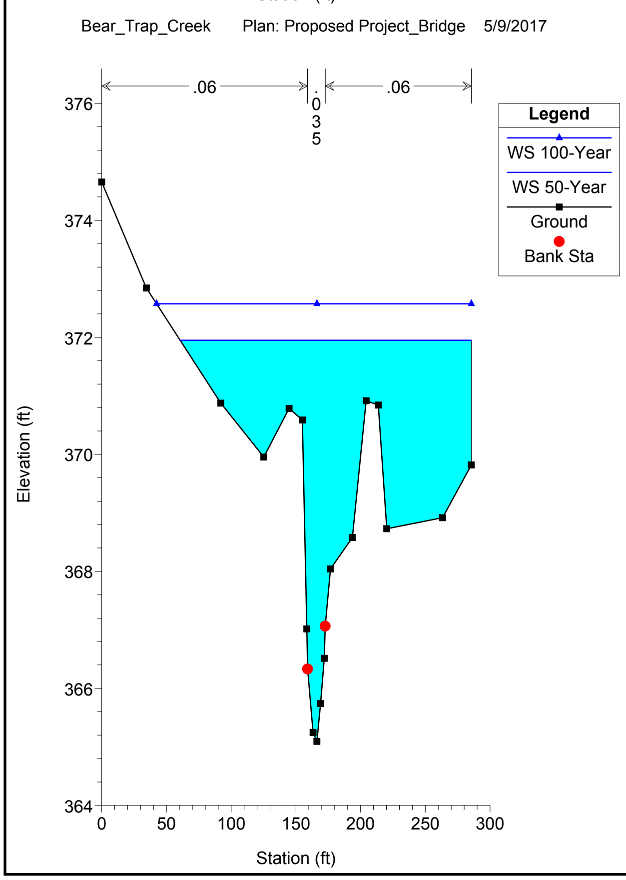
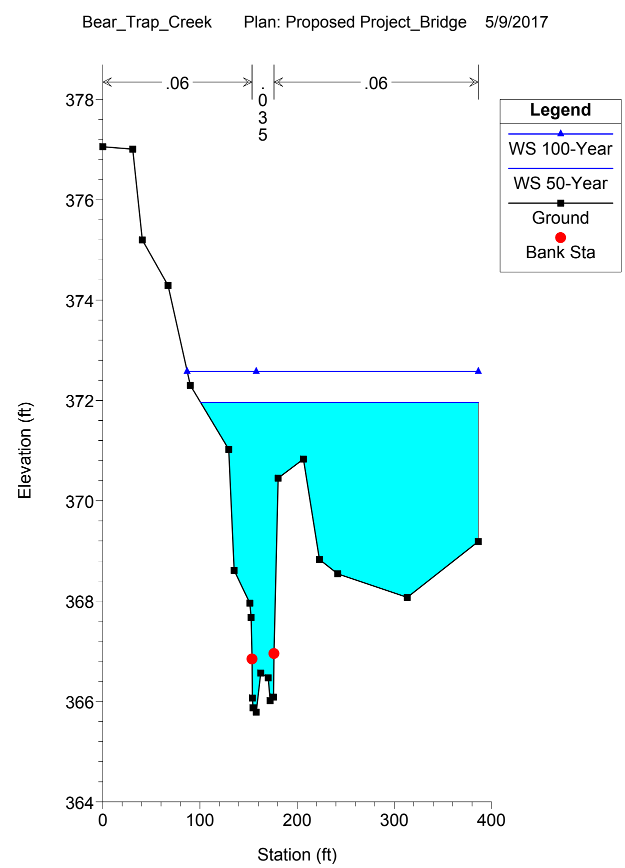
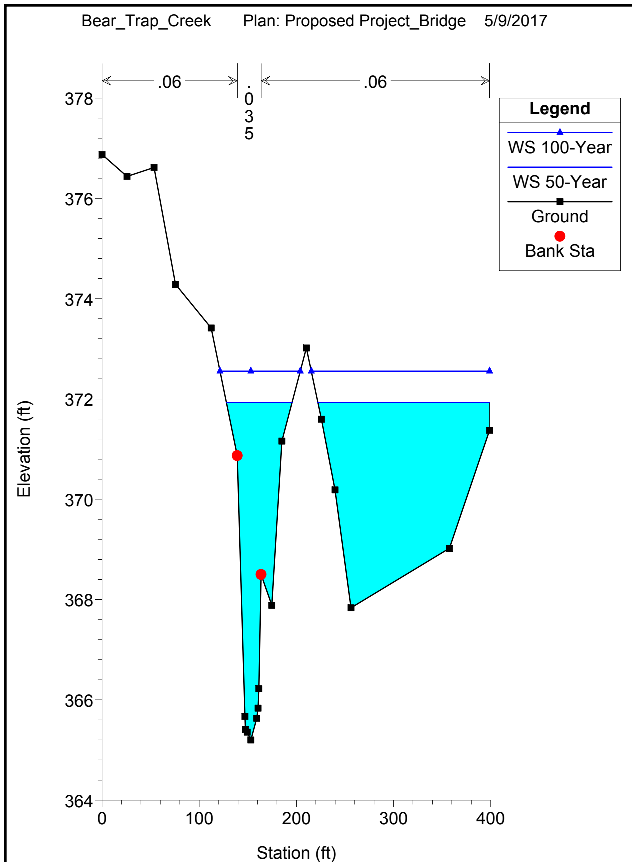
370
375
380
385
390
395
200
400
600
800
1000
1200
1400
1600
1800

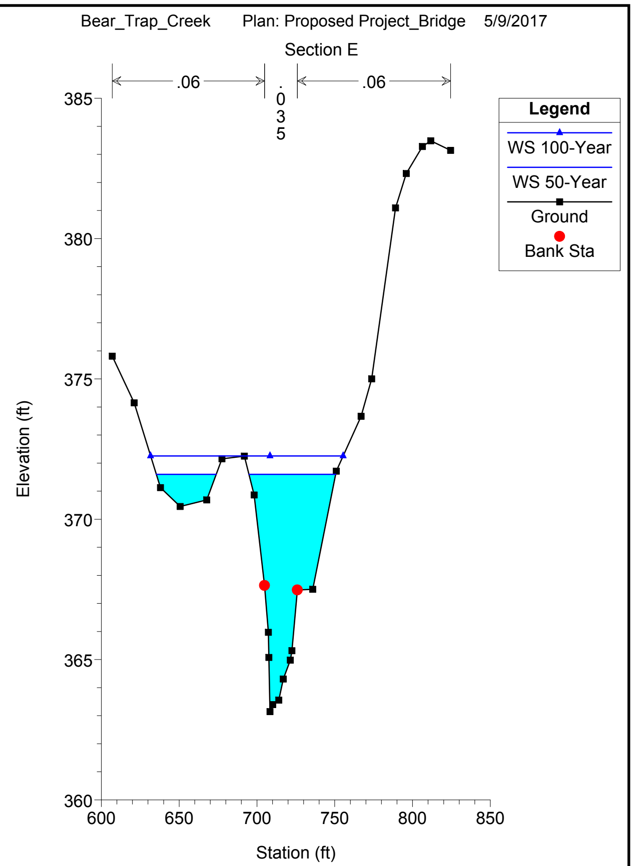

Bear_Trap_Creek Plan: Proposed Project_Bridge 5/9/2017
100 DS Bear Trap Creek
.06
.035
.06
Legend
WS 100-Year
WS 50-Year
Ground
Bank Sta
Elevation (ft)
Station (ft)

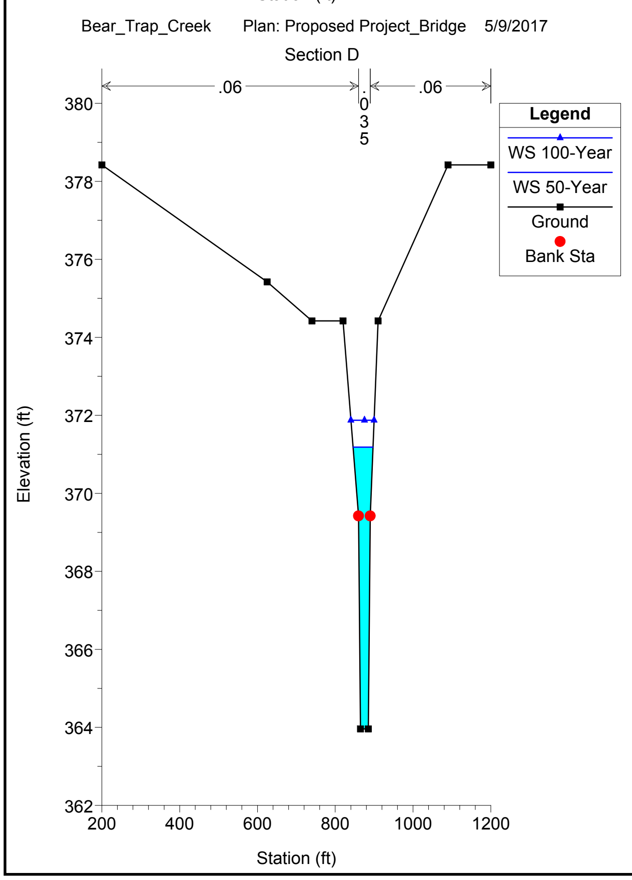

Bear_Trap_Creek Plan: Proposed Project_Bridge 5/9/2017
.06
.035
.06
Legend
WS 100-Year
WS 50-Year
Ground
Bank Sta
Elevation (ft)
Station (ft)


Bear_Trap_Creek Plan: Proposed Project_Bridge 5/9/2017
.06
.035
.06
Legend
WS 100-Year
WS 50-Year
Ground
Bank Sta
Elevation (ft)
Station (ft)


Bear_Trap_Creek Plan: Proposed Project_Bridge 5/9/2017
.06
.035
.06
Legend
WS 100-Year
WS 50-Year
Ground
Bank Sta
Elevation (ft)
Station (ft)


Bear_Trap_Creek Plan: Proposed Project_Bridge 5/9/2017
.06
.035
.06
Legend
WS 100-Year
WS 50-Year
Ground
Bank Sta
Elevation (ft)
Station (ft)
378
376
374
372
370
368
366
364
0
100
200
300
400


Bear_Trap_Creek Plan: Proposed Project_Bridge 5/9/2017
Section E
.06
.035
.06
Legend
WS 100-Year
WS 50-Year
Ground
Bank Sta
Elevation (ft)
Station (ft)
385
380
375
370
365
360
600
650
700
750
800
850


Bear_Trap_Creek Plan: Proposed Project_Bridge 5/9/2017
Section D
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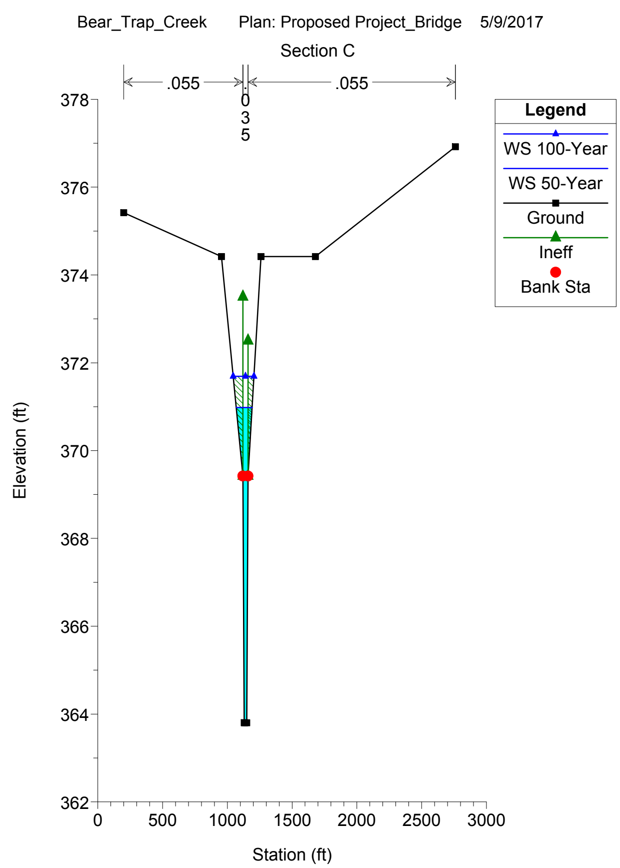
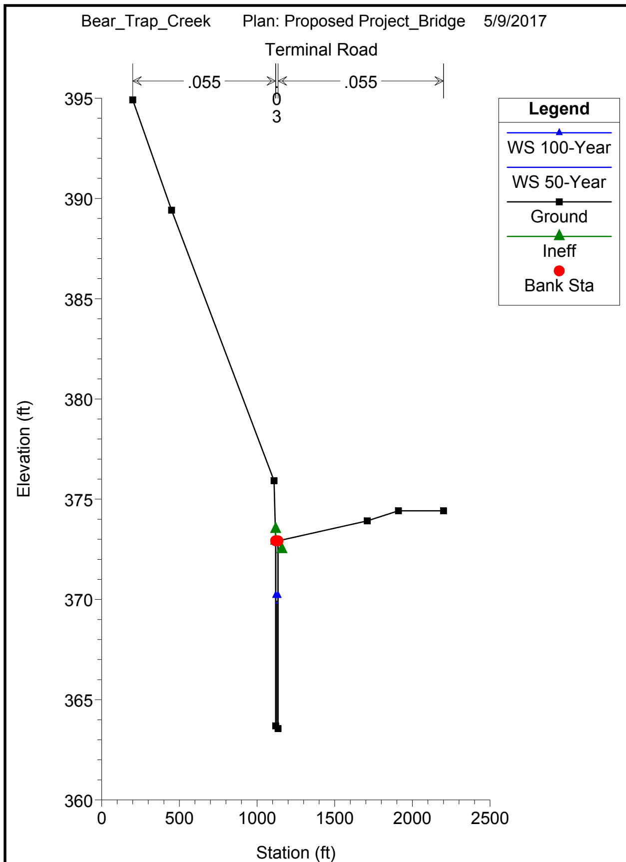
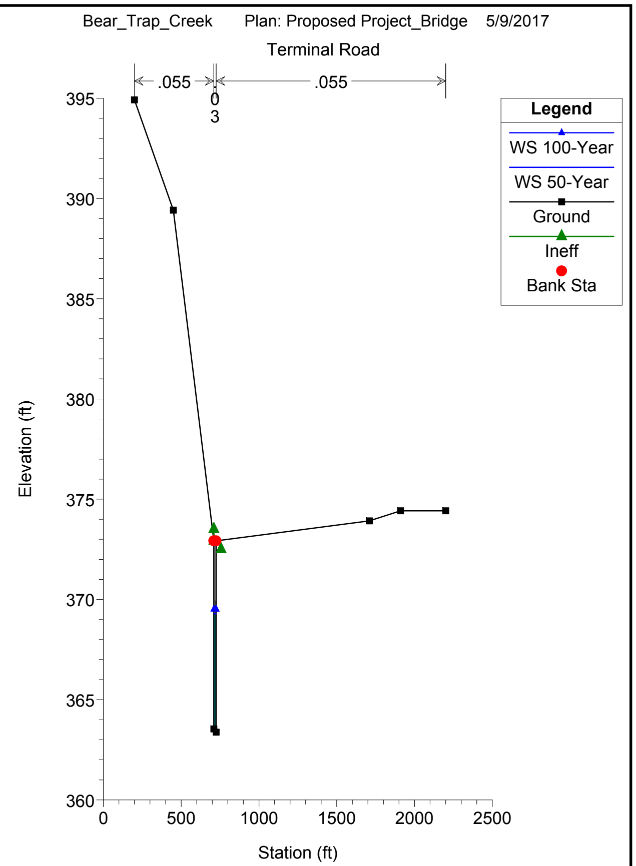
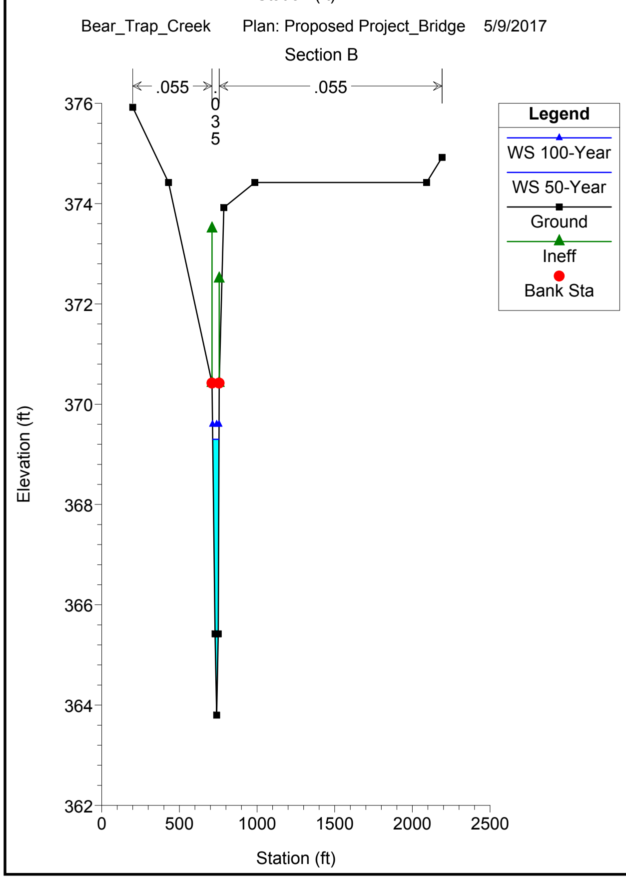
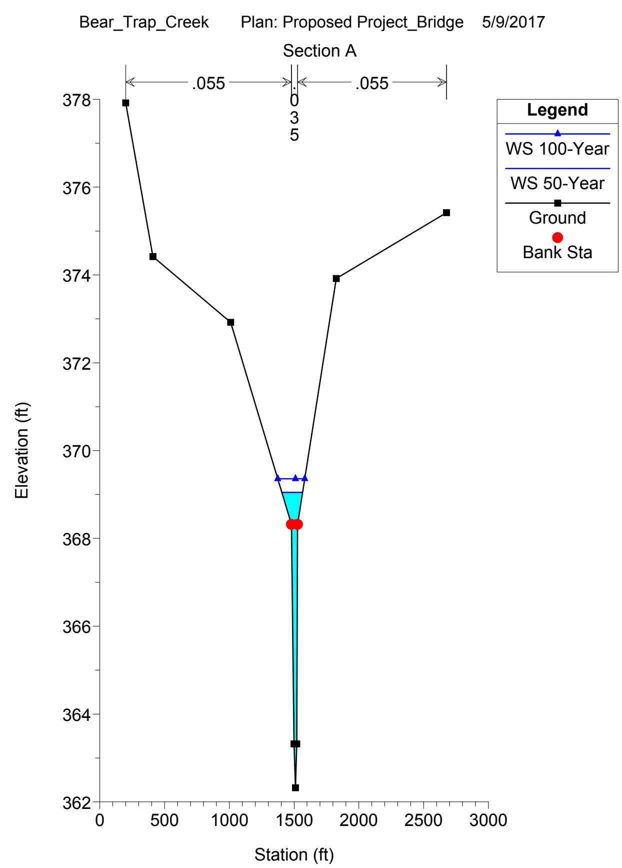
.035
.06
Legend
WS 100-Year
WS 50-Year
Ground
Bank Sta
Elevation (ft)
Station (ft)
380
378
376
374
372
370
368
366
364
362
200
400
600
800
1000
1200


Bear_Trap_Creek Plan: Proposed Project_Bridge 5/9/2017
Section C
.055
.035
.055
Legend
WS 100-Year
WS 50-Year
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
378
376
374
372
370
368
366
364
362
0
500
1000
1500
2000
2500
3000


Bear_Trap_Creek Plan: Proposed Project_Bridge 5/9/2017
Terminal Road
.055
0
3
.055
Legend
WS 100-Year
WS 50-Year
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
395
390
385
380
375
370
365
360
0
500
1000
1500
2000
2500


Bear_Trap_Creek Plan: Proposed Project_Bridge 5/9/2017
Terminal Road
.055
0
3
.055
Legend
WS 100-Year
WS 50-Year
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
395
390
385
380
375
370
365
360
0
500
1000
1500
2000
2500


Bear_Trap_Creek Plan: Proposed Project_Bridge 5/9/2017
Section B
.055
0
3
5
.055
Legend
WS 100-Year
WS 50-Year
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
376
374
372
370
368
366
364
362
0
500
1000
1500
2000
2500


Bear_Trap_Creek Plan: Proposed Project_Bridge 5/9/2017
Section A
.055
0
3
5
.055
Legend
WS 100-Year
WS 50-Year
Ground
Bank Sta
Elevation (ft)
Station (ft)
378
376
374
372
370
368
366
364
362
0
500
1000
1500
2000
2500
3000

Appendix C : COMPARISON OF HEC-RAS MODELS EXISTING VS PROPOSED CONDITIONS

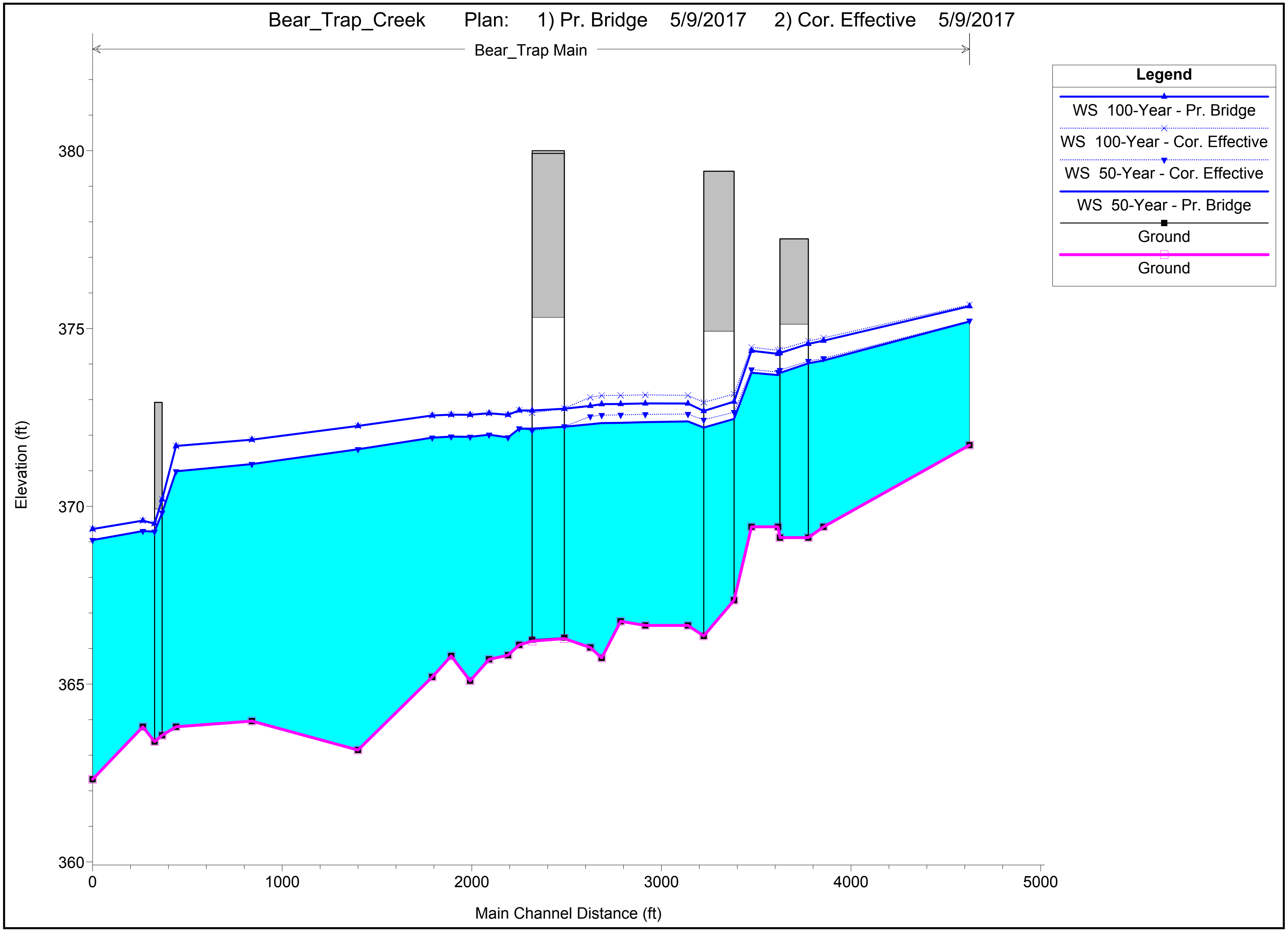
FEMA Section ID	100-Year Storm Comparison Table						
	HEC-2 WS Elev.	Adjusted HEC-2 WS Elev.	Dupl. Eff. WS Elev.	Δ WS Elev.	Existing Conditions	Proposed WS Elev.	Δ WS Elev.
M	377.09	376.51	376.75	0.24	375.66	375.63	-0.03
L	376.75	376.17	376.34	0.17	374.73	374.66	-0.07
NYSTA Ramp	376.23	375.65					
K	375.74	375.16	375.92	0.76	374.39	374.28	-0.11
J	375.69	375.11	375.98	0.87	374.47	374.37	-0.1
NYSTA Ramp	375.08	374.5					
I	374.15	373.57	374.11	0.54	373.12	372.89	-0.23
H	374.13	373.55	374.18	0.63	373.13	372.89	-0.24
					373.12	372.88	-0.24
					373.11	372.87	-0.24
G	374.04	373.46	374.1	0.64	373.06	372.82	-0.24
NYSTA Mainline							
F	373.56	372.98	373.6	0.62	372.7	372.7	0
E	373.07	372.49	373.22	0.73	372.57	372.57	0
					372.62	372.62	0
					372.57	372.57	0
					372.58	372.58	0
					372.55	372.55	0
					372.26	372.26	0
D	372.48	371.9	372.87	0.97	371.87	371.87	0
C	372.31	371.73	372.77	1.04	371.69	371.69	0
Terminal Road Bridge	371.17	370.59					
B	370.1	369.52	369.59	0.07	369.6	369.6	0
A	369.94	369.36	369.36	0	369.36	369.36	0

HEC-RAS River: Bear_Trap Reach: Main

Reach	River Sta	Profile	Plan	E.G. Elev	W.S. Elev	Crit W.S.	Frctn Loss	C & E Loss	Top Width	Q Left	Q Channel	Q Right	Vel Chnl
				(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(cfs)	(cfs)	(cfs)	(ft/s)
Main	4795	50-Year	Pr. Bridge	375.28	375.19		0.73	0.03	319.39	347.05	255.18	77.77	3.67
Main	4795	50-Year	Cor. Effective	375.30	375.22		0.70	0.03	320.21	348.71	252.80	78.49	3.62
Main	4795	100-Year	Pr. Bridge	375.69	375.63		0.56	0.04	335.85	428.47	248.17	103.37	3.18
Main	4795	100-Year	Cor. Effective	375.72	375.66		0.53	0.04	337.27	430.48	245.12	104.41	3.11
Main	4005	50-Year	Pr. Bridge	374.52	374.10	372.27	0.07	0.00	177.11		680.00		5.22
Main	4005	50-Year	Cor. Effective	374.57	374.16	372.27	0.07	0.00	181.75		680.00		5.14
Main	4005	100-Year	Pr. Bridge	375.09	374.66	372.51	0.07	0.01	218.37		780.00		5.30
Main	4005	100-Year	Cor. Effective	375.16	374.73	372.51	0.07	0.01	224.18		780.00		5.22
Main	3875 BR U	50-Year	Pr. Bridge	374.44	374.02	371.85	0.20	0.02	26.50		680.00		5.24
Main	3875 BR U	50-Year	Cor. Effective	374.50	374.08	371.85	0.19	0.01	26.50		680.00		5.17
Main	3875 BR U	100-Year	Pr. Bridge	375.02	374.56	372.12	0.20	0.01	26.50		780.00		5.41
Main	3875 BR U	100-Year	Cor. Effective	375.09	374.65	372.12	0.19	0.01	26.50		780.00		5.33
Main	3875 BR D	50-Year	Pr. Bridge	374.23	373.75	371.85	0.01	0.01	26.50		680.00		5.54
Main	3875 BR D	50-Year	Cor. Effective	374.29	373.83	371.85	0.01	0.01	26.50		680.00		5.45
Main	3875 BR D	100-Year	Pr. Bridge	374.81	374.31	372.12	0.01	0.00	26.50		780.00		5.67
Main	3875 BR D	100-Year	Cor. Effective	374.89	374.40	372.12	0.01	0.00	26.50		780.00		5.57
Main	3765	50-Year	Pr. Bridge	374.20	373.69	372.27	0.09	0.15	98.95		680.00		5.76
Main	3765	50-Year	Cor. Effective	374.27	373.78	372.27	0.08	0.15	101.65		680.00		5.64
Main	3765	100-Year	Pr. Bridge	374.80	374.28	372.51	0.07	0.16	117.13		780.00		5.74
Main	3765	100-Year	Cor. Effective	374.88	374.39	372.51	0.06	0.15	120.23		780.00		5.61
Main	3625	50-Year	Pr. Bridge	373.96	373.76	371.81	0.09	0.28	230.01		680.00		3.64
Main	3625	50-Year	Cor. Effective	374.04	373.84	371.81	0.08	0.26	236.83		680.00		3.56
Main	3625	100-Year	Pr. Bridge	374.57	374.37	371.98	0.08	0.31	277.46		780.00		3.59
Main	3625	100-Year	Cor. Effective	374.66	374.47	371.98	0.07	0.29	285.28		780.00		3.50
Main	3525 BR U	50-Year	Pr. Bridge	373.59	372.45	371.31	0.49	0.25	16.00		680.00		8.55
Main	3525 BR U	50-Year	Cor. Effective	373.70	372.64	371.31	0.44	0.23	16.00		680.00		8.24
Main	3525 BR U	100-Year	Pr. Bridge	374.18	372.94	371.68	0.52	0.26	16.00		780.00		8.93
Main	3525 BR U	100-Year	Cor. Effective	374.30	373.16	371.68	0.47	0.24	16.00		780.00		8.60
Main	3525 BR D	50-Year	Pr. Bridge	372.86	372.21	369.88	0.05	0.22	18.00		680.00		6.45
Main	3525 BR D	50-Year	Cor. Effective	373.03	372.43	369.88	0.05	0.21	18.00		680.00		6.22
Main	3525 BR D	100-Year	Pr. Bridge	373.41	372.68	370.24	0.05	0.26	18.00		780.00		6.85
Main	3525 BR D	100-Year	Cor. Effective	373.60	372.92	370.24	0.04	0.24	18.00		780.00		6.59
Main	3290	50-Year	Pr. Bridge	372.58	372.38	369.53	0.06	0.04	130.84		680.00		3.55
Main	3290	50-Year	Cor. Effective	372.77	372.59	369.53	0.05	0.04	140.45		680.00		3.40
Main	3290	100-Year	Pr. Bridge	373.10	372.89	369.78	0.05	0.05	154.12		780.00		3.68
Main	3290	100-Year	Cor. Effective	373.31	373.12	369.78	0.04	0.05	164.80		780.00		3.53
Main	3065	50-Year	Pr. Bridge	372.49	372.36		0.03	0.01	277.36	131.56	507.36	41.08	3.22
Main	3065	50-Year	Cor. Effective	372.68	372.58		0.03	0.00	295.74	144.00	491.03	44.97	2.99
Main	3065	100-Year	Pr. Bridge	373.00	372.89		0.03	0.00	321.60	184.47	537.93	57.60	3.10
Main	3065	100-Year	Cor. Effective	373.22	373.13		0.02	0.00	341.69	198.76	519.18	62.06	2.88
Main	2835.272	50-Year	Pr. Bridge	372.42	372.34		0.02	0.00	238.78	144.24	265.70	270.06	3.47
Main	2835.272	50-Year	Cor. Effective	372.63	372.56		0.01	0.00	241.46	150.67	254.84	274.49	3.21
Main	2835.272	100-Year	Pr. Bridge	372.94	372.87		0.01	0.00	245.16	181.65	277.54	320.81	3.32
Main	2835.272	100-Year	Cor. Effective	373.17	373.11		0.01	0.00	249.65	188.24	268.21	323.55	3.09
Main	2775	50-Year	Pr. Bridge	372.40	372.30	369.24	0.04	0.01	194.37		680.00		2.45
Main	2775	50-Year	Cor. Effective	372.61	372.53	369.24	0.05	0.05	208.08		680.00		2.34
Main	2775	100-Year	Pr. Bridge	372.92	372.82	369.42	0.04	0.01	226.24		780.00		2.53
Main	2775	100-Year	Cor. Effective	373.15	373.06	369.42	0.05	0.06	241.26		780.00		2.42
Main	2650 BR U	50-Year	Pr. Bridge	372.35	372.23	368.51	0.05	0.00	56.00		680.00		2.73
Main	2650 BR U	50-Year	Cor. Effective	372.50	372.25	368.93	0.11	0.00	28.00		680.00		4.08
Main	2650 BR U	100-Year	Pr. Bridge	372.87	372.74	368.71	0.05	0.00	56.00		780.00		2.87
Main	2650 BR U	100-Year	Cor. Effective	373.04	372.75	369.19	0.12	0.00	28.00		780.00		4.31
Main	2650 BR D	50-Year	Pr. Bridge	372.30	372.18	368.45	0.02	0.02	56.01		680.00	0.00	2.72
Main	2650 BR D	50-Year	Cor. Effective	372.39	372.13	368.89	0.03	0.09	28.00		680.00		4.13
Main	2650 BR D	100-Year	Pr. Bridge	372.82	372.69	368.64	0.02	0.02	56.01		780.00	0.00	2.87
Main	2650 BR D	100-Year	Cor. Effective	372.92	372.63	369.15	0.03	0.10	28.00		780.00		4.37
Main	2400	50-Year	Pr. Bridge	372.26	372.18	368.65	0.03	0.05	151.37		680.00		2.28
Main	2400	50-Year	Cor. Effective	372.27	372.19	368.65	0.04	0.05	151.64		680.00		2.27
Main	2400	100-Year	Pr. Bridge	372.78	372.70	368.85	0.03	0.02	170.43		780.00		2.37
Main	2400	100-Year	Cor. Effective	372.79	372.70	368.85	0.03	0.02	170.64		780.00		2.37
Main	2340.5	50-Year	Pr. Bridge	372.18	371.94		0.06	0.06	169.65	116.45	426.06	137.49	4.92
Main	2340.5	50-Year	Cor. Effective	372.18	371.94		0.06	0.06	169.65	116.45	426.06	137.49	4.92
Main	2340.5	100-Year	Pr. Bridge	372.73	372.57		0.05	0.04	171.97	129.49	412.66	237.85	4.28
Main	2340.5	100-Year	Cor. Effective	372.73	372.57		0.05	0.04	171.97	129.49	412.66	237.85	4.28
Main	990	50-Year	Pr. Bridge	371.37	371.18		0.24	0.02	51.16	7.58	668.69	3.73	3.53
Main	990	50-Year	Cor. Effective	371.37	371.18		0.24	0.02	51.16	7.58	668.69	3.73	3.53
Main	990	100-Year	Pr. Bridge	372.07	371.87		0.22	0.02	59.42	17.31	754.16	8.53	3.59
Main	990	100-Year	Cor. Effective	372.07	371.87		0.22	0.02	59.42	17.31	754.16	8.53	3.59

HEC-RAS River: Bear_Trap Reach: Main (Continued)

Reach	River Sta	Profile	Plan	E.G. Elev	W.S. Elev	Crit W.S.	Frctn Loss	C & E Loss	Top Width	Q Left	Q Channel	Q Right	Vel Chnl
				(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(cfs)	(cfs)	(cfs)	(ft/s)
Main	590	50-Year	Pr. Bridge	371.12	370.98	366.80	0.10	0.25	122.78		680.00		2.94
Main	590	50-Year	Cor. Effective	371.12	370.98	366.80	0.10	0.25	122.78		680.00		2.94
Main	590	100-Year	Pr. Bridge	371.83	371.69	367.06	0.10	0.32	160.50		780.00		3.01
Main	590	100-Year	Cor. Effective	371.83	371.69	367.06	0.10	0.32	160.50		780.00		3.01
Main	550 BR U	50-Year	Pr. Bridge	370.77	369.82	367.80	0.37	0.04	14.00		680.00		7.84
Main	550 BR U	50-Year	Cor. Effective	370.77	369.82	367.80	0.37	0.04	14.00		680.00		7.84
Main	550 BR U	100-Year	Pr. Bridge	371.41	370.20	368.22	0.55	0.03			780.00		8.85
Main	550 BR U	100-Year	Cor. Effective	371.41	370.20	368.22	0.55	0.03			780.00		8.85
Main	550 BR D	50-Year	Pr. Bridge	370.36	369.28	367.63	0.32	0.34	14.00		680.00		8.34
Main	550 BR D	50-Year	Cor. Effective	370.36	369.28	367.63	0.32	0.34	14.00		680.00		8.34
Main	550 BR D	100-Year	Pr. Bridge	370.83	369.51	368.05	0.35	0.43	14.00		780.00		9.21
Main	550 BR D	100-Year	Cor. Effective	370.83	369.51	368.05	0.35	0.43	14.00		780.00		9.21
Main	415	50-Year	Pr. Bridge	369.71	369.30	367.76	0.38	0.13	40.18		680.00		5.11
Main	415	50-Year	Cor. Effective	369.71	369.30	367.76	0.38	0.13	40.18		680.00		5.11
Main	415	100-Year	Pr. Bridge	370.04	369.60	368.03	0.38	0.14	41.71		780.00		5.38
Main	415	100-Year	Cor. Effective	370.04	369.60	368.03	0.38	0.14	41.71		780.00		5.38
Main	150	50-Year	Pr. Bridge	369.20	369.05	365.87			159.69	10.65	663.77	5.58	3.18
Main	150	50-Year	Cor. Effective	369.20	369.05	365.87			159.69	10.65	663.77	5.58	3.18
Main	150	100-Year	Pr. Bridge	369.52	369.36	366.13			207.97	27.27	738.43	14.30	3.31
Main	150	100-Year	Cor. Effective	369.52	369.36	366.13			207.97	27.27	738.43	14.30	3.31



1 in Horiz. = 750 ft 1 in Vert. = 4 ft

Appendix D : SCOUR ANALYSIS

100-year Scour for a 56' Clear Span Structure

Contraction Scour

		Left	Channel	Right
Input Data				
	Average Depth (ft):	0.15	3.00	0.36
	Approach Velocity (ft/s):	0.25	5.22	0.44
	Br Average Depth (ft):		3.18	
	BR Opening Flow (cfs):		224.48	
	BR Top WD (ft):		44.00	
	Grain Size D50 (mm):	9.5	9.5	9.5
	Approach Flow (cfs):	0.82	208.45	15.20
	Approach Top WD (ft):	21.31	13.29	97.58
	K1 Coefficient:	0.590	0.590	0.590
Results				
	Scour Depth Ys (ft):		0.00	
	Critical Velocity (ft/s):		4.23	
	Equation:		Live	

Abutment Scour

		Left	Right
Input Data			
	Station at Toe (ft):	587.99	644.00
	Toe Sta at appr (ft):	258.10	271.40
	Abutment Length (ft):	21.31	97.58
	Depth at Toe (ft):	-7.11	2.86
	K1 Shape Coef:	1.00 - Vertical abutment	
	Degree of Skew (degrees):	90.00	90.00
	K2 Skew Coef:	1.00	1.00
	Projected Length L' (ft):	21.31	97.58
	Avg Depth Obstructed Ya (ft):	0.15	0.36
	Flow Obstructed Qe (cfs):	0.82	15.20
	Area Obstructed Ae (sq ft):	3.30	34.66
Results			
	Scour Depth Ys (ft):		11.93
	Froude #:		0.19
	Equation:	Default	HIRE

500-Year Scour for a 56' Clear Span Structure

Contraction Scour

		Left	Channel	Right
Input Data				
	Average Depth (ft):	3.72	7.60	3.98
	Approach Velocity (ft/s):	0.67	3.10	0.70
	Br Average Depth (ft):		7.45	9.59
	BR Opening Flow (cfs):		1020.00	0.00
	BR Top WD (ft):		44.00	
	Grain Size D50 (mm):	9.50	9.5	9.50
	Approach Flow (cfs):	269.85	312.75	437.40
	Approach Top WD (ft):	107.94	13.29	156.70
	K1 Coefficient:	0.590	0.590	0.590
Results				
	Scour Depth Ys (ft):		0.00	
	Critical Velocity (ft/s):		4.94	
	Equation:		Clear	

Abutment Scour

		Left	Right
Input Data			
	Station at Toe (ft):	587.99	644.00
	Toe Sta at appr (ft):	258.10	271.40
	Abutment Length (ft):	107.94	156.70
	Depth at Toe (ft):	-2.79	7.19
	K1 Shape Coef:	1.00 - Vertical abutment	
	Degree of Skew (degrees):	90.00	90.00
	K2 Skew Coef:	1.00	1.00
	Projected Length L' (ft):	107.94	156.70
	Avg Depth Obstructed Ya (ft):	3.72	3.98
	Flow Obstructed Qe (cfs):	269.85	437.40
	Area Obstructed Ae (sq ft):	402.04	622.95
Results			
	Scour Depth Ys (ft):		12.02
	Qe/Ae = Ve:		0.70
	Froude #:		0.06
	Equation:	Default	Froehlich