WIN. 22627.01 PLEASANT STREET (PLEASANT RIVER BRIDGE) OVER PLEASANT RIVER

MILO, MAINE

FINAL
HYDROLOGIC AND HYDRAULIC REPORT

AUGUST 2020

PREPARED FOR

MaineDOT
16 State House Station
Augusta, ME 04333

PREPARED BY

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HNTB

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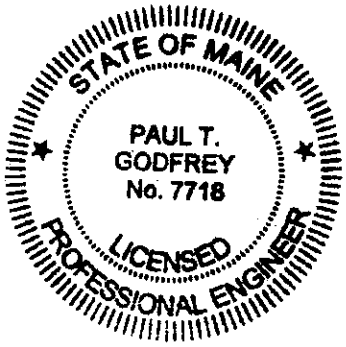

8/7/20

Paul Godfrey, P.E.

Prepared For:
Maine Department of Transportation
16 State House Station
Augusta, ME 04333

Prepared By:
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The following is a final report of the hydrologic and hydraulic analysis of the existing and proposed bridges at Pleasant River Bridge (Bridge No. 3244) over Pleasant River in the town of Milo in Piscataquis County, Maine.

1.0 Introduction

The Pleasant River Bridge carries Pleasant Street over the Pleasant River. The existing bridge is a steel thru-truss bridge with a cast-in-place concrete deck. The existing bridge was built in 1936 and the bridge serves approximately 930 cars per day (2020). The bridge is located approximately 6.0 miles upstream of the confluence with Piscataquis River.

The bridge spans over the Pleasant River with a total length of approximately 309.25 feet from abutment to abutment and contains two spans and a single pier. The existing structure features concrete abutments that are parallel to the streamflow. The structure itself is at approximately a 20-degree skew to the streamflow. The low chord elevation of the existing bridge is 284.68 feet. The existing structure has a hydraulic opening of approximately 4076 square feet.

The proposed structure is being constructed on a new alignment approximately 75 feet upstream of the existing bridge from centerline to centerline. The proposed bridge consists of two 172.5-foot spans, a single triangular nose shaped pier, and integral abutments. The pier widens from 3.5 feet at the top to 6.5 feet at the streambed. The total span from abutment to abutment measures approximately 345 feet. The proposed structure has a low chord of 285.80 feet which is 1.12 feet higher than the existing low chord. Additionally, the proposed structure is perched and provides an average low chord of approximately 286.65 feet. The proposed bridge provides a hydraulic opening of 4960 square feet. The increase in hydraulic area is due to the increased low chord elevation and increased span length from existing to proposed.

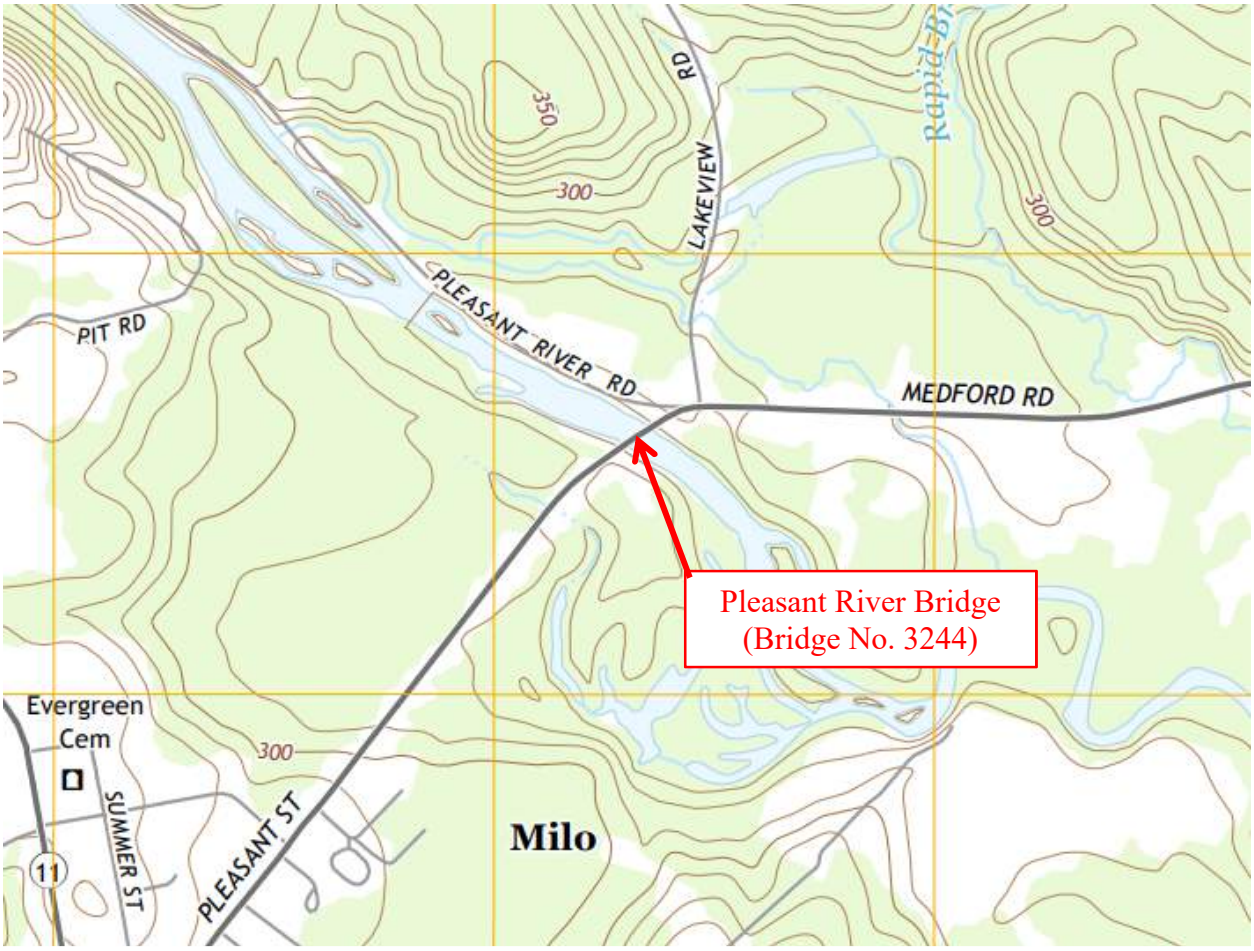

Figure 1 – Project Location Map (USGS Quadrangle – Milo North, ME)

The nearest bridge upstream from Pleasant River Bridge is 4.3 miles upstream of the project site. There are no structures over Pleasant River downstream of the project site. Approximately 6 miles downstream from Pleasant River Bridge is the confluence with the Piscataquis River. The Pleasant River receives backwater effects from the Piscataquis River approximately 2900 feet downstream of the project site as shown on the Federal Emergency Management Agency (FEMA) profile in **Appendix D.**

Figure 2 – Aerial image showing project site

2.0 Existing Data Review

- Site Photographs are provided in **Appendix A**.
- The FEMA Flood Insurance Study (FIS) Rate Map (Effective May 20, 1996) has been provided in **Appendix B**. The map indicated that the project is in Zone AE with base flood elevations having been determined. The map also indicates the project is located within a floodway. The 100-year flood elevations at the cross sections in the map approximately 150 feet upstream (Cross Section D) of the bridge is shown to be 286.4 feet. Immediately downstream of the bridge, the 100-yr water surface elevation is approximately 285.8 feet.

- There is a United States Geological Survey (USGS) stream gage (#01033500) located approximately 2 miles upstream from the project site. The stream gage has a watershed area of 323 sq. miles which is slightly smaller than the project watershed of 332 sq. miles. The gage has records from 1920 to 1979 and the largest record flow occurred in 1967 with a peak flow of 28,600 cfs.
- The Pleasant River flows in the project area were calculated by adjusting the gage values for the difference in the project watershed and gage watershed areas.

3.0 Hydrology

The peak flows calculated for design were based on the upstream USGS stream gage and adjusted to account for the difference in drainage area between the project area and the stream gage. Because the length of record is relatively long, the regression estimates were not used in developing the peak flow estimates for the project area. Additionally, the regression estimates were 50-60% lower than the gage based estimates, suggesting that the regression method underestimates the flow in the project area. The final site area-weighted analysis provided flows that were slightly higher for the 10-year and 50-year flood events and slightly less than the 100-year and 500-year flood events as compared to the flows published in the FEMA FIS report.

The calculated flows as well as the flows published in the FEMA Flood Insurance Study have been provided in **Table 1**. The hydrology report can be found in **Appendix C**.

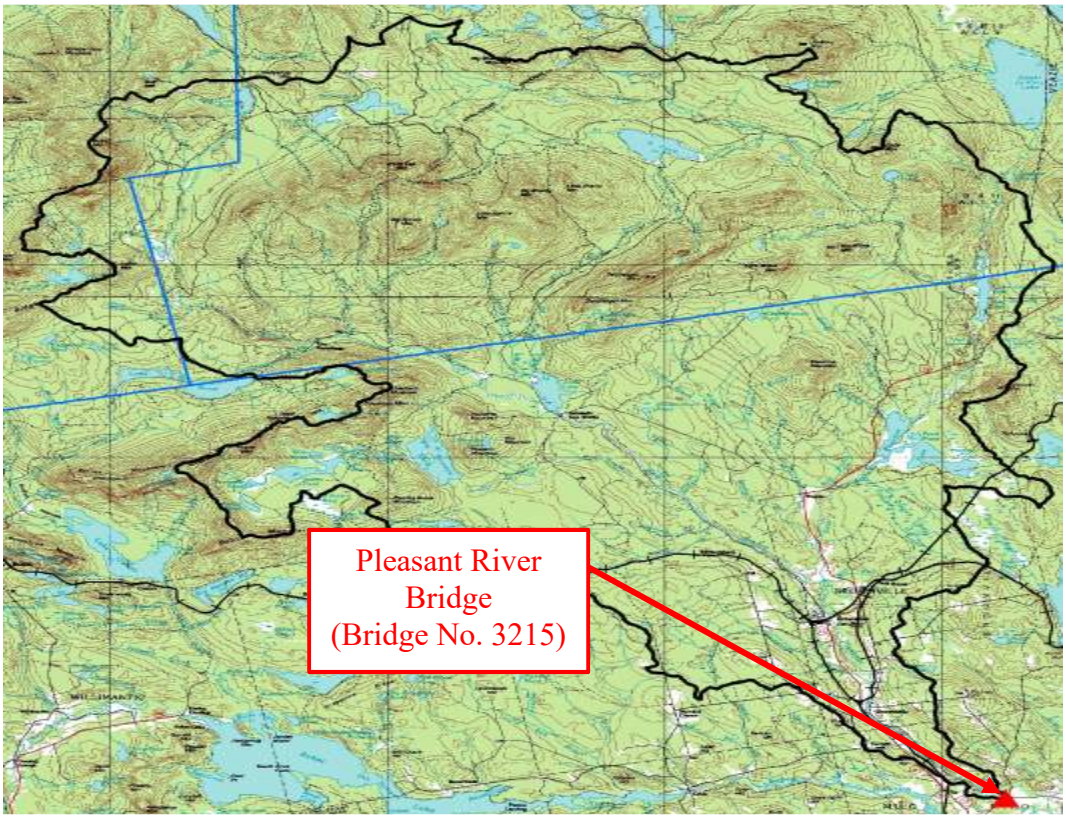

Figure 3 – Watershed above Pleasant River Bridge over Pleasant River

Table 1: Flood Information
(For calculations see **Appendix C**)

Year Storm	**Calculated Flows (cfs)**	**FEMA FIS (cfs)**
Drainage Area	**332 sq. mi.**	**321.4 sq. mi.**
$Q_{1.1}$	**4,280**	---
Q_2	**8,630**	---
Q_5	**14,225**	---
Q_{10}	**21,495**	17,400
Q_{25}	**25,980**	---
Q_{50}	**29,240**	29,200
Q_{100}	**33,175**	35,200
Q_{500}	**42,970**	52,400
Q_{max}	**29,180**	---

As mentioned earlier, the calculated flows were used in the hydraulic analysis of Pleasant River Bridge. The hydrology report can be found in **Appendix C.**

It was noted in the FEMA FIS report that the Piscataquis River watershed (includes the Pleasant River) experienced an unprecedented large flooding event. The flood had an estimated recurrence interval of 45 years for Pleasant River.

4.0 Hydraulic Analysis

Hydraulic calculations for the existing and proposed conditions along the Pleasant River were performed using the U.S. Army Corps of Engineers' software HEC-RAS, version 5.0.3 HEC-RAS supports one-dimensional, steady flow, water surface profiles calculations. Cross-sections were cut from survey gathered for this project.

The model was run using the calculated flows provided in the hydrology report and the flows provided in the FEMA FIS report. The calculated flows were run utilizing a normal depth downstream boundary condition of Pleasant River for the 1.1-year through the 5-yr events. The stream slope downstream of the project area was taken to be 0.009 ft/ft from the project survey. Multiple iterations using different downstream slopes revealed that a slope of 0.009 ft/ft was the most appropriate.

The downstream boundary condition for the HEC-RAS model run using the calculated flows were set to known water surface since the FEMA FIS provided flood profiles for the Pleasant River in the area of the project. The downstream water surfaces were pulled from the FEMA flood profiles for the 10-, 50-, 100-, and 500-year events. The 25-yr event was given an interpolated downstream water surface elevation. The existing conditions were analyzed in HEC-RAS to determine the validity of the known water surface elevations for the downstream boundary conditions. When comparing the upstream and downstream water surface elevation of the existing model to the FEMA FIS profile, the values obtained in HEC-RAS were similar to those obtained from the

FEMA FIS report. **Table 2** displays the differences between the 100-yr event water surface elevations for the HEC-RAS model and the elevations found in the FEMA FIS profile.

Table 2: Comparison of FEMA FIS vs. HEC-RAS Model Water Surface Elevations

Location	FEMA FIS WSE (ft)	HEC-RAS Model WSE (ft)	Difference (ft)
Upstream	286.40	286.21	-0.19
Downstream	285.80	285.80	0.00

The differences between the HEC-RAS model and the FEMA FIS water surface elevations, is likely due to a difference in how the bridge openings were modeled when the FEMA FIS report was completed (Revised 1996) and how the bridge opening is modeled in HEC-RAS. It stated in the FEMA FIS report that the water surface elevations were computed using the SCS WSP-2 computer program (Reference 11). The HEC-RAS model is based off of recent survey information gathered for this project.

The HEC-RAS model was run using "subcritical" flow due to the Froude numbers at all cross-sections below 1.0. The model was run in "subcritical" flow in order to ensure that the model uses the downstream boundary conditions set by the FEMA FIS flood profiles discussed above.

The model covers approximately 320 feet upstream of the existing structure and 105 feet downstream of the existing structure. Since the proposed structure is set to be placed approximately 75 feet upstream from the centerline of the existing structure to the proposed structure centerline, the two have differing cross sections upstream of the structures so as to avoid having the existing cross sections intersect the proposed structure and the bounding cross sections of the proposed structure. The two models do have one common cross section farther upstream (RS 880.50) that was used as a point of comparison in the model. It should be noted that this cross section was transposed upstream and adjusted for elevations based on the slope of the stream.

The FEMA FIS also provided values for the Manning's n-values along the Pleasant River. The values provided in the FIS were 0.050-0.065 for the channel and 0.080-0.095 for the overbank areas. These values were reviewed against the survey data, photographs and aerial images of the project area. It was determined that the appropriate Manning's n-values for the channel was 0.05 due to the river winding but with weeds and stones within the analysis site. The overbank areas on the left side of the project site were determined to be mature cultivated areas with a few trees and dense brush scattered throughout and therefore were given a manning's value of 0.085 in the analysis.

Ineffective flow areas were set upstream and downstream of the bridge based on contraction and expansion from the existing and proposed bridge in both existing and proposed models. These ineffective flow areas were set to the elevation of the low spots to the south of the bridge and to the roadway elevation on the north side of the bridge. Once these elevations are overtopped, the flow will become effective and the ineffective flow areas turn off.

The existing and proposed models were run using the energy and momentum (due to presence of a pier) equations with the highest energy answer used for the low flow scenarios. The high flow scenarios were run utilizing the pressure and/or weir equation.

The existing two span structure has a hydraulic opening of 4076 square feet. The results of the existing model show that the existing structure is running under energy flow for the smaller storm events (1.1-yr through 5-yr events). The energy flow indicates that the flood is running without any impact from the bridge structure or roadway for the smaller storm events. This also indicates that flow is not being affected by the presence of the pier. For the 10-yr and 25-yr events, the energy/weir equation was used as the water surface overtops the roadway, but does not receive pressure flow from the structure as these events pass under the low chord. The 50-yr event is run using the pressure/weir equation as the water surface overtops the roadway and hits the low chord of the structure causing the pressure flow to occur. The larger storm events (100-yr and 500-yr) are modeled using the pressure and/or weir flow equations, but because the bridge is completely submerged by these storms, HEC-RAS has modeled the bridge using the energy equation as the structure and approach roadways have little effect on the water surface elevations.

The proposed structure is being constructed on a new alignment 75 feet upstream of the existing bridge and has a proposed hydraulic opening of 4960 square feet. The proposed model is run under momentum flow for the smaller storm events (1.1-yr through 5-yr flood event). The momentum flow indicates that the flow is affected by the presence of the pier. The 10-yr flood event through the 100-yr flood event are running under energy/weir which means the flow is overtopping the roadway, but does not impact the low chord of the structure. The 500-yr storm event is run under energy only as the bridge opening (and approach roadways) is completely submerged.

The Bridge Design Guide (BDG) states that bridges that are not major riverine bridges must provide four feet over the 50-year event or one foot over the 100-year event. The proposed structure does not meet this criteria as the structure provides 0.75 feet of freeboard from the lowest point of the substructure (Low Chord Elevation=285.80 feet) for the 50-year event and the 100-year event (Water Surface Elevation=285.93') clips the low chord. It should be noted that because the proposed structure is perched the average low chord elevation is 286.65 feet which does pass the 100-year event. The structure does pass the flood of record (Q=29,180 cfs) which is closest to the 50-yr event. It should be noted that the approach roadways are overtopped for the 10-yr flood event and greater, but this is allowable by the Bridge Design Guide (Chapter 2, Section A).

It should be noted that the proposed structure does show an increase in the 10-yr and 500-yr flood events at the common cross section (RS 880.50) upstream of the structures, but these increases are minimal (0.05 feet maximum increase) and will not adversely impact any adjacent property owners upstream of the proposed structure. Although there is an increase in the water surface elevations for these storm events, there is a decrease in the velocity at the common cross section.

Table 3 provides a summary of the hydraulic analysis of existing and proposed conditions at the Pleasant River Bridge over the Pleasant River. It should be noted that the comparisons of the headwaters, velocities, and other hydraulic information are based off the cross section immediately upstream of each structure. When comparing the overall profiles of the existing and proposed, the

proposed conditions closely match the existing conditions for the majority of the model. It should also be noted there are no increases in the 100-year event from the existing to proposed condition.

Table 3: Hydraulic Analysis Summary

Summary of Hydraulic Data-Pleasant River Bridge over the Pleasant River in Milo, Maine	Existing Conditions (RS 358.41)	Proposed Conditions (RS 467.75)
Low Chord	284.68	285.80
Average Low Chord	284.68	286.65
Floodplain width at Q100, ft	3116.82	3061.90
Floodplain width at Q500, ft	3704.00	3651.92
Width at Banks, ft	325.01	334.32
Headwater Q10, ft	282.91	283.09
Headwater Q25, ft	283.97	283.84
Headwater Q50, ft	284.97	285.05
Headwater Q100, ft	285.97	285.93
Headwater Q500, ft	288.39	288.49
Headwater Qmax ft	284.97	285.05
Discharge Velocity Q10, fps	3.91	3.69
Discharge Velocity Q25, fps	3.95	3.92
Discharge Velocity Q50, fps	3.79	3.65
Discharge Velocity Q100, fps	3.71	3.64
Discharge Velocity Q500, fps	3.51	3.40
Discharge Velocity Qmax, fps	3.78	3.64
Ordinary High-Water Elevation (Q1.1), ft	274.63	275.07
Discharge Velocity Q1.1, fps	3.59	3.31
Clearance at Q10, ft	1.77	2.71
Clearance at Q25, ft	0.71	1.96
Clearance at Q50, ft	0.00	0.75
Clearance at Q100, ft	0.00	0.00
Clearance at Q500, ft	0.00	0.00
Clearance at Qmax, ft	0.00	0.75
Bridge Opening Area, ft^2	4076.35	4960.38
Flow area at Q100, ft^2	18685.15	18851.16
Flow area at Q500, ft^2	26933.82	27447.23

The HEC-RAS model was reviewed for errors, warnings, and notes. There were several notes produced by HEC-RAS for the existing and proposed models about multiple critical depths found at several cross-sections. While there were no errors produced, some warnings stated there might be a need for more cross-sections. These warnings were reviewed and it was deemed that additional

cross-sections were not necessary. HEC-RAS outputs including cross-sections and profiles are provided for existing conditions in **Appendix E** and proposed conditions in **Appendix F**.

5.0 Scour Analysis

A scour analysis was performed based on equations from FHWA publication HEC-18 (Fifth Edition). The 100-year and 500-year events were analyzed for scour at the proposed Pleasant River Bridge crossing. The D_{50} of the streambed material was approximated to be 2.0 mm or 0.00656 feet. This D_{50} was used to determine whether clear water or live bed scour analysis was to be performed. At the Pleasant River Bridge, live bed scour was required to be calculated. In addition, local scour was calculated per HEC-18 for the near and far abutments as well as the pier. From the scour analysis it was found that there was no live bed scour at the proposed project site, only local scour at the near and far abutments.

The total scour depths can be found in **Table 4** and the scour analysis can be found in **Appendix G**.

Table 4: Scour Depths

	100 - year storm		
	Near Abutment	Pier	Far Abutment
Aggradation/ Degradation (ft)	---	---	---
Contraction/Expansion Scour (ft)	---	0.00	---
Local Scour (ft)	22.48	6.69	20.00
Pressure Flow Scour (ft)	---	---	---
TOTAL SCOUR (ft)	***22.48***	***6.69***	***20.00***

	500-year storm		
	Near Abutment	Pier	Far Abutment
Aggradation/ Degradation (ft)	---	---	---
Contraction/Expansion Scour (ft)	---	0.00	---
Local Scour (ft)	25.97	6.64	24.41
Pressure Flow Scour (ft)	---	5.05	---
TOTAL SCOUR (ft)	***25.97***	***11.69***	***24.41***

Note that local scour is known to be conservative and the calculations do not account for any proposed scour protection such as riprap.

6.0 Summary

In summary, the existing Pleasant River Bridge over Pleasant River in Piscataquis County is proposed to be replaced. The low chord of the existing structure is at 284.68 feet. The existing structure offers approximately 4076 square feet of hydraulic opening. The 10-yr and greater storm events overtop the approach roadways on either side of the structure and the 50-yr event (and greater) will clip the low chord of the existing structure while also overtopping the approach roadways.

The proposed bridge is designed to be on a new alignment, while raising the existing low chord elevation and lengthening the span. The span length from abutment to abutment is proposed to be 345 feet. Increasing the span and raising the low chord elevation increases the hydraulic opening to approximately 4960 square feet. The proposed structure allows the 10-yr storm event (and greater) to overtop the approach roadways, however the 500-year event is the only storm to completely submerge the perched low chord of the substructure.

The proposed structure and revised profile will improve the overall hydraulic conditions at the Pleasant River Bridge over Pleasant River.

Appendix Contents

APPENDIX A

Site Photographs

Photo 1 – Eastern View of Existing Structure– Looking Upstream

Photo 2 – Pleasant St– Looking North

Photo 3 – Pleasant St – Looking South

Photo 4 – View of the Downstream Side of Pleasant River – Looking East

Photo 5 – View of the Upstream Side of Pleasant River – Looking West

APPENDIX B

FEMA FIRM

PLEASANT RIVER BRIDGE
PROJECT SITE

ZONE X
ZONE A
ZONE AE
RM 6
RM 7
RM 8
RM 9
RM 10
RM 14
x 289
PLEASANT RIVER
PLEASANT STREET
KNOWLES AVENUE
PROSPECT STREET
ALBERT STREET
WILLOW STREET
WATER ST
SEBEC RIVER DAM
MEDFORD ROAD
REARDON ROAD
HOVEY
LORD ROAD
LAKE
300
298
296
294
292
290
288
287
286
285
284

APPROXIMATE SCALE
1000 0 1000 FEET

NATIONAL FLOOD INSURANCE PROGRAM

FIRM
FLOOD INSURANCE RATE MAP

TOWN OF
MILO, MAINE
PISCATAQUIS COUNTY

PANEL 10 OF 10
(SEE MAP INDEX FOR PANELS NOT PRINTED)

COMMUNITY-PANEL NUMBER
230177 0010 C

MAP REVISED:
MAY 20, 1996

Federal Emergency Management Agency

APPENDIX C

Hydrology Report

Environmental Office – Hydrology Section
16 State House Station
Augusta ME 04333-0016
207.557.1052
Charles.Hebson@maine.gov

Maine Department of Transportation

Memo

To: Brian Nichols

From: Charles Hebson

CC: Josh Hasbrouck

Date: 2017 September 21

Re: 22627 Bridge #3244 – Pleasant River Bridge - Hydrology Report

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Pleasant River Bridge carries Pleasant St / North Rd over the Pleasant River in Milo, 4.4 miles upstream of the confluence with the Piscataquis River. The project location and watershed are show in Figure 1. The final recommended design hydrology is summarized in Table 1 under "USGS Gage 17B Est." and "Empirical Weibull PP" as well as Figure 2 below.

There was a USGS gage (#01033500 Pleasant River near Milo, Maine) approximately 2 miles upstream of the project; the record covers the years 1920 – 1979 along an estimated flow for the 1987 event. The gage watershed (A_g = 323 mi^2) is slightly smaller than the ungaged project watershed (A_u = 332 mi^2); all gage flows have been adjusted for the difference in watershed areas. Because the record length is so long and because the gage estimates differ significantly from the regression estimates, the regression estimates are not used in the final recommended design values and the gage flows should serve as basis for design. The regression estimates are only reported for the sake of completeness. The Weibull plotting positions for the ranked gage flows are also reported. The final set of recommended design values consist of the Bulletin 17B LP-III values for return periods T $\leq$ 2 years and the Weibull Plotting Position (PP) values for T $\geq$ 5 years. The area-adjusted maximum of record can be used as a check flow. Hydrology from the 1996 Flood Insurance Study is also included.

Discussion

MaineDOT design hydrology for larger structures is ordinarily calculated with statewide peak flow regression equations (Hodgkins, 1999). When the structure is on a gaged river, the regression and gage estimates are generally combined in a weighted estimate according to Hodgkins (1999). For long gage record lengths and for gages near the project site, the site regression estimates have relatively little effect on the final site estimates; the final site estimates mostly reflect area-weighted adjustments of the gage values.

Pleasant River Bridge is located in Milo and carries Pleasant Street / North Road over the Pleasant River. The watershed map is shown in Figure 2. There was a USGS gage (#01033500) on the Pleasant River 2 miles upstream of the project bridge. The time series for annual maximum flows is shown in Figure 3. The maximum of record, 28,600 ft^3/s, occurred in 1967; there were 5 other annual peaks greater than 20,000 ft^3/s. The gage flood frequency analysis as executed with PeakFQ is shown in Figure 4.

The ungaged watershed area at the bridge (A_u) is 332 mi^2 with 10.05% wetlands as determined by StreamStats (U.S. Geological Survey, 2012). Since the Milo gage record is relatively long (60 years), the regression estimates will not be used in developing design peak flow estimates. Furthermore, the regression estimates are 50% - 60% of the gage-based estimates, suggesting regression significantly underestimates peak flow

hydrology at this location. The only adjustments to the gage values will be for the small difference between the project and gage watershed areas (A_u/A_g = 1.03).

The project watershed (332 mi^2) is 1.03 times larger than the gage watershed area A_g (323 mi^2). Thus we can expect the project design hydrology to be just a bit larger than the gage data. Adjustment for the difference between gage (A_g) and ungaged project (A_u) watershed areas is

$Q_u = Q_g(A_u/A_g)^a$

where a = exponent from simple area-only regression equations (Hodgkins, 1999); see also Figure 5.

This relation shows that are adjustment is not a simple linear scaling. Since a < 1, linear scaling by area would produce a larger, more conservative adjusted flow.

References:

Hodgkins, 1999. Estimating the Magnitude of Peak Flows for Stream in Maine for Selected Recurrence Intervals, US Geological Survey, *WRIR 99-4408*.

Flynn, K., W.H. Kirby, & P.R. Hummel, 2006. User's Manual for Program PeakFQ, Annual Flood Frequency Analysis Using Bulletin 17B Guidelines. US Geological Survey, *Techniques & Methods 4-B4*.

U.S. Geological Survey, 2012. The StreamStats program, online at https://streamstatsags.cr.usgs.gov/streamstats/

Table 1. Design Hydrology Summary

Area (mi^2)			332	323		321.4
NWI (%)			10.05	--		
Return Period T	**Exceedance Prob P_{ex}**	**Area exponent "a"**	**Site Regression Q_r**	**USGS Gage[1] 17B Est. Q_g**	**Empirical Weibull PP[1]**	**FIS**
1.005	0.995	0.860	2 090	***2 125***		
1.01	0.990	0.860	2 320	***2 430***		
1.05	0.952	0.856	3 085	***3 515***	3 350	
1.1	0.909	0.852	3 560	***4 280***	4 545	
1.5	0.667	0.836	5 245	***6 810***	6 855	
2	0.500	0.825	6 315	***8 630***	7 660	
5	0.200	0.797	9 020	13 740	***14 225***	
10	0.100	0.783	10 930	17 545	***21 495***	17 600
25	0.040	0.767	13 350	22 785	***25 980***	
50	0.020	0.757	15 185	27 005	***29 240***	29 200
100	0.010	0.748	17 105	31 480	***33 175***[2]	35 200
500	0.002	0.729	21 725	42 970	***42 970***[2]	52 400
Record Max - 1967					***29 180***[1]	

Notes: 1. gage flows adjusted for project watershed area

2. 100 & 500-yr flows for Weibull plotting position extrapolated from 10, 25 & 50-yr flows

Figure 1. Pleasant River at Pleasant St / North Rd in Milo, ME

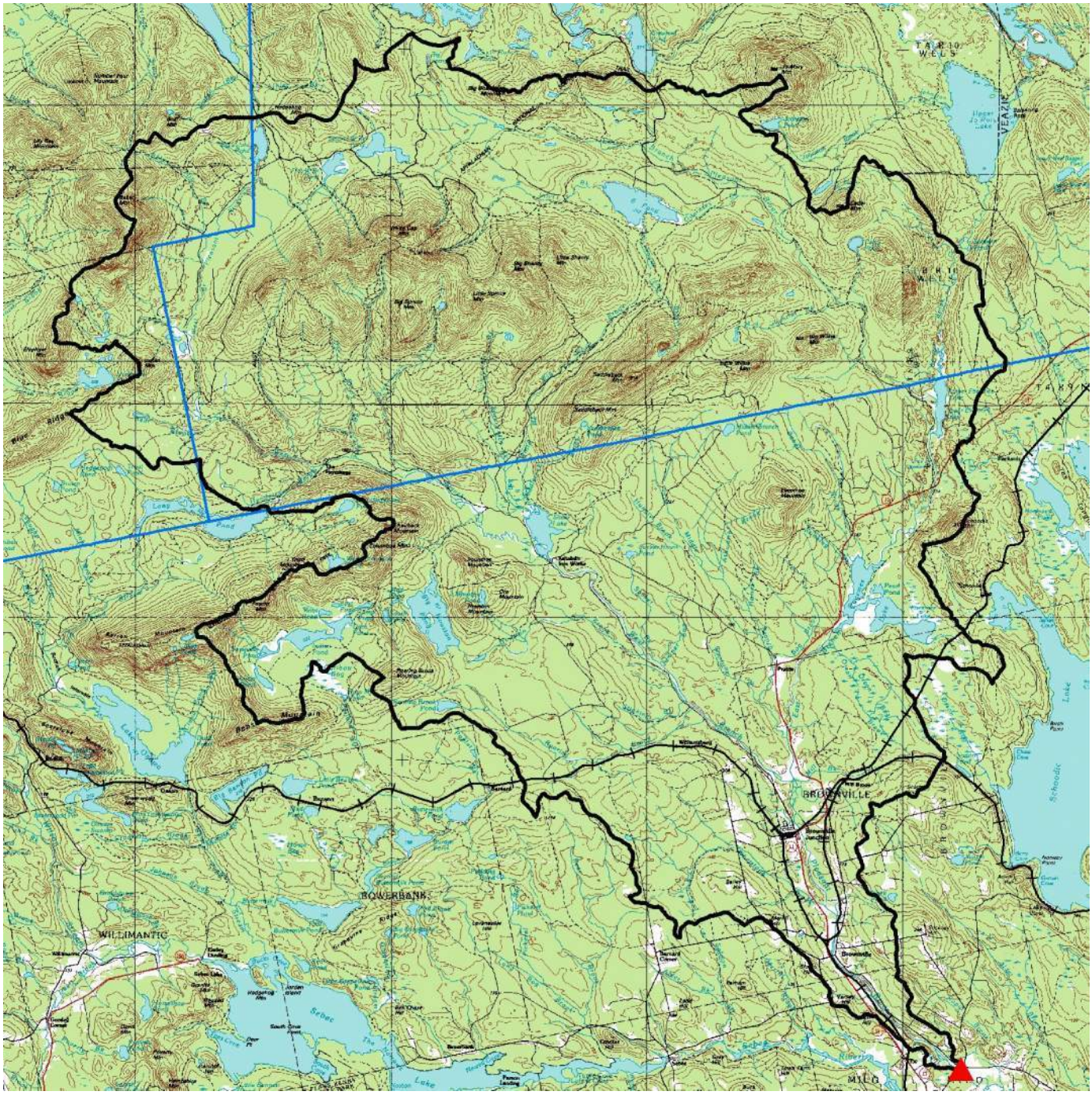
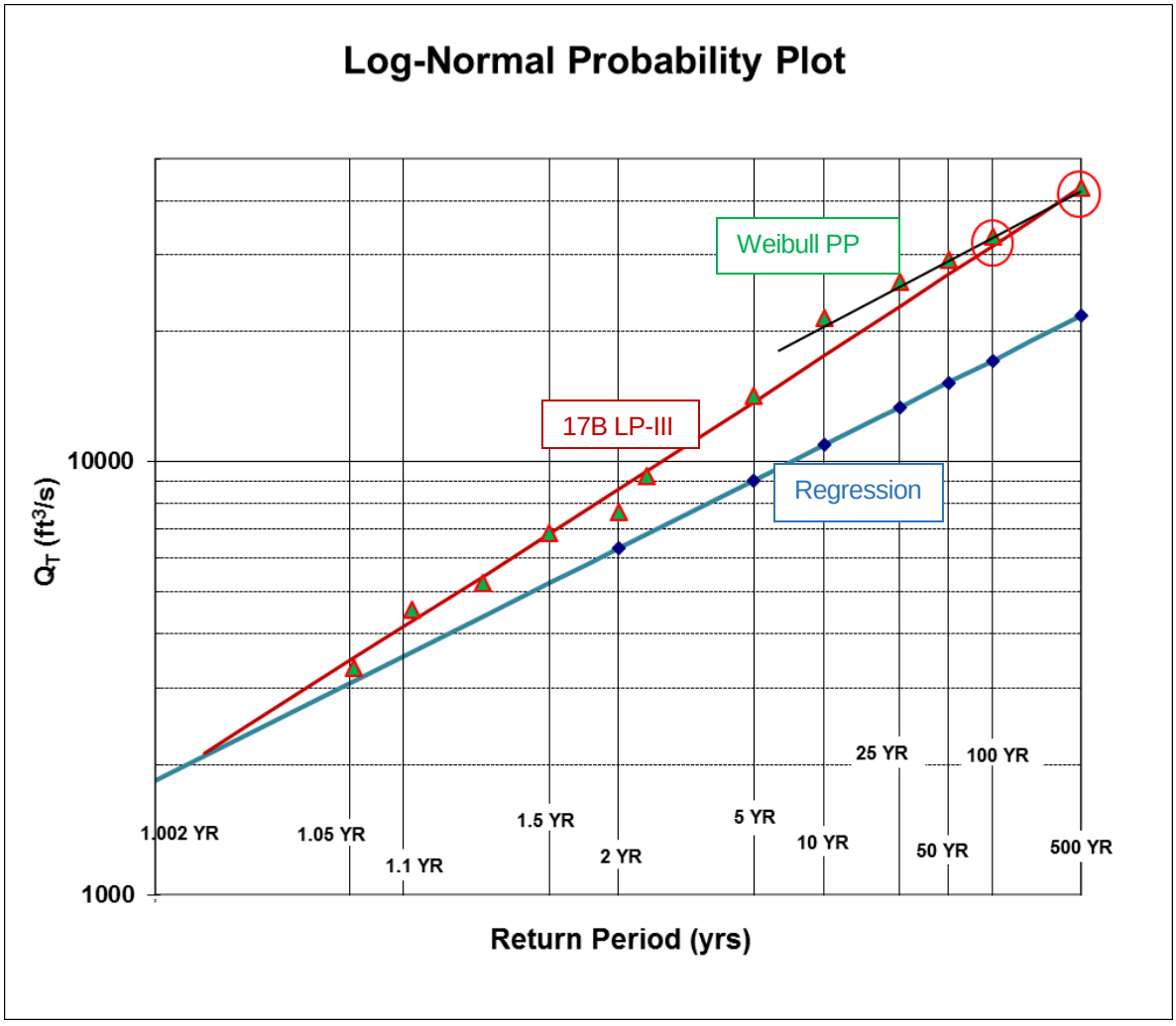


Figure 2. Probability Plot – Regression & Area-Adjusted Gage Flows



Notes: triangular points by Weibull plotting position

Weibull 100-yr & 500-yr flows extrapolated from 10-. 25- & 50-yr values

Figure 3. Annual maximum flows at Milo Gage (not adjusted for area)

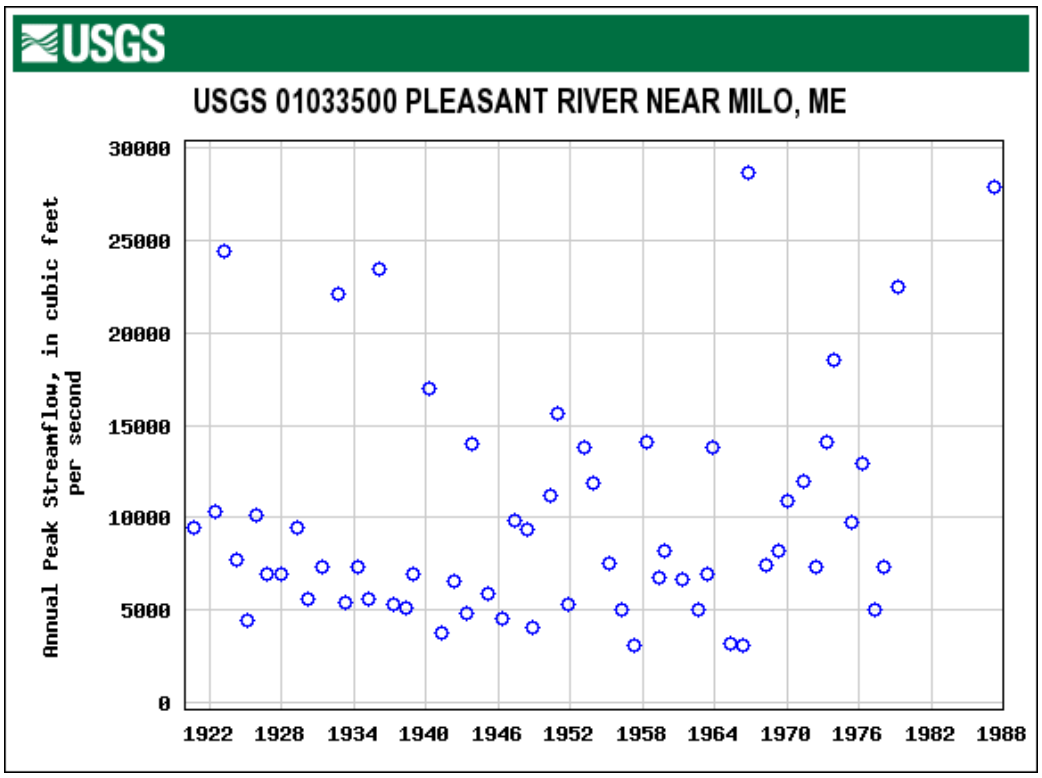


Figure 4. Results of 17B gage LPIII peak flow analysis from PeakFQ (not adjusted for area)

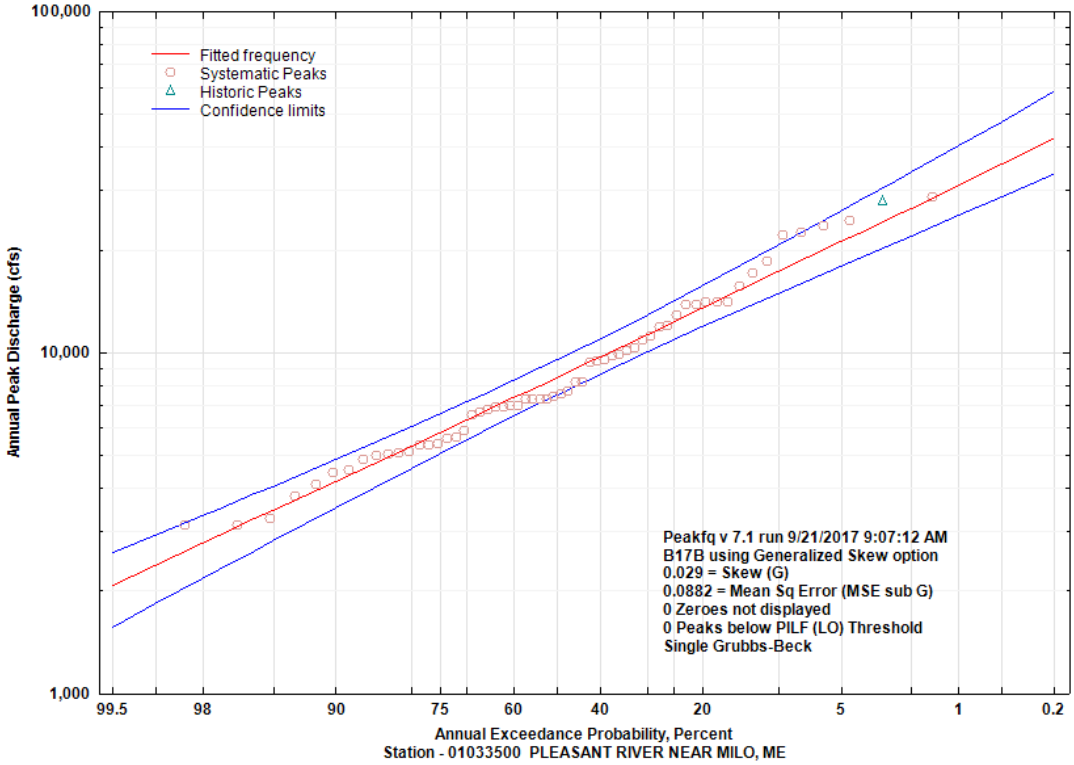
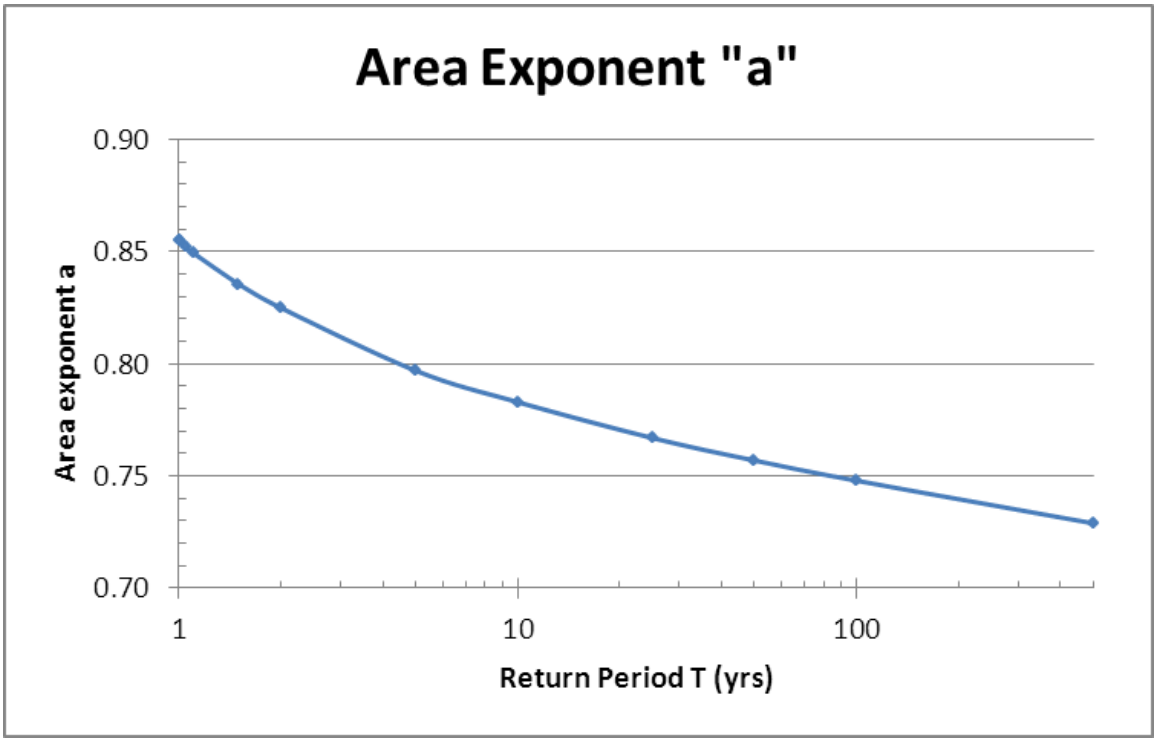


Figure 5. Area Exponent "a" for Watershed Area Scaling of Gage Peak Flow Estimates



APPENDIX D

FEMA Flood Insurance Study Information

FEMA HYDROLOGY USED

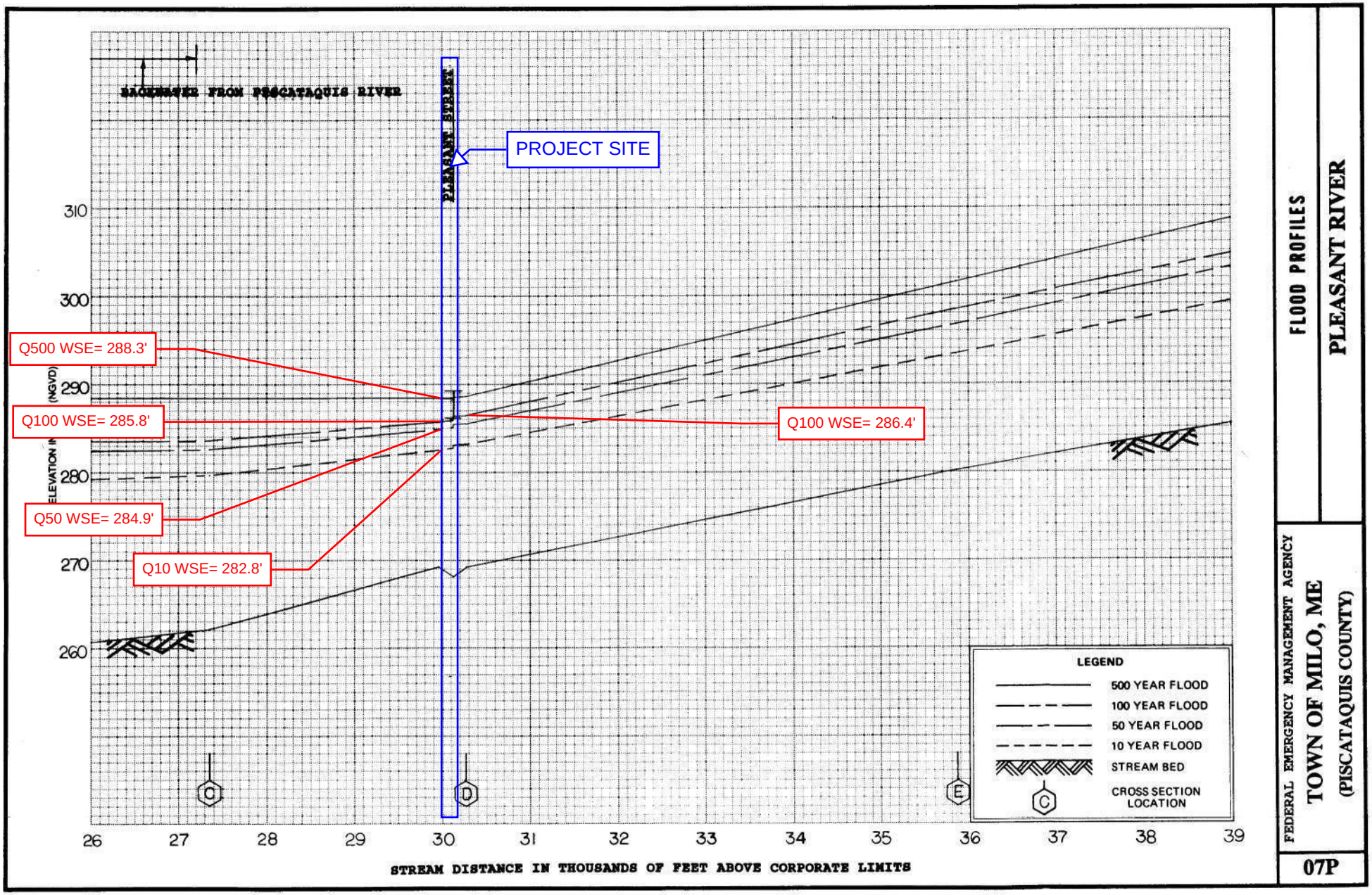
PLEASANT RIVER					
At downstream corporate limits	335.4	18,000	29,900	36,100	53,700
At Pleasant Street	321.4	17,600	29,200	35,200	52,400
At upstream corporate limits	324.0	17,400	28,900	34,900	51,900

FEMA HYDRAULICS PROGRAM USED

Water-surface elevations of floods of the selected recurrence intervals were computed using the SCS WSP-2 computer program (Reference 11). Starting water-surface elevations for the Piscataquis River were determined from an SCS study of the feasibility of flood prevention measures in the upper Piscataquis River watershed (Reference 7). The starting water-surface elevations for the Sebec River, Pleasant River, and Meadow Brook were calculated using the slope/area method.

FEMA MANNING'S n VALUES USED

Stream	Channel "n"	Overbank "n"
Piscataquis River	0.035-0.060	0.040-0.095
Sebec River	0.020-0.070	0.035-0.095
Pleasant River	0.050-0.065	0.080-0.095
Meadow Brook	0.055	0.090



FLOOD PROFILES

PLEASANT RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWN OF MILO, ME

(PISCATAQUIS COUNTY)

07P

APPENDIX E

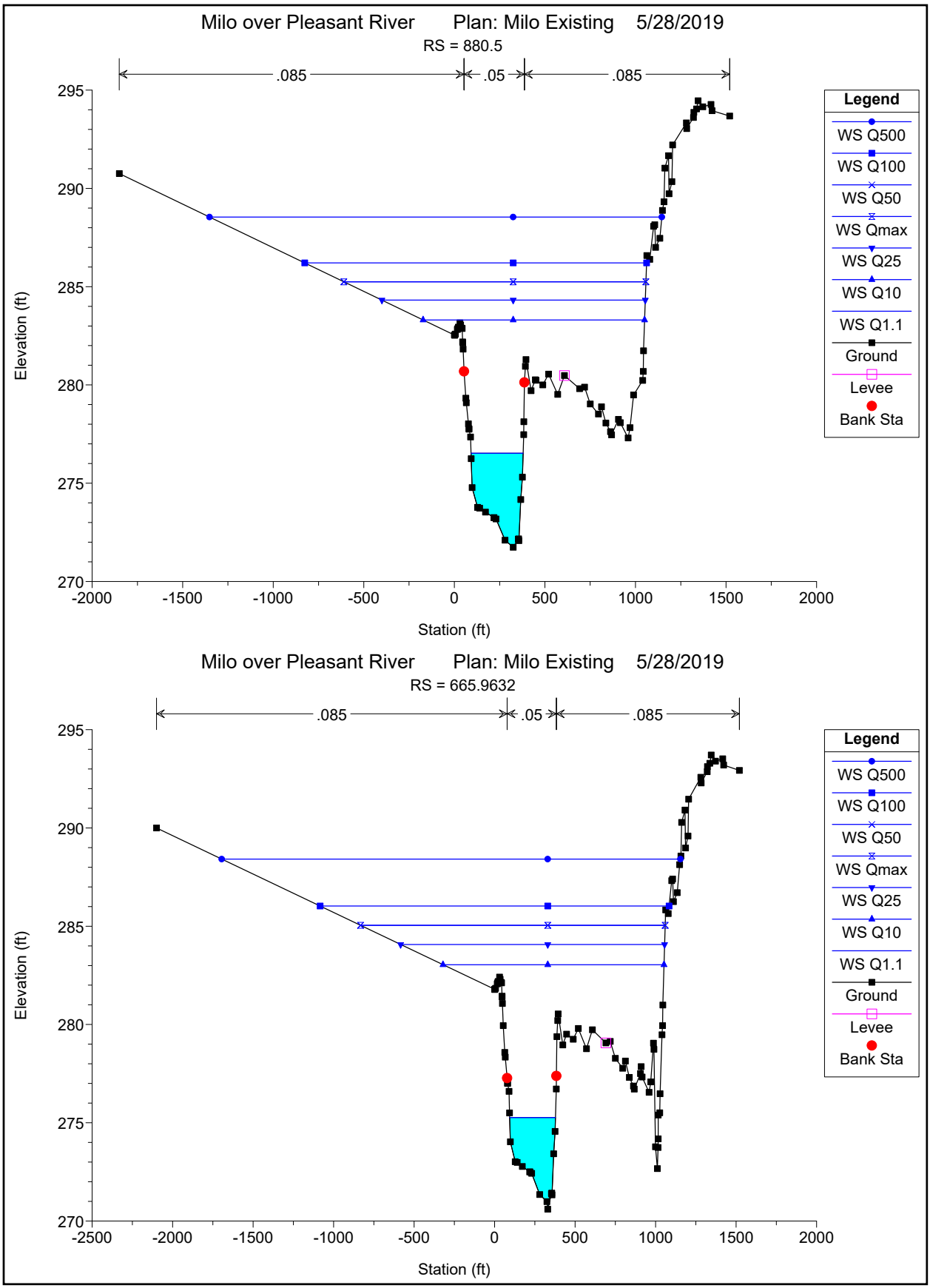
Existing HEC-RAS Analysis

HEC-RAS Plan: Milo Existing River: Stream Reach: Reach

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Reach	880.5	Q1.1	4280.00	271.74	276.52	274.96	276.82	0.004213	4.36	981.17	287.76	0.42
Reach	880.5	Q10	21495.00	271.74	283.30	278.78	283.67	0.001644	5.37	5841.75	1222.69	0.31
Reach	880.5	Q25	25980.00	271.74	284.31	279.52	284.68	0.001524	5.53	7193.58	1454.09	0.30
Reach	880.5	Q50	29240.00	271.74	285.25	280.10	285.59	0.001303	5.41	8652.32	1668.16	0.28
Reach	880.5	Q100	33175.00	271.74	286.21	281.15	286.52	0.001147	5.36	10355.51	1887.64	0.27
Reach	880.5	Q500	42970.00	271.74	288.54	282.07	288.81	0.000852	5.18	15479.44	2497.36	0.24
Reach	880.5	Qmax	29180.00	271.74	285.25	280.07	285.58	0.001298	5.40	8650.08	1667.86	0.28
Reach	665.9632	Q1.1	4280.00	270.60	275.27	274.18	275.67	0.006889	5.08	842.66	284.55	0.52
Reach	665.9632	Q10	21495.00	270.60	283.04	277.97	283.34	0.001246	5.00	6672.37	1372.53	0.27
Reach	665.9632	Q25	25980.00	270.60	284.07	278.70	284.38	0.001174	5.16	8223.90	1639.89	0.27
Reach	665.9632	Q50	29240.00	270.60	285.05	279.41	285.32	0.001005	5.04	9944.04	1892.66	0.25
Reach	665.9632	Q100	33175.00	270.60	286.03	280.29	286.29	0.000899	5.02	11932.76	2167.69	0.24
Reach	665.9632	Q500	42970.00	270.60	288.42	281.22	288.63	0.000661	4.80	17944.29	2849.65	0.21
Reach	665.9632	Qmax	29180.00	270.60	285.05	279.41	285.32	0.001001	5.03	9943.06	1892.53	0.25
Reach	574.7724	Q1.1	4280.00	269.85	275.07	272.78	275.28	0.002278	3.63	1180.22	287.43	0.32
Reach	574.7724	Q10	21495.00	269.85	283.03	276.57	283.23	0.000759	4.24	9446.68	2194.38	0.22
Reach	574.7724	Q25	25980.00	269.85	284.08	277.34	284.27	0.000693	4.29	11873.66	2430.78	0.21
Reach	574.7724	Q50	29240.00	269.85	285.06	277.85	285.23	0.000582	4.12	14372.72	2646.21	0.20
Reach	574.7724	Q100	33175.00	269.85	286.05	278.43	286.20	0.000513	4.06	17101.45	2882.94	0.19
Reach	574.7724	Q500	42970.00	269.85	288.44	280.87	288.56	0.000378	3.85	24715.31	3468.36	0.16
Reach	574.7724	Qmax	29180.00	269.85	285.06	277.83	285.23	0.000579	4.12	14371.19	2646.08	0.19
Reach	486.4205	Q1.1	4280.00	269.08	274.91	272.38	275.08	0.001843	3.32	1288.14	305.44	0.29
Reach	486.4205	Q10	21495.00	269.08	283.01	276.09	283.16	0.000579	3.68	10983.66	2416.86	0.19
Reach	486.4205	Q25	25980.00	269.08	284.06	276.91	284.20	0.000529	3.73	13637.72	2635.77	0.18
Reach	486.4205	Q50	29240.00	269.08	285.05	277.39	285.17	0.000446	3.60	16341.76	2841.50	0.17
Reach	486.4205	Q100	33175.00	269.08	286.04	277.94	286.15	0.000396	3.55	19263.07	3068.12	0.16
Reach	486.4205	Q500	42970.00	269.08	288.43	280.34	288.52	0.000298	3.40	27299.29	3629.06	0.14
Reach	486.4205	Qmax	29180.00	269.08	285.05	277.39	285.17	0.000444	3.59	16340.28	2841.40	0.17
Reach	437.6685	Q1.1	4280.00	269.67	274.81	272.39	274.99	0.002001	3.43	1247.46	299.77	0.30
Reach	437.6685	Q10	21495.00	269.67	282.99	276.18	283.13	0.000544	3.56	11287.20	2410.76	0.18
Reach	437.6685	Q25	25980.00	269.67	284.04	276.92	284.17	0.000504	3.63	13947.49	2649.33	0.18
Reach	437.6685	Q50	29240.00	269.67	285.03	277.41	285.15	0.000426	3.51	16671.59	2852.77	0.17
Reach	437.6685	Q100	33175.00	269.67	286.02	277.94	286.13	0.000379	3.47	19607.29	3076.70	0.16
Reach	437.6685	Q500	42970.00	269.67	288.42	280.10	288.51	0.000286	3.33	27666.52	3631.24	0.14
Reach	437.6685	Qmax	29180.00	269.67	285.03	277.40	285.15	0.000424	3.50	16670.29	2852.67	0.17
Reach	395.9304	Q1.1	4280.00	269.51	274.73	272.30	274.91	0.001999	3.41	1256.31	304.99	0.30
Reach	395.9304	Q10	21495.00	269.51	282.97	276.03	283.11	0.000543	3.53	11401.13	2445.91	0.18
Reach	395.9304	Q25	25980.00	269.51	284.02	276.80	284.15	0.000498	3.59	14113.71	2702.13	0.18
Reach	395.9304	Q50	29240.00	269.51	285.02	277.36	285.13	0.000419	3.46	16897.49	2901.02	0.17
Reach	395.9304	Q100	33175.00	269.51	286.01	277.90	286.12	0.000371	3.41	19884.53	3120.01	0.16
Reach	395.9304	Q500	42970.00	269.51	288.41	279.19	288.50	0.000279	3.27	28044.85	3662.56	0.14
Reach	395.9304	Qmax	29180.00	269.51	285.02	277.35	285.13	0.000417	3.45	16896.34	2900.94	0.16
Reach	358.4056	Q1.1	4280.00	269.95	274.63	272.33	274.83	0.002274	3.59	1191.16	294.06	0.31
Reach	358.4056	Q10	21495.00	269.95	282.91	276.13	283.08	0.000646	3.91	10279.03	2352.74	0.20
Reach	358.4056	Q25	25980.00	269.95	283.97	276.91	284.13	0.000588	3.95	12914.73	2631.65	0.19
Reach	358.4056	Q50	29240.00	269.95	284.97	277.40	285.11	0.000490	3.79	15689.15	2879.21	0.18
Reach	358.4056	Q100	33175.00	269.95	285.97	277.95	286.10	0.000429	3.71	18685.15	3116.82	0.17
Reach	358.4056	Q500	42970.00	269.95	288.39	279.27	288.49	0.000314	3.51	26933.82	3704.00	0.15
Reach	358.4056	Qmax	29180.00	269.95	284.97	277.39	285.11	0.000488	3.78	15688.53	2879.16	0.18
Reach	321		Bridge									
Reach	284.8751	Q1.1	4280.00	269.63	274.28	272.47	274.57	0.003760	4.32	991.81	271.26	0.40
Reach	284.8751	Q10	21495.00	269.63	282.82	276.51	283.02	0.000792	4.22	9622.32	2355.34	0.22
Reach	284.8751	Q25	25980.00	269.63	283.62	277.29	283.83	0.000792	4.42	11589.31	2553.61	0.22
Reach	284.8751	Q50	29240.00	269.63	284.91	277.80	285.07	0.000567	4.00	15099.18	2855.04	0.19
Reach	284.8751	Q100	33175.00	269.63	285.81	278.39	285.96	0.000514	3.97	17770.64	3133.66	0.18
Reach	284.8751	Q500	42970.00	269.63	288.31	281.01	288.42	0.000359	3.69	26647.74	3931.44	0.16
Reach	284.8751	Qmax	29180.00	269.63	284.91	277.80	285.07	0.000564	3.99	15099.18	2855.04	0.19
Reach	245.9087	Q1.1	4280.00	269.46	274.04	272.54	274.38	0.005034	4.71	923.02	284.04	0.45
Reach	245.9087	Q10	21495.00	269.46	282.82	276.65	282.96	0.000599	3.57	11372.31	2450.11	0.19
Reach	245.9087	Q25	25980.00	269.46	283.62	277.33	283.76	0.000606	3.76	13411.12	2638.08	0.19
Reach	245.9087	Q50	29240.00	269.46	284.92	278.23	285.03	0.000443	3.45	17002.47	2913.10	0.17
Reach	245.9087	Q100	33175.00	269.46	285.82	279.24	285.92	0.000403	3.44	19711.20	3115.73	0.16
Reach	245.9087	Q500	42970.00	269.46	288.31	280.34	288.39	0.000291	3.27	29021.91	3994.63	0.14
Reach	245.9087	Qmax	29180.00	269.46	284.92	278.28	285.03	0.000441	3.44	17002.29	2913.08	0.17
Reach	200.4046	Q1.1	4280.00	269.31	273.59	272.67	274.07	0.009008	5.57	784.25	290.28	0.59
Reach	200.4046	Q10	21495.00	269.31	282.80	276.60	282.93	0.000572	3.59	11771.49	2476.03	0.19
Reach	200.4046	Q25	25980.00	269.31	283.60	277.39	283.74	0.000581	3.79	13822.94	2653.56	0.19
Reach	200.4046	Q50	29240.00	269.31	284.90	278.16	285.01	0.000427	3.47	17446.54	2923.42	0.17
Reach	200.4046	Q100	33175.00	269.31	285.80	279.17	285.90	0.000391	3.47	20165.73	3130.58	0.16

HEC-RAS Plan: Milo Existing River: Stream Reach: Reach (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Reach	200.4046	Q500	42970.00	269.31	288.30	280.31	288.38	0.000281	3.27	29765.60	4000.80	0.14
Reach	200.4046	Qmax	29180.00	269.31	284.90	278.21	285.01	0.000425	3.46	17446.54	2923.42	0.17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.05
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Station (ft)
Legend
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WS Q100
WS Q50
WS Qmax
WS Q25
WS Q10
WS Q1.1
Ground
Levee
Bank Sta
Milo over Pleasant River Plan: Milo Existing 5/28/2019
RS = 665.9632
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.05
.085
Elevation (ft)
Station (ft)
Legend
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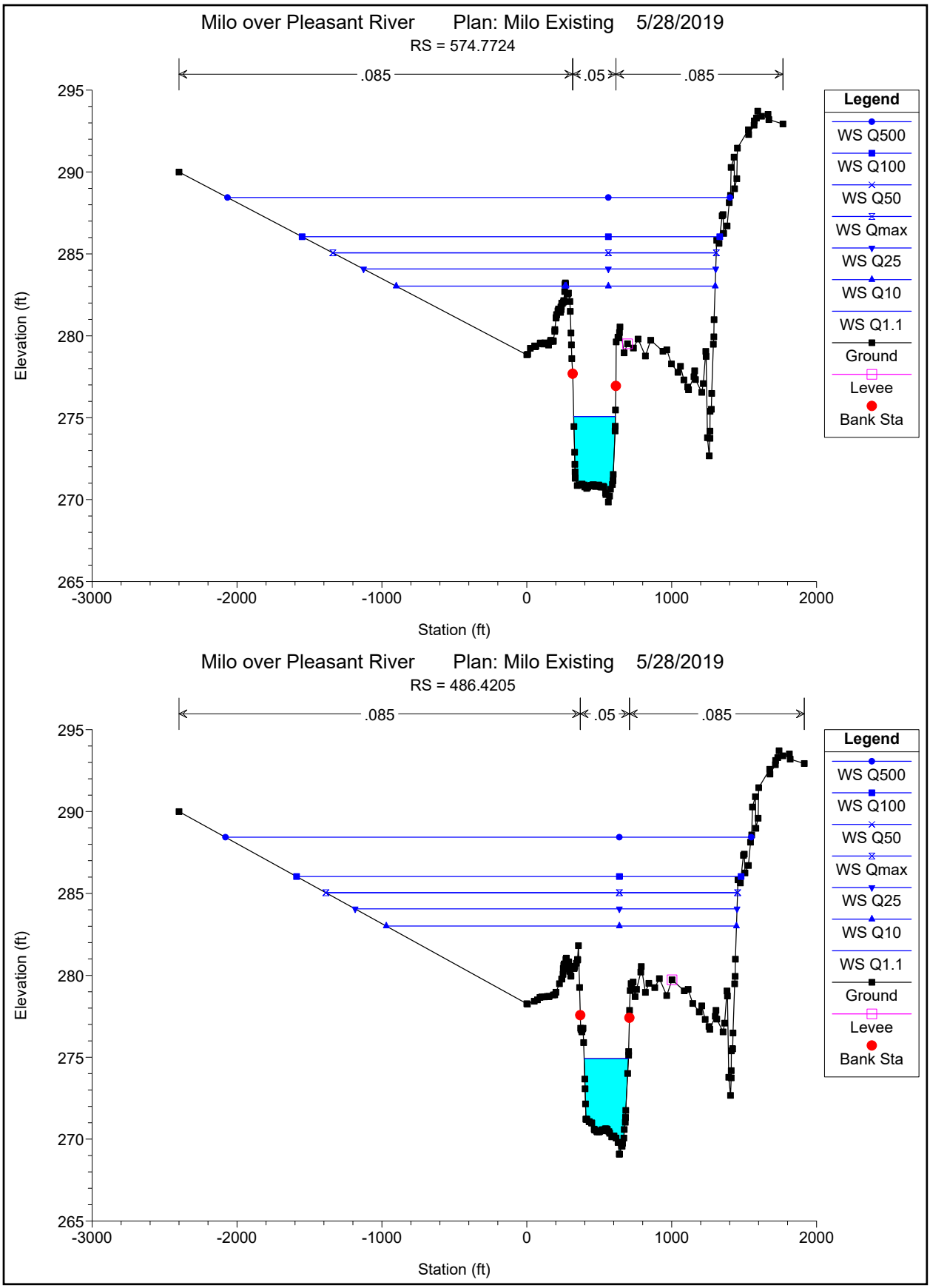
WS Qmax
WS Q25
WS Q10
WS Q1.1
Ground
Levee
Bank Sta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275
270
265
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-2000
-1000
0
1000
2000
Station (ft)
Legend
WS Q500
WS Q100
WS Q50
WS Qmax
WS Q25
WS Q10
WS Q1.1
Ground
Levee
Bank Sta
Milo over Pleasant River Plan: Milo Existing 5/28/2019
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.05
.085
Elevation (ft)
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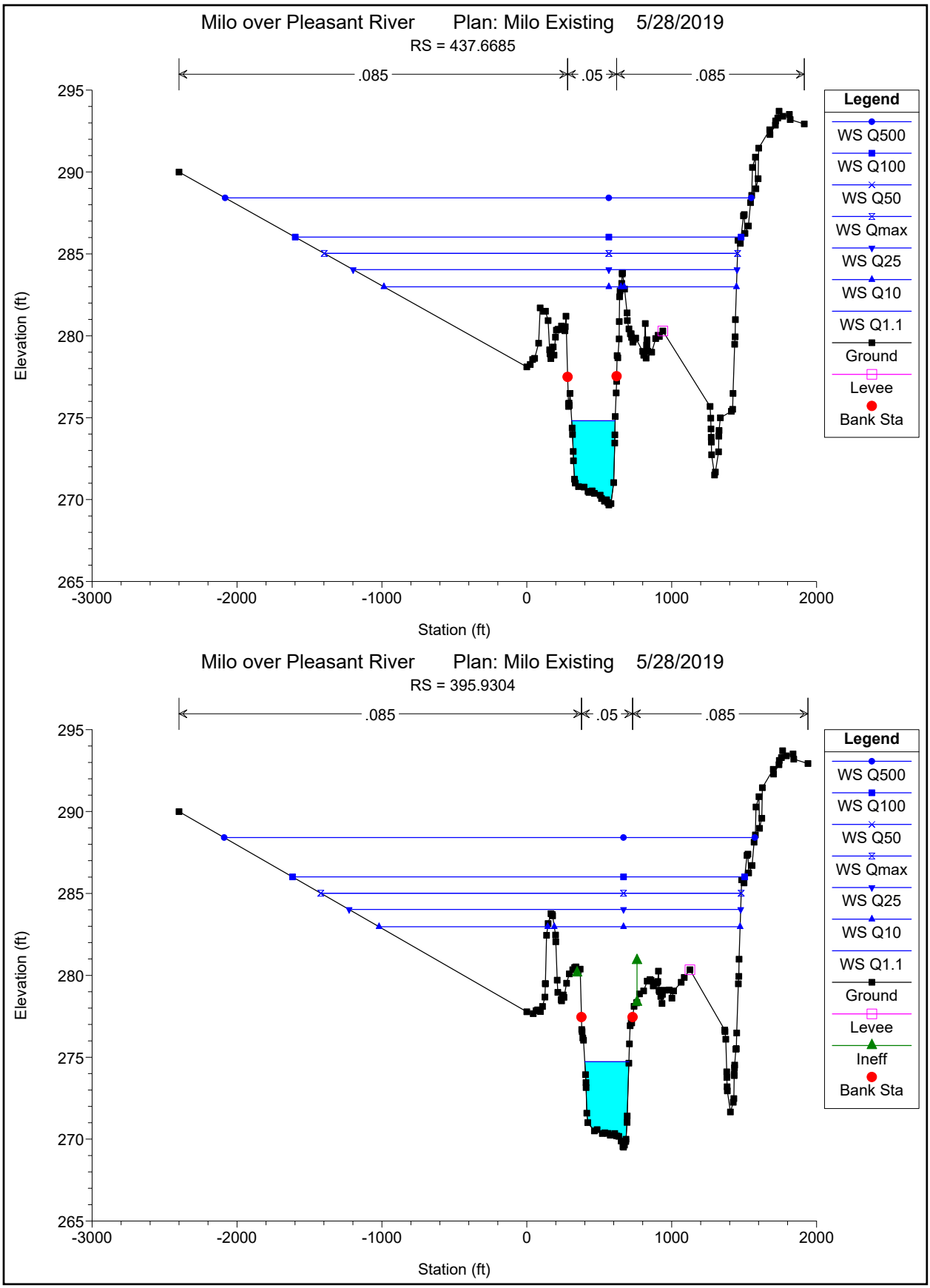
290
285
280
275
270
265
-3000
-2000
-1000
0
1000
2000
Station (ft)
Legend
WS Q500
WS Q100
WS Q50
WS Qmax
WS Q25
WS Q10
WS Q1.1
Ground
Levee
Bank Sta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275
270
265
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-1000
0
1000
2000
Station (ft)
Legend
WS Q500
WS Q100
WS Q50
WS Qmax
WS Q25
WS Q10
WS Q1.1
Ground
Levee
Bank Sta
Milo over Pleasant River Plan: Milo Existing 5/28/2019
RS = 395.9304
.085
.05
.085
Elevation (ft)
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285
280
275
270
265
-3000
-2000
-1000
0
1000
2000
Station (ft)
Legend
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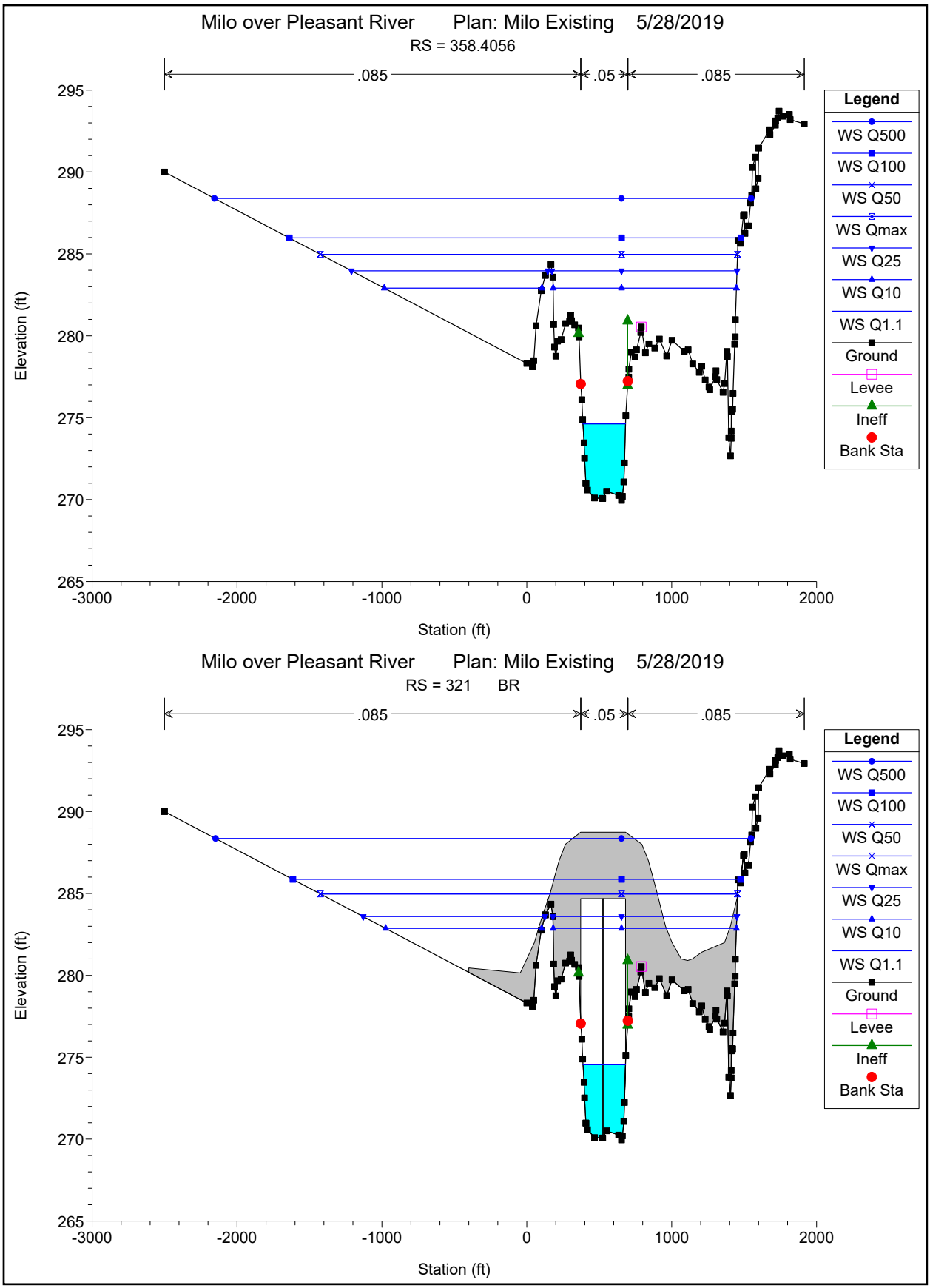
WS Q50
WS Qmax
WS Q25
WS Q10
WS Q1.1
Ground
Levee
Ineff
Bank Sta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280
275
270
265
-3000
-2000
-1000
0
1000
2000
Station (ft)
Legend
WS Q500
WS Q100
WS Q50
WS Qmax
WS Q25
WS Q10
WS Q1.1
Ground
Levee
Ineff
Bank Sta
Milo over Pleasant River Plan: Milo Existing 5/28/2019
RS = 321 BR
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.05
.085
Elevation (ft)
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290
285
280
275
270
265
-3000
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-1000
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1000
2000
Station (ft)
Legend
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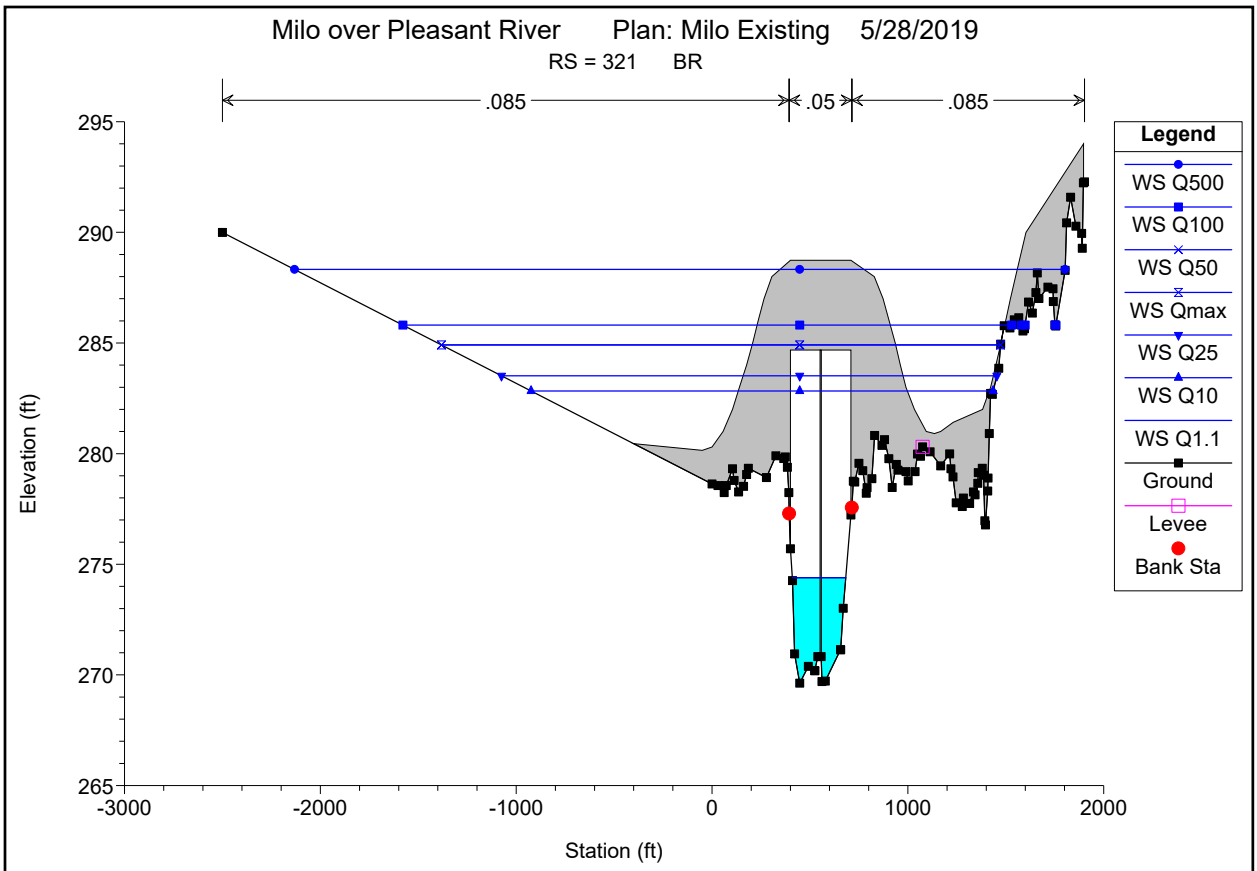
WS Q100
WS Q50
WS Qmax
WS Q25
WS Q10
WS Q1.1
Ground
Levee
Ineff
Bank Sta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.05
.085
Elevation (ft)
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290
285
280
275
270
265
-3000
-2000
-1000
0
1000
2000
Station (ft)
Legend
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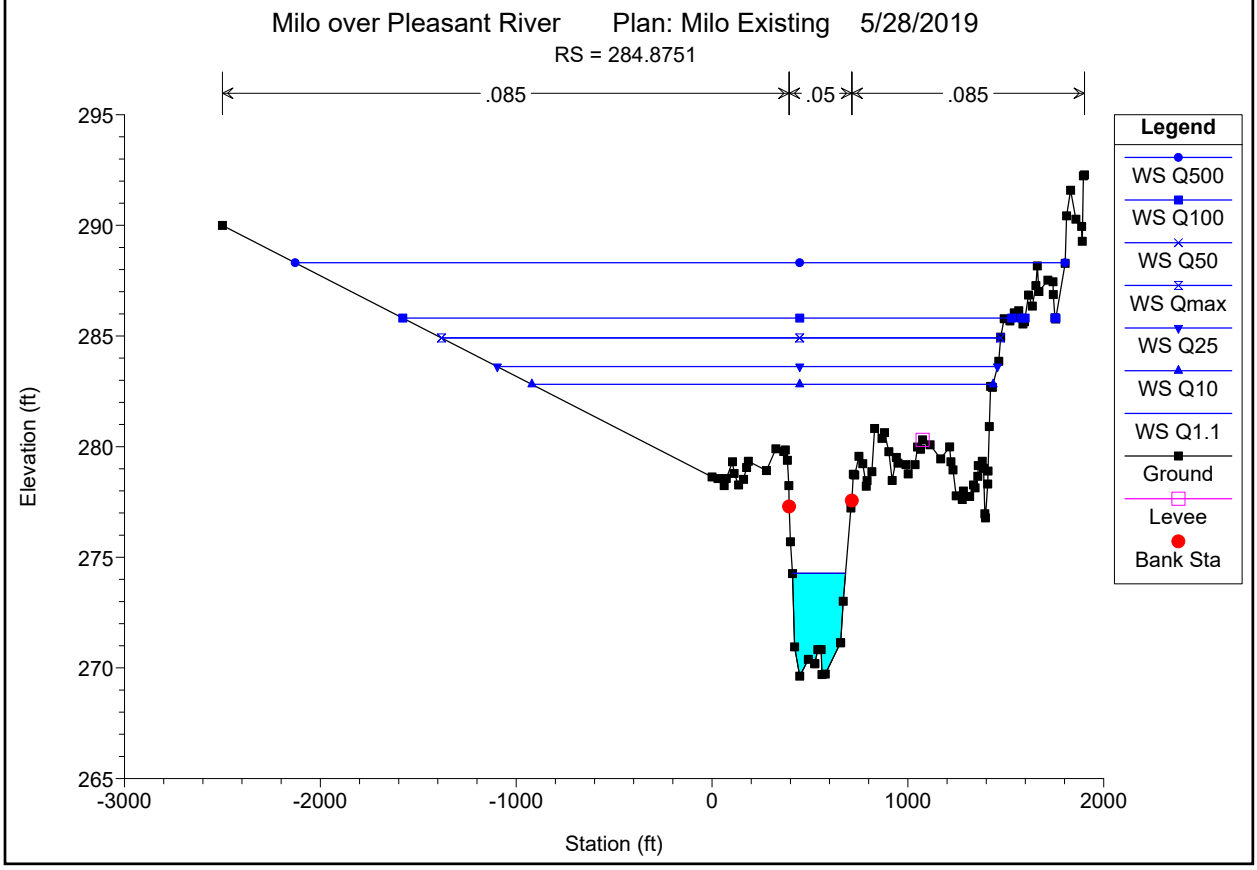
WS Q100
WS Q50
WS Qmax
WS Q25
WS Q10
WS Q1.1
Ground
Levee
Bank Sta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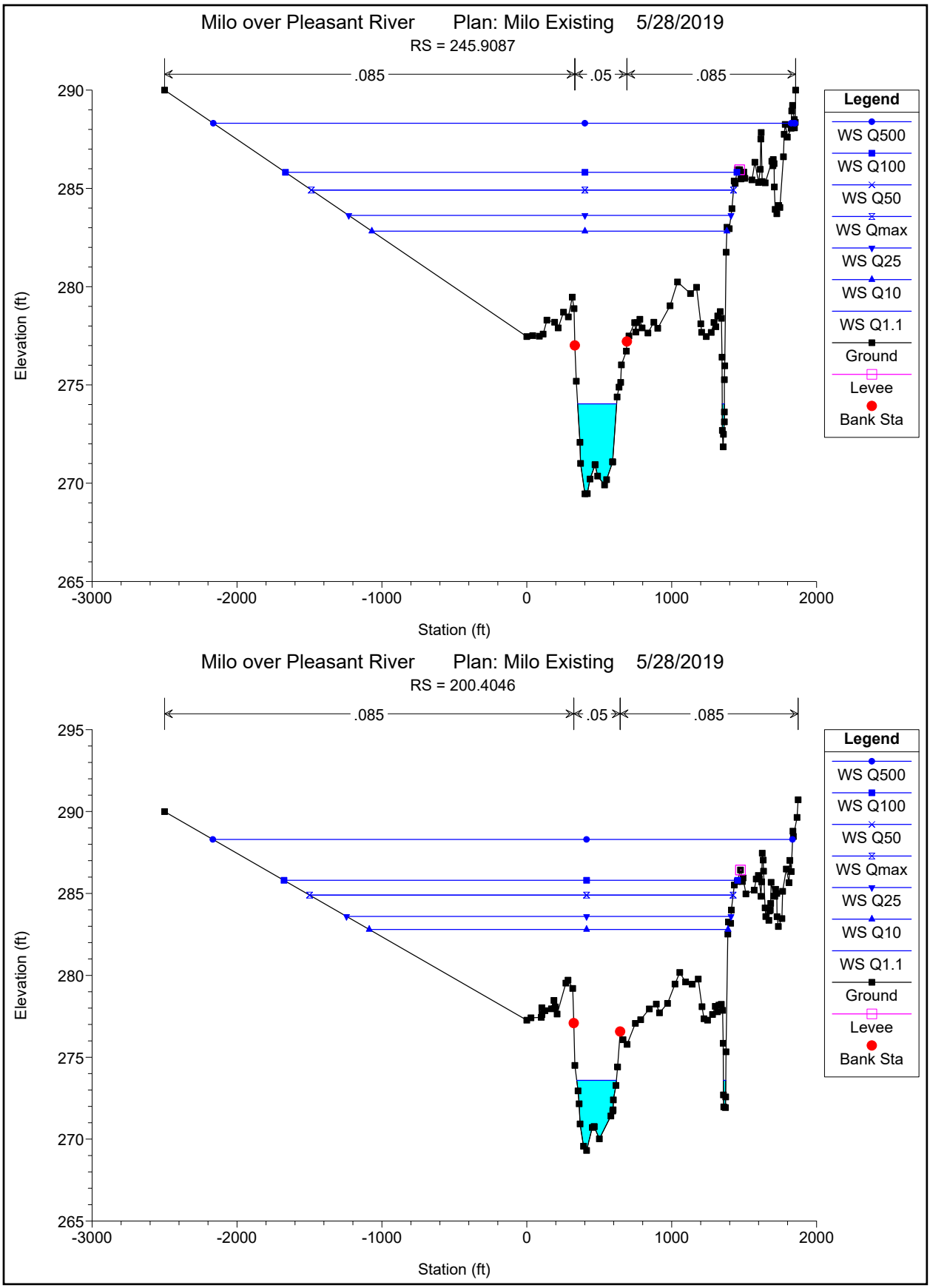
285
280
275
270
265
-3000
-2000
-1000
0
1000
2000
Station (ft)
Legend
WS Q500
WS Q100
WS Q50
WS Qmax
WS Q25
WS Q10
WS Q1.1
Ground
Levee
Bank Sta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.05
.085
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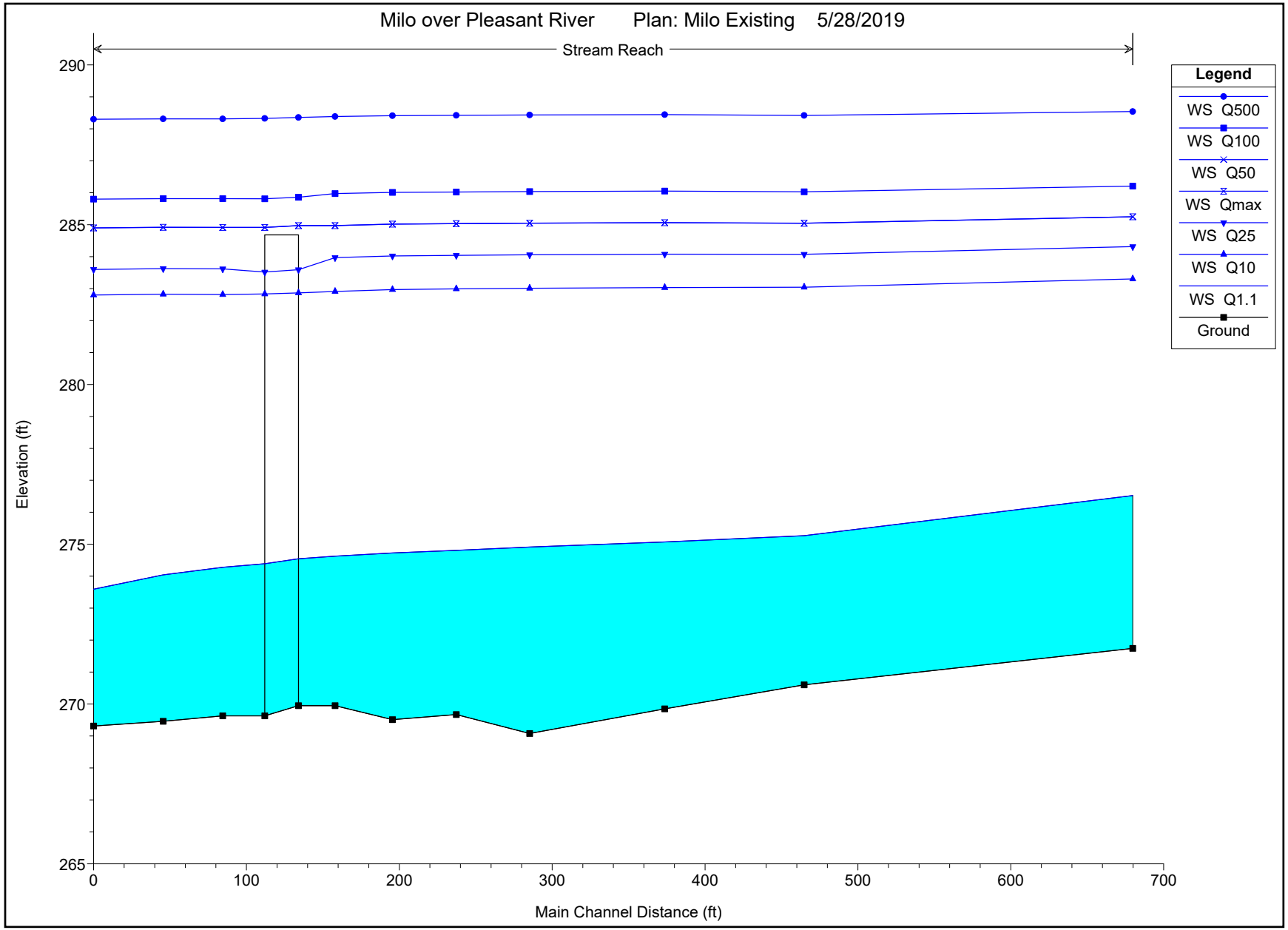
285
280
275
270
265
Elevation (ft)
-3000
-2000
-1000
0
1000
2000
Station (ft)
Legend
WS Q500
WS Q100
WS Q50
WS Qmax
WS Q25
WS Q10
WS Q1.1
Ground
Levee
Bank Sta
Milo over Pleasant River Plan: Milo Existing 5/28/2019
RS = 200.4046
.085
.05
.085
295
290
285
280
275
270
265
Elevation (ft)
-3000
-2000
-1000
0
1000
2000
Station (ft)
Legend
WS Q500
WS Q100
WS Q50
WS Qmax
WS Q25
WS Q10
WS Q1.1
Ground
Levee
Bank Sta


Milo over Pleasant River
Plan: Milo Existing
5/28/2019
Stream Reach
Legend
WS Q500
WS Q100
WS Q50
WS Qmax
WS Q25
WS Q10
WS Q1.1
Ground
Elevation (ft)
290
285
280
275
270
265
0
100
200
300
400
500
600
700
Main Channel Distance (ft)

APPENDIX F

Proposed HEC-RAS Analysis

HEC-RAS Plan: Milo Pro River: Stream Reach: Reach

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Reach	880.5	Q1.1	4280.00	271.74	276.13	274.96	276.50	0.006293	4.94	866.72	285.29	0.50
Reach	880.5	Q10	21495.00	271.74	283.35	278.78	283.71	0.001608	5.33	5899.58	1233.47	0.30
Reach	880.5	Q25	25980.00	271.74	284.10	279.52	284.50	0.001671	5.71	6892.21	1405.80	0.31
Reach	880.5	Q50	29240.00	271.74	285.23	280.10	285.57	0.001311	5.42	8626.28	1664.59	0.28
Reach	880.5	Q100	33175.00	271.74	286.10	281.15	286.43	0.001197	5.44	10150.30	1862.57	0.27
Reach	880.5	Q500	42970.00	271.74	288.59	282.07	288.85	0.000838	5.15	15595.16	2508.25	0.24
Reach	880.5	Qmax	29180.00	271.74	285.23	280.07	285.57	0.001306	5.41	8624.05	1664.28	0.28
Reach	635.51	Q1.1	4280.00	270.56	275.37	273.15	275.57	0.002325	3.60	1190.31	298.19	0.32
Reach	635.51	Q10	21495.00	270.56	283.14	276.88	283.39	0.000891	4.48	7703.07	1709.16	0.23
Reach	635.51	Q25	25980.00	270.56	283.88	277.60	284.16	0.000955	4.83	9042.04	1894.86	0.24
Reach	635.51	Q50	29240.00	270.56	285.07	278.09	285.30	0.000756	4.58	11462.91	2191.01	0.22
Reach	635.51	Q100	33175.00	270.56	285.95	278.65	286.17	0.000707	4.62	13500.29	2434.57	0.22
Reach	635.51	Q500	42970.00	270.56	288.49	279.08	288.67	0.000500	4.33	20605.22	3133.18	0.19
Reach	635.51	Qmax	29180.00	270.56	285.07	278.08	285.30	0.000753	4.57	11461.30	2190.83	0.22
Reach	521.4742	Q1.1	4280.00	269.72	275.18	272.48	275.34	0.001589	3.17	1351.25	307.92	0.27
Reach	521.4742	Q10	21495.00	269.72	283.12	276.16	283.28	0.000612	3.80	10258.80	2226.60	0.19
Reach	521.4742	Q25	25980.00	269.72	283.86	276.94	284.04	0.000645	4.06	11984.36	2385.97	0.20
Reach	521.4742	Q50	29240.00	269.72	285.06	277.46	285.20	0.000503	3.81	14990.84	2640.76	0.18
Reach	521.4742	Q100	33175.00	269.72	285.94	278.02	286.08	0.000467	3.83	17420.89	2852.71	0.18
Reach	521.4742	Q500	42970.00	269.72	288.49	279.27	288.60	0.000334	3.60	25485.60	3458.33	0.15
Reach	521.4742	Qmax	29180.00	269.72	285.06	277.46	285.20	0.000501	3.80	14988.99	2640.61	0.18
Reach	467.7519	Q1.1	4280.00	269.63	275.07	272.42	275.24	0.001752	3.31	1293.47	296.84	0.28
Reach	467.7519	Q10	21495.00	269.63	283.09	276.30	283.24	0.000582	3.69	11047.93	2442.50	0.19
Reach	467.7519	Q25	25980.00	269.63	283.84	277.02	284.00	0.000605	3.92	12939.05	2603.76	0.20
Reach	467.7519	Q50	29240.00	269.63	285.05	277.50	285.17	0.000462	3.65	16226.05	2855.24	0.17
Reach	467.7519	Q100	33175.00	269.63	285.93	278.04	286.05	0.000424	3.64	18851.16	3061.90	0.17
Reach	467.7519	Q500	42970.00	269.63	288.49	279.33	288.58	0.000297	3.40	27447.23	3651.92	0.14
Reach	467.7519	Qmax	29180.00	269.63	285.05	277.49	285.17	0.000460	3.64	16224.23	2855.11	0.17
Reach	404		Bridge									
Reach	364.7315	Q1.1	4280.00	269.90	274.64	272.35	274.84	0.002282	3.59	1193.61	296.40	0.32
Reach	364.7315	Q10	21495.00	269.90	282.92	276.16	283.08	0.000599	3.73	10840.41	2406.92	0.19
Reach	364.7315	Q25	25980.00	269.90	283.72	276.90	283.88	0.000610	3.94	12840.99	2606.38	0.20
Reach	364.7315	Q50	29240.00	269.90	284.98	277.43	285.11	0.000456	3.63	16333.10	2911.64	0.17
Reach	364.7315	Q100	33175.00	269.90	285.88	277.99	285.99	0.000418	3.62	19028.59	3124.61	0.17
Reach	364.7315	Q500	42970.00	269.90	288.35	279.32	288.44	0.000300	3.41	27507.33	3712.57	0.15
Reach	364.7315	Qmax	29180.00	269.90	284.98	277.43	285.11	0.000454	3.63	16332.04	2911.56	0.17
Reach	284.8751	Q1.1	4280.00	269.63	274.30	272.47	274.59	0.003699	4.29	997.16	271.58	0.39
Reach	284.8751	Q10	21495.00	269.63	282.80	276.51	283.01	0.000798	4.23	9587.27	2351.71	0.22
Reach	284.8751	Q25	25980.00	269.63	283.60	277.30	283.81	0.000798	4.43	11552.45	2550.09	0.22
Reach	284.8751	Q50	29240.00	269.63	284.90	277.80	285.06	0.000569	4.00	15072.04	2852.91	0.19
Reach	284.8751	Q100	33175.00	269.63	285.80	278.37	285.95	0.000516	3.98	17744.17	3130.09	0.18
Reach	284.8751	Q500	42970.00	269.63	288.30	279.81	288.41	0.000359	3.70	26626.89	3930.29	0.16
Reach	284.8751	Qmax	29180.00	269.63	284.90	277.79	285.06	0.000567	4.00	15072.04	2852.91	0.19
Reach	245.9087	Q1.1	4280.00	269.46	274.07	272.55	274.41	0.004984	4.71	909.20	284.54	0.45
Reach	245.9087	Q10	21495.00	269.46	282.82	276.71	282.96	0.000599	3.57	11372.31	2450.11	0.19
Reach	245.9087	Q25	25980.00	269.46	283.62	277.39	283.76	0.000606	3.76	13411.04	2638.08	0.19
Reach	245.9087	Q50	29240.00	269.46	284.92	277.88	285.03	0.000443	3.45	17002.47	2913.10	0.17
Reach	245.9087	Q100	33175.00	269.46	285.82	278.46	285.92	0.000403	3.44	19711.20	3115.73	0.16
Reach	245.9087	Q500	42970.00	269.46	288.31	279.83	288.39	0.000291	3.27	29021.91	3994.63	0.14
Reach	245.9087	Qmax	29180.00	269.46	284.92	277.85	285.03	0.000441	3.44	17002.29	2913.08	0.17
Reach	200.4046	Q1.1	4280.00	269.31	273.62	272.67	274.10	0.009006	5.59	765.97	290.86	0.59
Reach	200.4046	Q10	21495.00	269.31	282.80	276.68	282.93	0.000572	3.59	11772.38	2476.03	0.19
Reach	200.4046	Q25	25980.00	269.31	283.60	277.45	283.74	0.000581	3.79	13823.83	2653.56	0.19
Reach	200.4046	Q50	29240.00	269.31	284.90	277.93	285.01	0.000426	3.47	17447.44	2923.42	0.17
Reach	200.4046	Q100	33175.00	269.31	285.80	278.47	285.90	0.000391	3.47	20166.62	3130.58	0.16
Reach	200.4046	Q500	42970.00	269.31	288.30	279.81	288.38	0.000281	3.27	29766.49	4000.80	0.14
Reach	200.4046	Qmax	29180.00	269.31	284.90	277.91	285.01	0.000425	3.46	17447.44	2923.42	0.17

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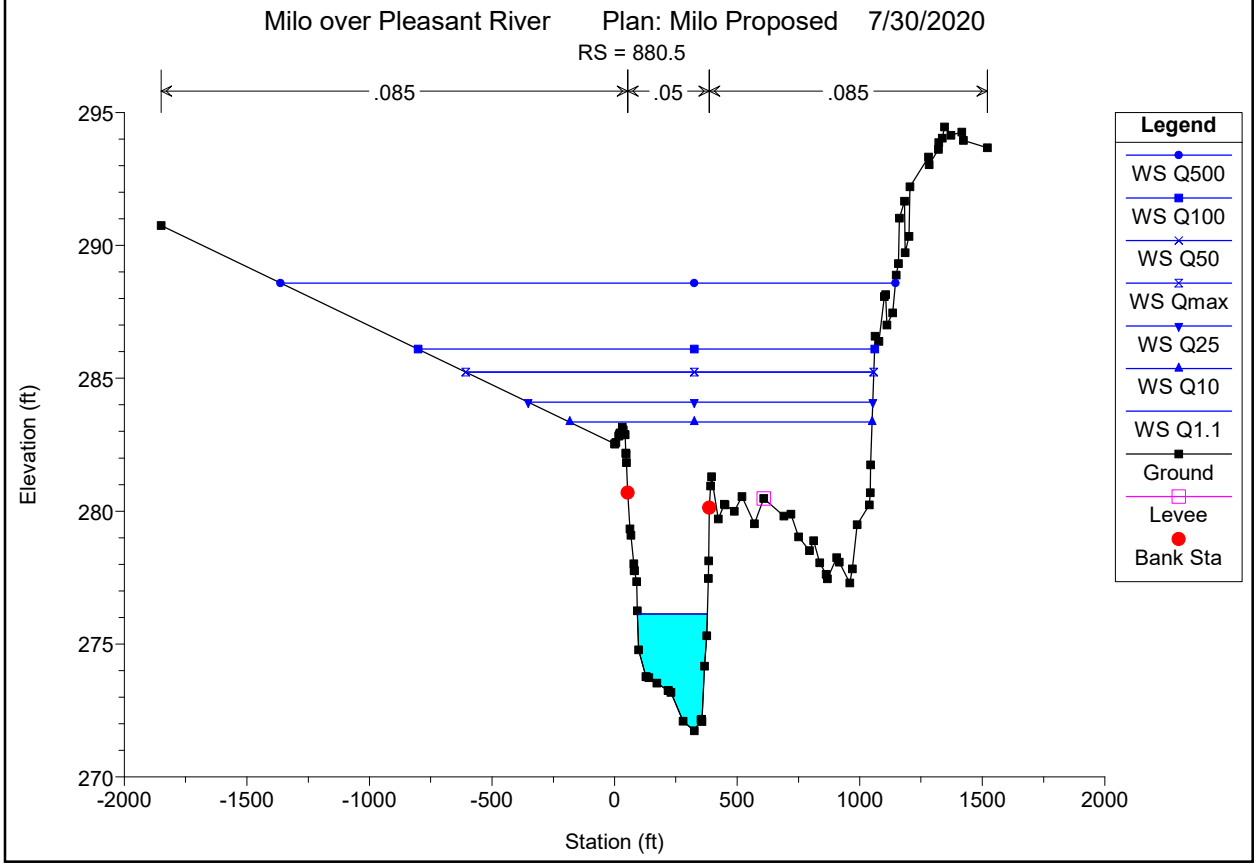

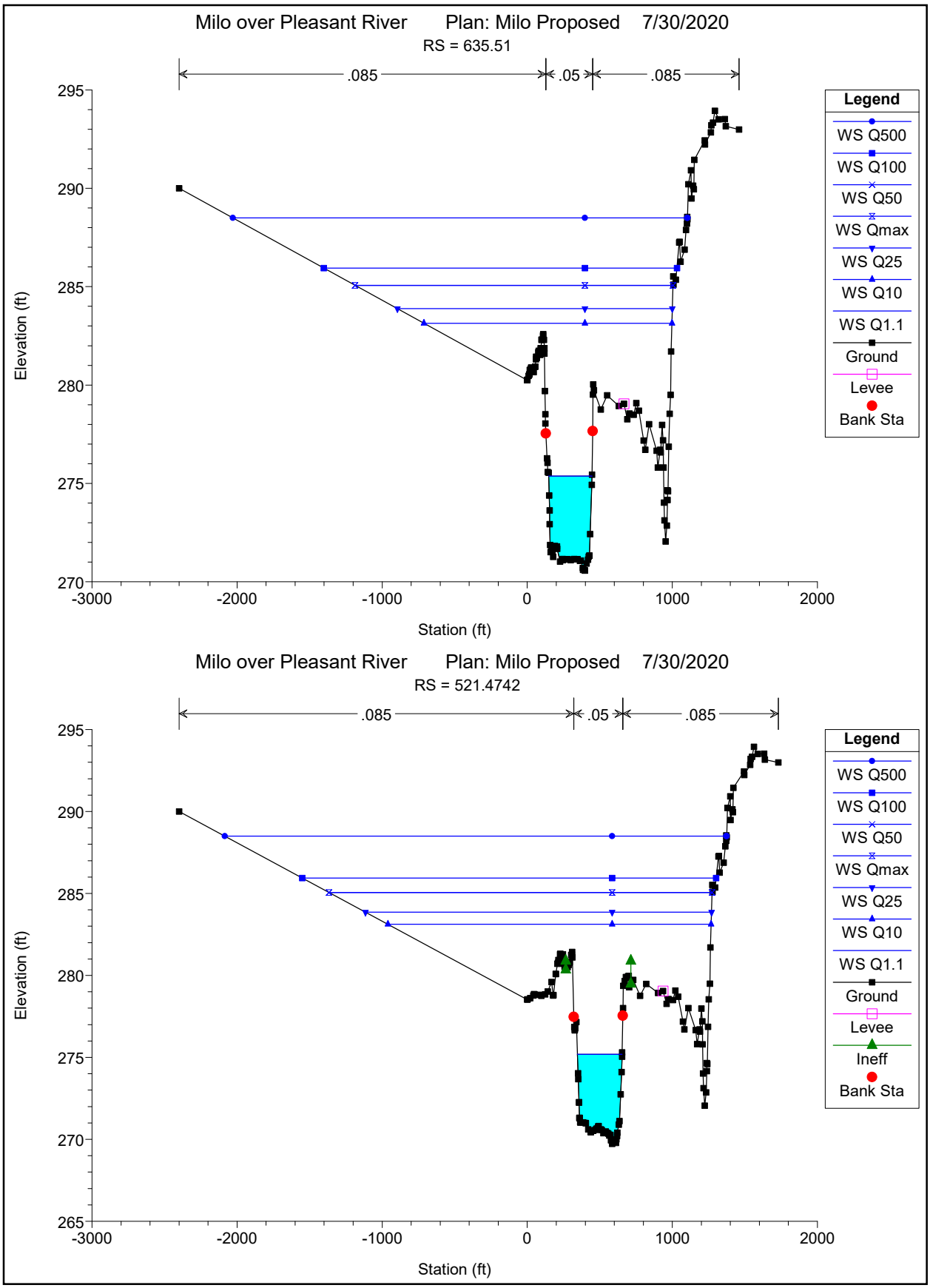
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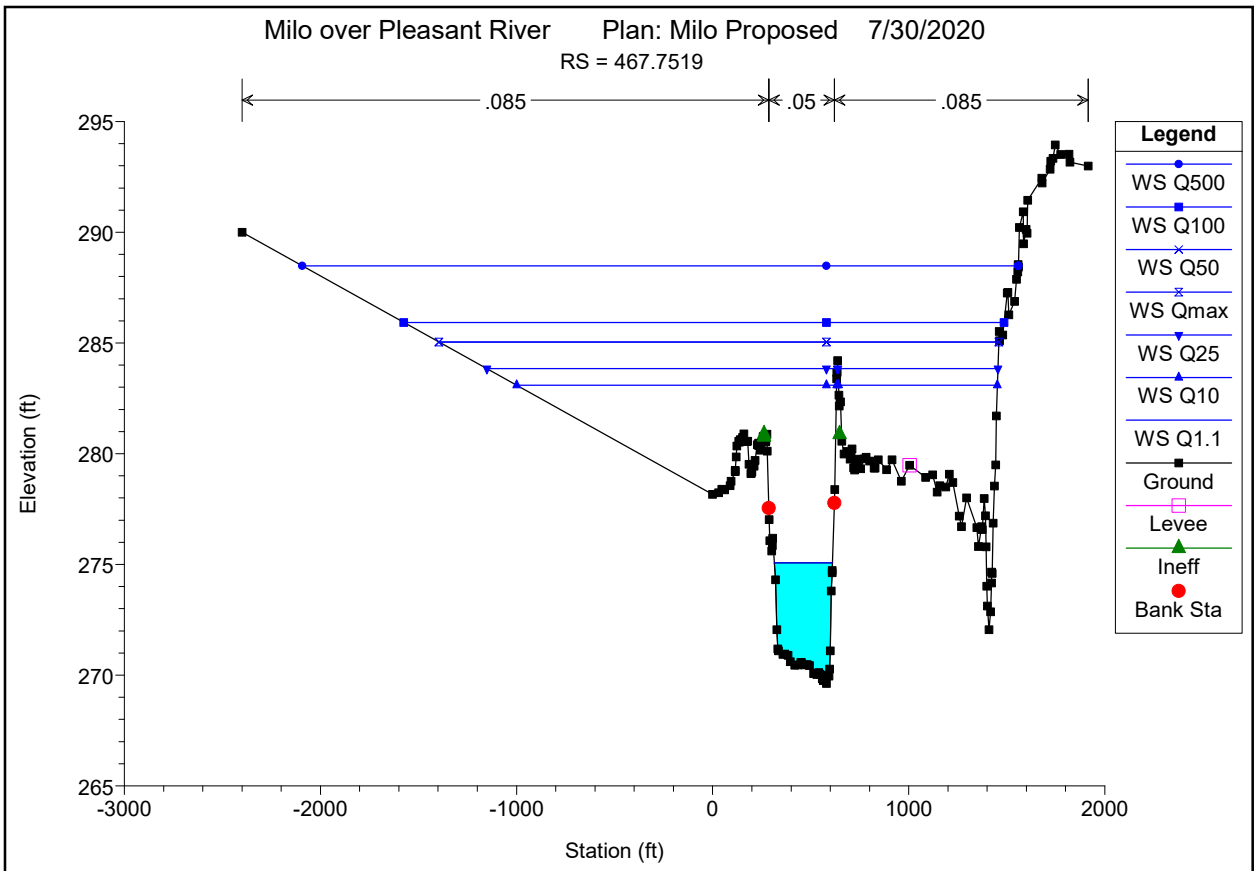
.085
.05
.085
Elevation (ft)
295
290
285
280
275
270
-3000
-2000
-1000
0
1000
2000
Station (ft)
Legend
WS Q500
WS Q100
WS Q50
WS Qmax
WS Q25
WS Q10
WS Q1.1
Ground
Levee
Bank Sta
Milo over Pleasant River Plan: Milo Proposed 7/30/2020
RS = 521.4742
.085
.05
.085
Elevation (ft)
295
290
285
280
275
270
265
-3000
-2000
-1000
0
1000
2000
Station (ft)
Legend
WS Q500
WS Q100
WS Q50
WS Qmax
WS Q25
WS Q10
WS Q1.1
Ground
Levee
Ineff
Bank Sta


Milo over Pleasant River Plan: Milo Proposed 7/30/2020
RS = 467.7519
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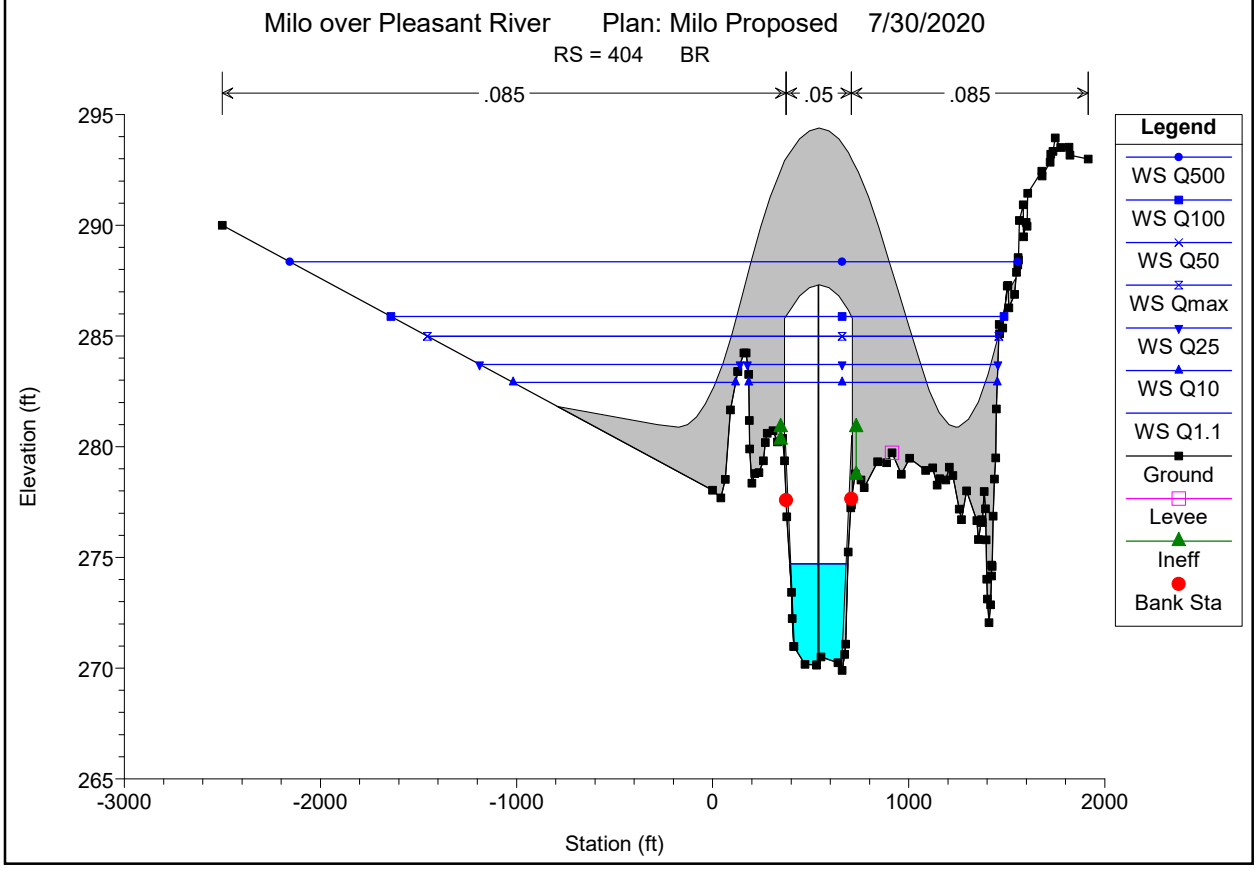
.05
.085
Elevation (ft)
295
290
285
280
275
270
265
-3000
-2000
-1000
0
1000
2000
Station (ft)
Legend
WS Q500
WS Q100
WS Q50
WS Qmax
WS Q25
WS Q10
WS Q1.1
Ground
Levee
Ineff
Bank Sta


Milo over Pleasant River Plan: Milo Proposed 7/30/2020
RS = 404 BR
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.05
.085
Elevation (ft)
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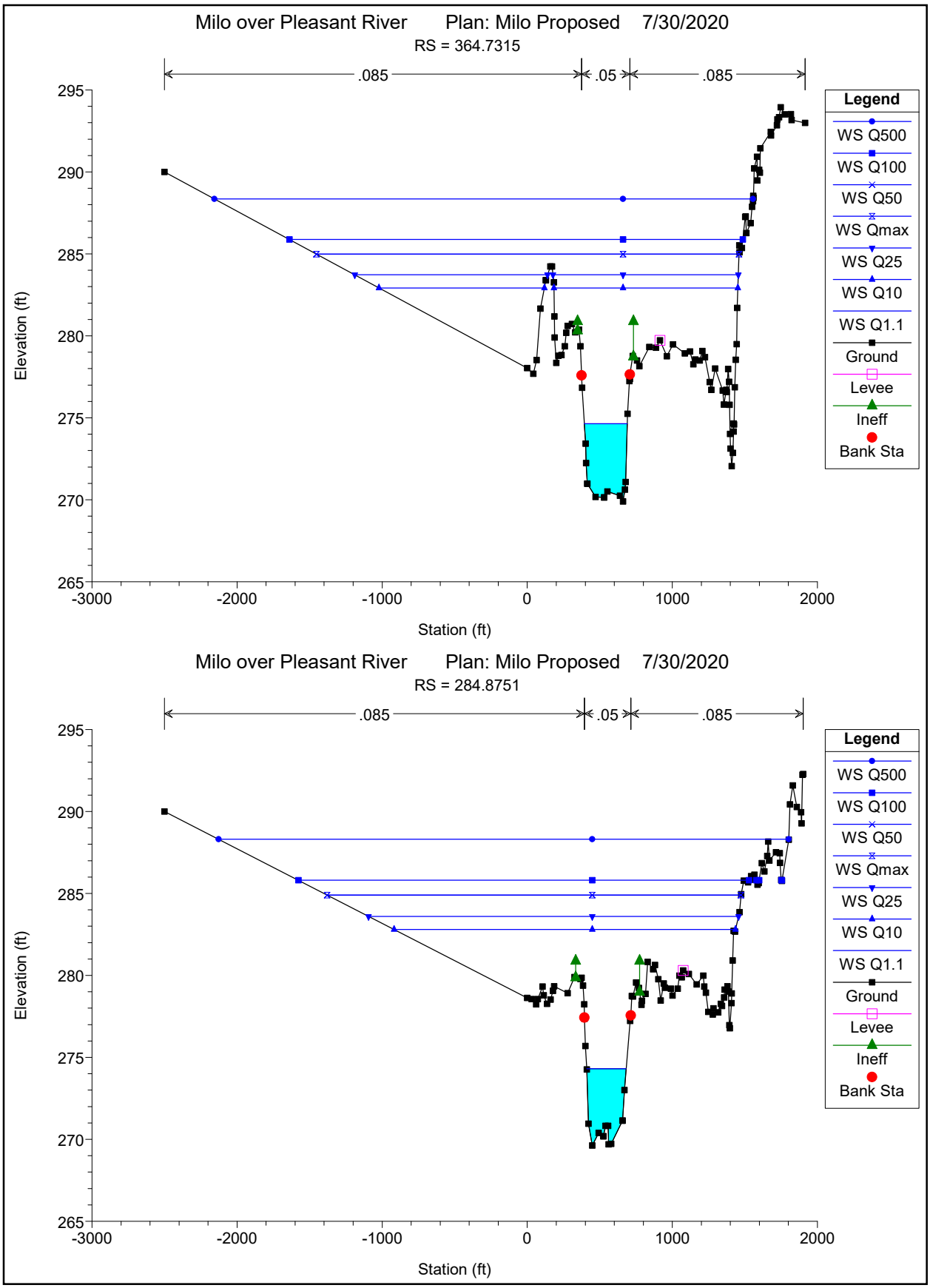
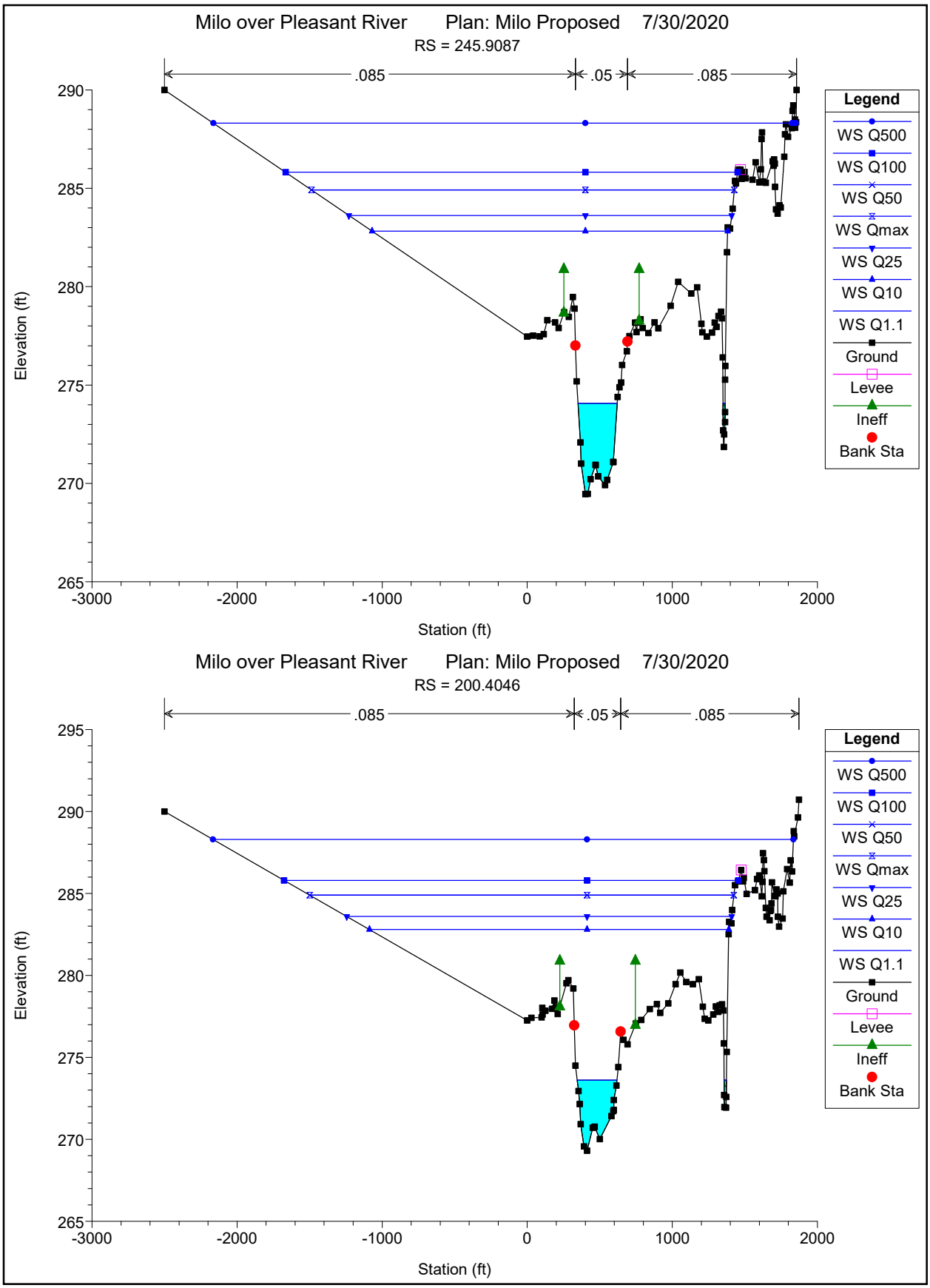
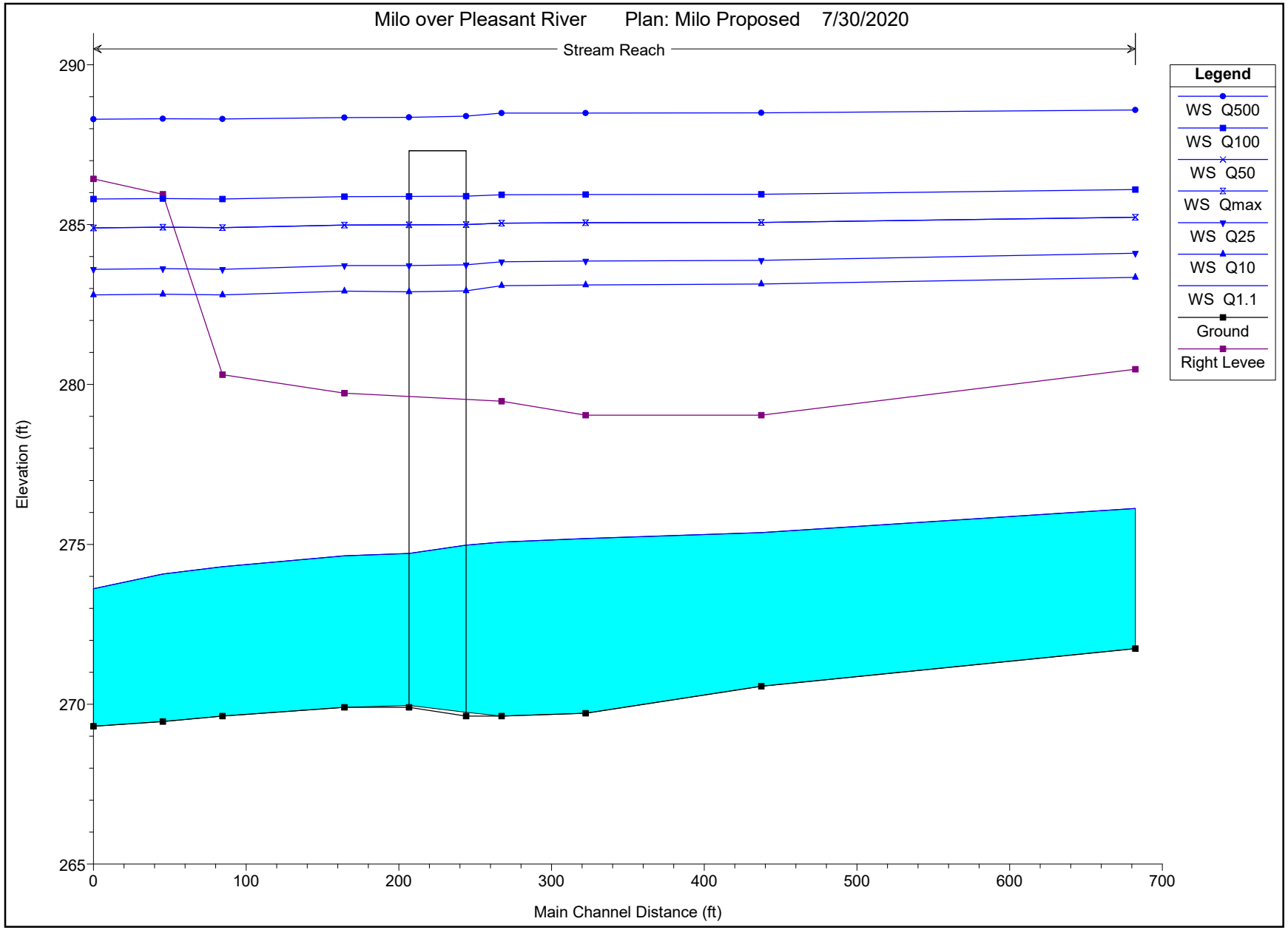
290
285
280
275
270
265
-3000
-2000
-1000
0
1000
2000
Station (ft)
Legend
WS Q500
WS Q100
WS Q50
WS Qmax
WS Q25
WS Q10
WS Q1.1
Ground
Levee
Ineff
Bank Sta


Milo over Pleasant River Plan: Milo Proposed 7/30/2020
RS = 364.7315
.085
.05
.085
Elevation (ft)
Station (ft)
Legend
WS Q500
WS Q100
WS Q50
WS Qmax
WS Q25
WS Q10
WS Q1.1
Ground
Levee
Ineff
Bank Sta
Milo over Pleasant River Plan: Milo Proposed 7/30/2020
RS = 284.8751
.085
.05
.085
Elevation (ft)
Station (ft)
Legend
WS Q500
WS Q100
WS Q50
WS Qmax
WS Q25
WS Q10
WS Q1.1
Ground
Levee
Ineff
Bank Sta


Milo over Pleasant River Plan: Milo Proposed 7/30/2020
RS = 245.9087
.085
.05
.085
Elevation (ft)
290
285
280
275
270
265
-3000
-2000
-1000
0
1000
2000
Station (ft)
Legend
WS Q500
WS Q100
WS Q50
WS Qmax
WS Q25
WS Q10
WS Q1.1
Ground
Levee
Ineff
Bank Sta
Milo over Pleasant River Plan: Milo Proposed 7/30/2020
RS = 200.4046
.085
.05
.085
Elevation (ft)
295
290
285
280
275
270
265
-3000
-2000
-1000
0
1000
2000
Station (ft)
Legend
WS Q500
WS Q100
WS Q50
WS Qmax
WS Q25
WS Q10
WS Q1.1
Ground
Levee
Ineff
Bank Sta


Milo over Pleasant River Plan: Milo Proposed 7/30/2020
Stream Reach
Legend
WS Q500
WS Q100
WS Q50
WS Qmax
WS Q25
WS Q10
WS Q1.1
Ground
Right Levee
Elevation (ft)
290
285
280
275
270
265
0
100
200
300
400
500
600
700
Main Channel Distance (ft)

APPENDIX G

Scour Analysis

Proj. Milo Bridge	Job No. 63738	Sheet No. 1 OF 7
Made by HHG	Checked by SPA	Backchecked by HHG
Date 7-27-2020	Date 7-28-2020	Date 7-28-2020

HNTB

Scour Analysis: 100-year storm U/S face of Pleasant St over Pleasant River

Aggradation/Degradation ft

Live Bed Vs. Clear Water

Depth of flow, y1	14.62	ft
Particle size in a mix of which 50% are smaller, D50 (m)	0.00200	m
Particle size in a mix of which 50% are smaller, D50 (ft)	0.00656	ft
Velocity of main Channel, V	3.83	ft/s
Critical Velocity, Vc	3.27	ft/s

$$V_c = K_u y^{1/6} D^{1/3}$$

Ku = 11.17

(HEC-18, 5th Edition, April 2012, Equation 6.1)

Live Bed vs. Clear Water Live Bed ←Type of Contraction Scour Analysis to be completed

Live Bed Scour

Avg depth in U/S main channel, y1	14.62	ft
Ex depth in the contracted section before scour, yo	14.62	ft
Flow in the U/S channel transporting sediment Q1	18942.92	ft^3/s
Flow in the contracted channel, Q2	17807.04	ft^3/s
Top width of U/S main channel, W1	338.7	ft
Top width of the main channel in the contracted section, W2	334.32	ft
Fall Velocity, ω	0.66	ft/s
Slope of energy grade line of main channel, S1	0.000467	ft/ft
Shear Velocity, Vα	0.47	
Vα/ω	0.71	
Exponent, k1	0.69	
Avg depth in contracted section, y2	13.99	
Scour depth, ys	-0.63	***ft***

$$V_\alpha = (g y_1 S_1)^{1/2}$$

$$\frac{y_2}{y_1} = \left(\frac{Q_2}{Q_1}\right)^{\frac{6}{7}} \left(\frac{W_1}{W_2}\right)^{k_1}$$

$$y_s = y_2 - y_0$$

(HEC-18, 5th Edition, April 2012, Equations 6.2 and 6.3)

Clear Water Scour

Discharge through the bridge, Q	13739.28	
Median diameter of bed material, D50	0.00656	ft
Diameter of smallest nontrasportable particle, Dm	0.00820	
Bottom width of the contracted section, W	334.32	
Existing depth in the contracted Section, yo	14.62	
Avg depth in the contracted section after contraction scour, y2	11.84	
Scour depth, ys	-2.78	***ft***

$$y_2 = \left[\frac{K_u Q^2}{D_m{}^2 W^2}\right]^{3/7}$$

$$y_s = y_2 - y_0$$

(HEC-18, 5th Edition, April 2012, Equation 6.4)

**** If calculated y_s returns negative answer, the scour depth equals zero***

Proj. Milo Bridge	Job No. 63738	Sheet No. 2 OF 7
Made by HHG	Checked by SPA	Backchecked by HHG
Date 7-27-2020	Date 7-28-2020	Date 7-28-2020

HNTB

Scour Analysis: 100-year storm U/S face of Pleasant St over Pleasant River

Local Scour Live Bed Scour - Pier

Flow depth directly upstream of pier, Y1	14.62	ft
Correction factor for pier nose shape, K1	0.90	
Correction factor for angle of attack of flow, K2	1	
Correction factor for bed condition, K3	1.1	
Pier Width, a	5	ft
Length of Pier, L	40	ft
Froude Number directly upstream of pier, Fr1	0.17	
Mean velocity of flow directly upstream of pier, V1	3.64	ft/s
Acceleration of gravity, g	32.2	

$$D_{50} = \frac{0.692(1.5V)^2}{(S-1)(2g)}$$

$$\frac{y_s}{a} = 2.0K_1K_2K_3\left(\frac{y_1}{a}\right)^{0.35} Fr_1{}^{0.43}$$

$$D_{50} = \frac{0.692(1.8V)^2}{(S-1)(2g)}$$

Scour Depth, ys: 6.69 ft (HEC-18, 5th Edition, April 2012, Equation 7.3)

Proj. Milo Bridge	Job No. 63738	Sheet No. 3 OF 7
Made by HHG	Checked by SPA	Backchecked by HHG
Date 7-27-2020	Date 7-28-2020	Date 7-28-2020

HNTB

Scour Analysis: 100-year storm U/S face of Pleasant St over Pleasant River

Local Scour at Abutments
Near Abutment

Coefficient for Abutment Shape, K1	0.55	
Coefficient for angle of embankment to flow, K2	1.00	
Length of active flow obstructed by embankment, L'	864.91	ft
Average depth of flow on embankment, ya	6.93	ft
Velocity on embankment, Ve	1.30	ft/s
Froude Number of approach flow = $V_e/(gy_a)^{1/2}$	0.087	
Length of embankment projected to normal flow, L		ft

$$\frac{y_s}{y_a} = 2.27K_1K_2\left(\frac{L'}{y_a}\right)^{0.43}(Fr)^{0.61} + 1$$

Near Abutment Scour Depth, ys 22.48 ***ft***

(HEC-18, 5th Edition, April 2012, Equation 8.1)

Far Abutment

Coefficient for Abutment Shape, K1	0.55	
Coefficient for angle of embankment to flow, K2	1.00	
Length of active flow obstructed by embankment, L'	1862.67	ft
Average depth of flow on embankment, ya	4.28	ft
Velocity on embankment, Ve	0.95	ft/s
Froude Number of approach flow = $V_e/(gy_a)^{1/2}$	0.081	
Length of embankment projected to normal flow, L		ft

$$\frac{y_s}{y_a} = 2.27K_1K_2\left(\frac{L'}{y_a}\right)^{0.43}(Fr)^{0.61} + 1$$

Far Abutment Scour Depth, ys 20.00 ***ft***

(HEC-18, 5th Edition, April 2012, Equation 8.1)

Proj. Milo Bridge	Job No. 63738	Sheet No. 4 OF 7
Made by HHG	Checked by SPA	Backchecked by HHG
Date 7-27-2020	Date 7-28-2020	Date 7-28-2020

HNTB

Scour Analysis: 500-year storm U/S face of Pleasant St over Pleasant River

Aggradation/Degradation ft

Live Bed Vs. Clear Water

Depth of flow, y1	17.17	ft
Particle size in a mix of which 50% are smaller, D50 (m)	0.00200	m
Particle size in a mix of which 50% are smaller, D50 (ft)	0.00656	ft
Velocity of main Channel, V	3.6	ft/s
Critical Velocity, Vc	3.36	ft/s

(HEC-18, 5th Edition, April 2012, Equation 6.1)

Live Bed vs. Clear Water Live Bed ←Type of Contraction Scour Analysis to be completed

Live Bed Scour

Avg depth in U/S main channel, y1	17.17	ft
Ex depth in the contracted section before scour, yo	17.18	ft
Flow in the U/S channel transporting sediment Q1	20929.61	ft^3/s
Flow in the contracted channel, Q2	19499.25	ft^3/s
Top width of U/S main channel, W1	338.7	ft
Top widthof the main channel in the contracted section, W2	334.32	ft
Fall Velocity, ω	0.66	ft/s
Slope of energy grade line of main channel, S1	0.000334	ft/ft
Shear Velocity, Vα	0.43	
Vα/ω	0.65	
Exponent, k1	0.69	
Avg depth in contracted section, y2	16.30	
Scour depth, ys	-0.88	ft

$$V_\alpha = (g y_1 S_1)^{1/2}$$

$$\frac{y_2}{y_1} = \left(\frac{Q_2}{Q_1}\right)^{\frac{6}{7}} \left(\frac{W_1}{W_2}\right)^{k_1}$$

$$y_s = y_2 - y_0$$

(HEC-18, 5th Edition, April 2012, Equations 6.2 and 6.3)

Clear Water Scour

Discharge through the bridge, Q	20341.82	
Median diameter of bed material, D50	0.00656	ft
Diameter of smallest nontrasportable particle, Dm	0.00820	
Bottom width of the contracted section, W	334.32	
Existing depth in the contracted Section, yo	17.18	
Avg depth in the contracted section after contraction scour, y2	16.58	
Scour depth, ys	-0.60	ft

$$y_2 = \left[\frac{K_u Q^2}{D_m{}^2 W^2}\right]^{3/7}$$

$$y_s = y_2 - y_0$$

(HEC-18, 5th Edition, April 2012, Equation 6.4)

**** If calculated y_s returns negative answer, the scour depth equals zero***

Proj. Milo Bridge	Job No. 63738	Sheet No. 5 OF 7
Made by HHG	Checked by SPA	Backchecked by HHG
Date 7-27-2020	Date 7-28-2020	Date 7-28-2020

HNTB

Scour Analysis: 500-year storm U/S face of Pleasant St over Pleasant River

Pressure Flow Scour

$$\frac{y_s}{a} = 2.0K_1K_2K_3K_4\left(\frac{y_1}{a}\right)^{0.35} {Fr_1}^{0.43}$$

Upstream Channel Discharge, Q1	20929.61	ft³/s
Upstream Channel Flow depth, hu	17.17	ft
Effective upstream channel flow depth for live-bed conditions, hue	23.82	ft
Effective channel discharge for live-bed conditions, Que	30425.86	ft³/s

$$Q_{ue} = Q_1\left[\frac{h_{ue}}{h_u}\right]^{8/7}$$

(HEC-18, 5th Edition, April 2012, Eqn 6.15)

Vertical size of the bridge opening prior to scour, hb	16.75	ft
Distance from the water surface to the lower face of bridge, ht	1.04	ft
Weir flow height, hw= ht - T for ht>T, hw = 0 for ht<T	0.00	ft
Upstream Channel flow depth, hu	17.17	ft
Separation Zone Thickness, t	4.76	ft

$$t = 0.5\left(\frac{h_b \cdot h_t}{{h_u}^2}\right)^{0.2}\left(1 - \frac{h_w}{h_t}\right)^{-0.1} * h_b$$

(HEC-18, 5th Edition, April 2012, Eqn. 6.16)

Y1 = hb + T (T = Obstruction height = 7.09 ft)	23.84	ft
Q1 = Que	30425.86	ft³/s
Q2 = Flow through bridge opening	20361.12	ft³/s
Top width of U/S main channel, W1	338.7	ft
Top width of the main channel in the contracted section, W2	334.32	ft

#DIV/0!

Average depth in contracted section, y2	17.05	ft
Separation Zone Thickness, t	4.76	ft
Vertical size of the bridge prior to scour, hb	16.75	ft

$$\frac{y_2}{y_1} = \left(\frac{Q_2}{Q_1}\right)^{\frac{6}{7}}\left(\frac{W_1}{W_2}\right)^{k_1}$$

$$y_s = y_2 + t - h_b$$

(HEC-18, April 2012, Eqn. 6.14)

Pressure Flow Scour Depth, ys	5.05	ft

Local Scour Live Bed Scour - Pier

Flow depth directly upstream of pier, Y1	17.18	ft
Correction factor for pier nose shape, K1	0.90	
Correction factor for angle of attack of flow, K2	1.00	
Correction factor for bed condition, K3	1.10	
Pier Width, a	5.00	ft
Length of Pier, L	40.00	ft
Froude Number directly upstream of pier, Fr1	0.14	
Mean velocity of flow directly upstream of pier, V1	3.40	ft/s
Acceleration of gravity, g	32.20	

$$D_{50} = \frac{0.692(1.5V)^2}{(S-1)(2g)}$$

$$\frac{y_s}{a} = 2.0K_1K_2K_3K_4\left(\frac{y_1}{a}\right)^{0.35} {Fr_1}^{0.43}$$

$$D_{50} = \frac{0.692(1.8V)^2}{(S-1)(2g)}$$

(HEC-18, 5th Edition, April 2012, Equation 7.3)

Scour Depth, ys	6.64	***ft***

Proj. Milo Bridge	Job No. 63738	Sheet No. 6 OF 7
Made by HHG	Checked by SPA	Backchecked by HHG
Date 7-27-2020	Date 7-28-2020	Date 7-28-2020

HNTB

Scour Analysis: 100-year storm U/S face of US2 over Mattawamkeag River

Local Scour at Abutments
Near Abutment

Coefficient for Abutment Shape, K1	0.55	
Coefficient for angle of embankment to flow, K2	1.00	
Length of active flow obstructed by embankment, L'	937.05	ft
Average depth of flow on embankment, ya	8.87	ft
Velocity on embankment, Ve	1.29	ft/s
Froude Number of approach flow = $V_e/(gy_a)^{1/2}$	0.076	
Length of embankment projected to normal flow, L		ft

$$\frac{y_s}{y_a} = 2.27K_1K_2\left(\frac{L'}{y_a}\right)^{0.43}(Fr)^{0.61} + 1$$

Near Abutment Scour Depth, ys 25.97 ***ft***

(HEC-18, 5th Edition, April 2012, Equation 8.1)

Far Abutment

Coefficient for Abutment Shape, K1	0.55	
Coefficient for angle of embankment to flow, K2	1.00	
Length of active flow obstructed by embankment, L'	2380.55	ft
Average depth of flow on embankment, ya	5.63	ft
Velocity on embankment, Ve	0.95	ft/s
Froude Number of approach flow = $V_e/(gy_a)^{1/2}$	0.071	
Length of embankment projected to normal flow, L		ft

$$\frac{y_s}{y_a} = 2.27K_1K_2\left(\frac{L'}{y_a}\right)^{0.43}(Fr)^{0.61} + 1$$

Far Abutment Scour Depth, ys 24.41 ***ft***

(HEC-18, 5th Edition, April 2012, Equation 8.1)

Proj. Milo Bridge	Job No. 63738	Sheet No. 7 OF 7
Made by HHG	Checked by SPA	Backchecked by HHG
Date 7-27-2020	Date 7-28-2020	Date 7-28-2020

HNTB

Scour Summary

	100 - year storm		
	Near Abutment	Pier	Far Abutment
Aggradation/ Degradation (ft)	---	---	---
Contraction/Expansion Scour (ft)	---	0.00	---
Local Scour (ft)	22.48	6.69	20.00
Pressure Flow Scour (ft)	---	---	---
TOTAL SCOUR (ft)	***22.48***	***6.69***	***20.00***

	500-year storm		
	Near Abutment	Pier	Far Abutment
Aggradation/ Degradation (ft)	---	---	---
Contraction/Expansion Scour (ft)	---	0.00	---
Local Scour (ft)	25.97	6.64	24.41
Pressure Flow Scour (ft)	---	5.05	---
TOTAL SCOUR (ft)	***25.97***	***11.69***	***24.41***

FALL VELOCITY

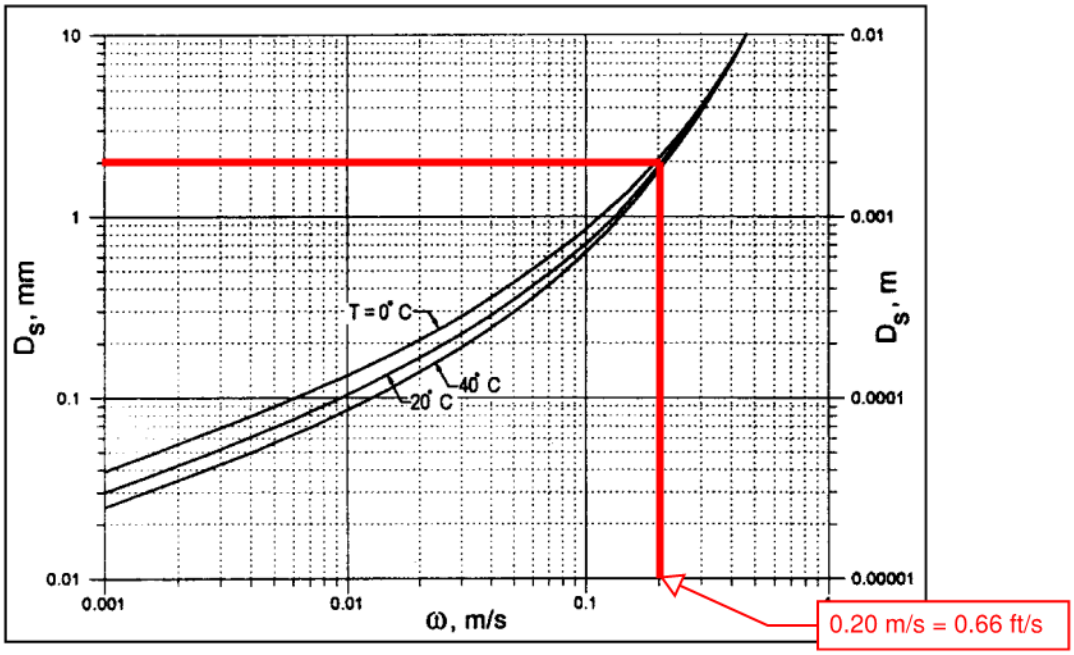


Figure 6.8. Fall velocity of sand-sized particles with specific gravity of 2.65 in metric units.

Plan: Milo Pro Stream Reach RS: 521.4742 Profile: Q100

E.G. Elev (ft)	286.08	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.14	Wt. n-Val.	0.085	0.050	0.085
W.S. Elev (ft)	285.94	Reach Len. (ft)	55.00	55.00	55.00
Crit W.S. (ft)	278.02	Flow Area (sq ft)	7778.07	4951.45	4691.37
E.G. Slope (ft/ft)	0.000467	Area (sq ft)	7778.07	4951.45	4691.37
Q Total (cfs)	33175.00	Flow (cfs)	7594.55	18942.92	6637.53
Top Width (ft)	2852.71	Top Width (ft)	1871.47	338.70	642.53
Vel Total (ft/s)	1.90	Avg. Vel. (ft/s)	0.98	3.83	1.41
Max Chl Dpth (ft)	16.22	Hydr. Depth (ft)	4.16	14.62	7.30
Conv. Total (cfs)	1534881.0	Conv. (cfs)	351371.1	876416.5	307093.4
Length Wtd. (ft)	55.00	Wetted Per. (ft)	1872.39	340.65	647.45
Min Ch El (ft)	269.72	Shear (lb/sq ft)	0.12	0.42	0.21
Alpha	2.48	Stream Power (lb/ft s)	0.12	1.62	0.30
Frctn Loss (ft)	0.02	Cum Volume (acre-ft)	49.50	35.35	31.31
C & E Loss (ft)	0.01	Cum SA (acres)	11.31	2.47	4.62

UNCONTRACTED SECTION

Plan: Milo Pro Stream Reach RS: 521.4742 Profile: Q500

E.G. Elev (ft)	288.60	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.11	Wt. n-Val.	0.085	0.050	0.085
W.S. Elev (ft)	288.49	Reach Len. (ft)	55.00	55.00	55.00
Crit W.S. (ft)	279.27	Flow Area (sq ft)	13229.41	5814.97	6441.22
E.G. Slope (ft/ft)	0.000334	Area (sq ft)	13229.41	5814.97	6441.22
Q Total (cfs)	42970.00	Flow (cfs)	13162.07	20929.61	8878.33
Top Width (ft)	3458.33	Top Width (ft)	2404.93	338.70	714.69
Vel Total (ft/s)	1.69	Avg. Vel. (ft/s)	0.99	3.60	1.38
Max Chl Dpth (ft)	18.77	Hydr. Depth (ft)	5.50	17.17	9.01
Conv. Total (cfs)	2352191.0	Conv. (cfs)	720495.8	1145693.0	486002.3
Length Wtd. (ft)	55.00	Wetted Per. (ft)	2405.85	340.65	719.88
Min Ch El (ft)	269.72	Shear (lb/sq ft)	0.11	0.36	0.19
Alpha	2.46	Stream Power (lb/ft s)	0.11	1.28	0.26
Frctn Loss (ft)	0.02	Cum Volume (acre-ft)	98.03	40.69	50.12
C & E Loss (ft)	0.01	Cum SA (acres)	17.99	1.93	6.83

UNCONTRACTED SECTION

FAR ABUTMENT

NEAR ABUTMENT

Plan: Milo Pro Stream Reach RS: 467.7519 Profile: Q100

E.G. Elev (ft)	286.05	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.12	Wt. n-Val.	0.085	0.050	0.085
W.S. Elev (ft)	285.93	Reach Len. (ft)	23.35	23.35	23.35
Crit W.S. (ft)	278.04	Flow Area (sq ft)	7972.14	4887.92	5991.10
E.G. Slope (ft/ft)	0.000424	Area (sq ft)	7972.14	4887.92	5991.10
Q Total (cfs)	33175.00	Flow (cfs)	7565.25	17807.04	7802.71
Top Width (ft)	3061.90	Top Width (ft)	1862.67	334.32	864.91
Vel Total (ft/s)	1.76	Avg. Vel. (ft/s)	0.95	3.64	1.30
Max Chl Dpth (ft)	16.30	Hydr. Depth (ft)	4.28	14.62	6.93
Conv. Total (cfs)	1610555.0	Conv. (cfs)	367272.2	864482.8	378800.3
Length Wtd. (ft)	23.35	Wetted Per. (ft)	1863.46	336.68	871.00
Min Ch El (ft)	269.63	Shear (lb/sq ft)	0.11	0.38	0.18
Alpha	2.50	Stream Power (lb/ft s)	0.11	1.40	0.24
Frctn Loss (ft)	0.01	Cum Volume (acre-ft)	39.56	29.14	24.56
C & E Loss (ft)	0.01	Cum SA (acres)	8.96	2.04	3.67

CONTRACTED SECTION

Plan: Milo Pro Stream Reach RS: 467.7519 Profile: Q500

FAR ABUTMENT

NEAR ABUTMENT

E.G. Elev (ft)	288.58	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.09	Wt. n-Val.	0.085	0.050	0.085
W.S. Elev (ft)	288.49	Reach Len. (ft)	23.35	23.35	23.35
Crit W.S. (ft)	279.33	Flow Area (sq ft)	13392.64	5742.07	8312.51
E.G. Slope (ft/ft)	0.000297	Area (sq ft)	13392.64	5742.07	8312.51
Q Total (cfs)	42970.00	Flow (cfs)	12769.03	19499.25	10701.73
Top Width (ft)	3651.92	Top Width (ft)	2380.55	334.32	937.05
Vel Total (ft/s)	1.57	Avg. Vel. (ft/s)	0.95	3.40	1.29
Max Chl Dpth (ft)	18.86	Hydr. Depth (ft)	5.63	17.18	8.87
Conv. Total (cfs)	2491601.0	Conv. (cfs)	740407.9	1130657.0	620536.1
Length Wtd. (ft)	23.35	Wetted Per. (ft)	2381.35	336.68	943.40
Min Ch El (ft)	269.63	Shear (lb/sq ft)	0.10	0.32	0.16
Alpha	2.41	Stream Power (lb/ft s)	0.10	1.08	0.21
Frctn Loss (ft)	0.01	Cum Volume (acre-ft)	81.23	33.39	40.81
C & E Loss (ft)	0.02	Cum SA (acres)	14.97	1.51	5.79

CONTRACTED SECTION

Plan: Milo Pro Stream Reach RS: 404 Profile: Q100

E.G. US. (ft)	286.05	Element	Inside BR US	Inside BR DS
W.S. US. (ft)	285.93	E.G. Elev (ft)	286.03	286.02
Q Total (cfs)	33175.00	W.S. Elev (ft)	285.89	285.88
Q Bridge (cfs)	13739.28	Crit W.S. (ft)	278.61	278.43
Q Weir (cfs)	19435.72	Max Chl Dpth (ft)	16.14	15.92
Weir Sta Lft (ft)	-1599.69	Vel Total (ft/s)	2.95	2.92
Weir Sta Rgt (ft)	1398.28	Flow Area (sq ft)	4657.53	4712.84
Weir Submerg	0.97	Froude # Chl	0.13	0.13
Weir Max Depth (ft)	5.17	Specif Force (cu ft)	34699.48	35433.62
Min El Weir Flow (ft)	280.89	Hydr Depth (ft)	14.13	14.24
Min El Prs (ft)	287.31	W.P. Total (ft)	393.86	392.92
Delta EG (ft)	0.06	Conv. Total (cfs)	745376.6	761698.3
Delta WS (ft)	0.06	Top Width (ft)	329.62	331.02
BR Open Area (sq ft)	4960.38	Frctn Loss (ft)	0.01	0.02
BR Open Vel (ft/s)	2.95	C & E Loss (ft)	0.00	0.01
BR Sluice Coef		Shear Total (lb/sq ft)	1.46	1.42
BR Sel Method	Energy/Weir	Power Total (lb/ft s)	4.31	4.14

Plan: Milo Pro Stream Reach RS: 404 Profile: Q500

E.G. US. (ft)	288.58	Element	Inside BR US	Inside BR DS
W.S. US. (ft)	288.49	E.G. Elev (ft)	288.55	288.49
Q Total (cfs)	42970.00	W.S. Elev (ft)	288.40	288.35
Q Bridge (cfs)	20361.12	Crit W.S. (ft)	280.03	279.85
Q Weir (cfs)		Max Chl Dpth (ft)	18.65	18.39
Weir Sta Lft (ft)		Vel Total (ft/s)	2.44	2.31
Weir Sta Rgt (ft)		Flow Area (sq ft)	17641.85	18629.55
Weir Submerg		Froude # Chl	0.13	0.12
Weir Max Depth (ft)		Specif Force (cu ft)	85643.58	89120.02
Min El Weir Flow (ft)	280.89	Hydr Depth (ft)	6.15	6.19
Min El Prs (ft)	287.31	W.P. Total (ft)	3596.55	3735.44
Delta EG (ft)	0.13	Conv. Total (cfs)	1134545.0	1199033.0
Delta WS (ft)	0.13	Top Width (ft)	2869.75	3007.97
BR Open Area (sq ft)	4960.38	Frctn Loss (ft)	0.05	0.02
BR Open Vel (ft/s)	4.10	C & E Loss (ft)	0.01	0.02
BR Sluice Coef		Shear Total (lb/sq ft)	0.44	0.40
BR Sel Method	Energy only	Power Total (lb/ft s)	1.07	0.92

APPENDIX H

Drawings

98% PS&E
June 17, 2020

FIELD ENTRANCE
CURVE DATA #1
PI = 400+36.43
D = 28°38'52.4"
Δ = 6°58'42.3" Rt.
R = 200.00'
L = 24.36'
T = 12.19'
E = 0.37'

PC = STA. 400+24.24
PT = STA. 400+48.59
S 60°58'29.02" E
S 53°59'46.70" E

FIELD ENTRANCE
CURVE DATA #2
PI = 400+96.21
D =190°59'09.4"
Δ = 89°52'46.7" Rt.
R = 30.00'
L = 47.06'
T = 29.94'
E = 12.38'

PC = STA. 400+66.27
PT = STA. 401+13.33

FIELD ENTRANCE
CURVE DATA #3
PI = 402+47.80
D =190°59'09.4"
Δ = 59°35'05.3" Lt.
R = 30.00'
L = 31.20'
T = 17.18'
E = 4.57'

PC = STA. 402+30.62
PT = STA. 402+61.82

PLEASANT STREET
CURVE DATA #2
PI = 11+46.12
D = 1°23'50.8"
Δ = 4°03'54.5" Lt.
R = 4100.00'
L = 290.90'
T = 145.51'
E = 2.58'

PRC = STA. 12+16.51

S 35°52'59.95" W

R=25'
R=5'
65°00'38"
77°41'21"
R=15'
R=5'

HB-MPR-202
HB-MPR-201

31" W-Beam Guardrail - Mid-Way Splice Flared Terminal (Typ.)
Remove Utility Pole (By Others)
31" W-Beam Guardrail - Mid-Way Splice (Typ.)
Remove and Reset Mailbox
Sta. 9+20, 31' Lt. Proposed Stub Pole (By Others)
Pleasant Street
To Route 6/11/16
N 37°08'22.51" E
60°19'29"
R=10'
Anchorage Assembly
Remove Utility Pole (By Others)
Sta. 9+20, 24' Rt. Proposed Utility Pole (By Others)
Match Existing Gravel Shoulder
Remove Existing Guardrail (Typ.)
Remove Utility Pole (By Others)
Sta. 11+20, 24' Rt. Proposed Utility Pole (By Others)
Remove Utility Pole (By Others)
Sta. 12+86, 30' Rt, Proposed Utility Pole (By Others)
Remove Existing Pavement, 2" Loam and Seed (Typ.)
36' X 15" C.P. Opt. 1
Sta. 14+00.00 Pleasant Street ℄ = Sta. 402+81.89 Field Entrance ℄
Remove Utility Pole (By Others)
Remove Sign
Remove Utility Pole (By Others)
Sta. 14+50, 26' Rt. Proposed Utility Pole (By Others)

PLEASANT STREET
CURVE DATA #3
PI = 14+69.01
D = 5°58'05.9"
Δ = 20°57'05.8" Rt.
R = 960.00'
L = 351.05'
T = 177.51'
E = 16.27'

PC = STA. 8+75.47
PRC = STA. 10+00.61

PLEASANT STREET
CURVE DATA #1
PI = 9+38.04
D = 1°23'50.8"
Δ = 1°44'55.7" Rt.
R = 4100.00'
L = 125.14'
T = 62.58'
E = 0.48'

PLAN
25 0 25 50
Scale of Feet

HNTB

STATE OF MAINE
DEPARTMENT OF TRANSPORTATION
2262701
WIN 022627.01
BRIDGE NO. 3244
BRIDGE PLANS

	BY	DATE
DESIGN-DETAILED	A. Lothe	
CHECKED-REVIEWED	C. Helmick	08\20
DESIGN2-DETAILED2	P. Bishop	08\20
DESIGN3-DETAILED3	L. Driscoll	
PROJ. MANAGER	R. Hanf	
REVISIONS 1		
REVISIONS 2		
REVISIONS 3		
REVISIONS 4		
FIELD CHANGES		

SIGNATURE
P.E. NUMBER
DATE

PLEASANT RIVER BRIDGE
PLEASANT RIVER
MILO PISCATIQUIS

GENERAL PLAN 1

SHEET NUMBER
4
OF 90

Filename: 004_BDPlan_01.dgn Division: Username: Date:7/26/2020

98% PS&E
June 17, 2020

PLEASANT RIVER ROAD
CURVE DATA #1
PI = 200+99.78
D = 4°46'28.7"
Δ = 7°38'30.1" Lt.
R = 1200.00'
L = 160.05'
T = 80.14'
E = 2.67'

201+00 To Brownville

PT = STA. 201+79.69

76°26'28"

Sta. 201+43, 37' Rt. Proposed Utility Pole (By Others)

Remove Utility Poles (By Others)

202+00 Pleasant River Road

S 75°00'28.26" E

Sta. 203+00, 24' Lt. Proposed Utility Pole (By Others)

PLEASANT RIVER RD.
CURVE DATA #2
PI = 203+89.79
D = 76°23'39.7"
Δ = 40°37'03.1" Rt.
R = 75.00'
L = 53.17'
T = 27.76'
E = 4.97'

203+00

PC = STA. 203+62.04

Low Volume End

Sta. 20+40, 27' Lt. Proposed Utility Pole (By Others)

℄ Brg. Abut. 2 Sta. 20+20.50

Remove Utility Pole (By Others)

PT = STA. 204+15.21

204+00

R=50'

R=25'

R=20'

Reset Sign

89°50'05"

Bridge Transition Type I (Typ.)

HB-MPR-203

400+00

S 60°58'29.02" E

PC = STA. 400+24.24

PT = STA. 400+48.59

PC = STA. 400+66.27

PT = STA. 401+13.33

401+00

S 53°59'46.70" E

S 35°52'59.95" W

3:1 W-Beam Guardrail - Mid-Way Splice Flared Terminal (Typ.)

3:1 W-Beam Guardrail - Mid-Way Splice (Typ.)

Sta. 16+30, 24' Lt. Proposed Utility Pole (By Others)

℄ Brg. Abut. 1 Sta. 16+75.50

172'-6"

℄ Brg. Pier 1 Sta. 18+48.00

172'-6"

25'0'0" (Typ.)

15+00 16+00 17+00 18+00 19+00 20+00 21+00 22+00

N 55°46'29.57" E

Pleasant Street

HB-MPR-202

Pleasant River

Plain Riprap (Typ.)

Remove Sign

Remove Existing Guardrail (Typ.)

Remove Utility Pole (By Others)

Remove Existing Pavement, 2" Loam and Seed (Typ.)

Remove Existing Substructures to 2'-0" below stream bed

Remove Existing Bridge

Remove Utility Pole (By Others)

Sta. 2225, 46' Rt. Temporary Utility Pole (By Others)

Remove Utility Pole (By Others)

PLEASANT STREET
CURVE DATA #3
PI = 14+69.01
D = 5°58'05.9"
Δ = 20°57'05.8" Rt.
R = 960.00'
L = 351.05'
T = 177.51'
E = 16.27'

Remove Utility Pole (By Others)

PT = STA. 16+42.55

Sta. 14+50, 26' Rt. Proposed Utility Pole (By Others)

Sta. 21+23.49 Pleasant Street ℄
= Sta. 204+31.26 Pleasant River Road ℄

PLAN

25 0 25 50
Scale of Feet

HNTB

STATE OF MAINE
DEPARTMENT OF TRANSPORTATION

2262701

WIN 022627.01

BRIDGE NO. 3244

BRIDGE PLANS

PROJ. MANAGER	A. Lothel		
DESIGN-DETAILED	C. Hdmick	P. Bishop	08\20
CHECKED-REVIEWED	L. Driscoll	R. Hanf	08\20
DESIGN2-DETAILED2			
DESIGN3-DETAILED3			
REVISIONS 1			
REVISIONS 2			
REVISIONS 3			
REVISIONS 4			
FIELD CHANGES			

SIGNATURE

P.E. NUMBER

DATE

PLEASANT RIVER BRIDGE
PLEASANT RIVER PISCATIQUIS
MILO

GENERAL PLAN 2

SHEET NUMBER
5
OF 90

Date:7/26/2020
Username:
Division:
Filename: 005_BDPlan_02.dgn

98% PS&E
June 17, 2020

Sta. 22+10, 29' Lt.
Proposed Utility Pole
(By Others)

PT = STA. 204+15.21

PC = STA. 22+60.38

Sta. 22+25, 46' Rt.
Temporary Utility Pole
(By Others)

Remove
and Reset
Sign

Remove Utility Pole
(By Others)

Service Utility Pole
(By Others)

Remove and
Reset Sign

HB-MPR-204

Sta. 23+50.47 Pleasant Street/Lakeview Road ℄
= Sta. 106+63.61 Medford Road ℄

PLEASANT STREET/
LAKEVIEW ROAD
CURVE DATA #4
PI = 24+85.09
D = 16°22'12.8"
Δ = 65°24'08.2" Lt.
R = 350.00'
L = 399.52'
T = 224.71'
E = 65.92'

Pleasant Street

Remove Sign

Remove and Reset
Mailbox

32" X 15" C.P.
Opt I

R=90'

N 48°58'19.62" W

90°00'00"

R=50'

R=45'

106+00

HB-MPR-205

Remove and
Reset Sign

PT = STA. 106+44.91

Riprap Downspout

Lakeview Road

25+00

Sta. 105+58, 39' Lt.
Proposed Utility Pole
(By Others)

Remove Utility Pole
(By Others)

Medford Road

105+00

Sta. 24+70, 27' Rt.
Proposed Utility Pole
(By Others)

HB-MPR-206

PT = STA. 26+59.90

Sta. 28+30, 30' Lt.
Proposed Utility Pole
(By Others)

Remove Utility Pole
(By Others)

24+00

28+00

N 9°37'38.60" W

27+00

To Schoodic Lake

Remove and
Reset Sign

Remove Utility Pole
(By Others)

Remove and
Reset Sign

Remove Existing Pavement
2" Loam and Seed (Typ.)

76' X 36" C.P. Opt. III
(Remove Exist. Culvert)

Sta. 26+45, 24' Rt.
Proposed Utility Pole
(By Others)

Reset From
Sta. 24+50± Rt.

Sta. 28+30, 23' Rt.
Proposed Utility Pole
(By Others)

Remove Utility Pole
(By Others)

Match Existing
Gravel Shoulder (Typ.)

PC = STA. 27+17.71

PT = STA. 28+89.20

MEDFORD ROAD
CURVE DATA #2
PI = 105+28.96
D = 15°54'55.8"
Δ = 38°24'53.0" Rt.
R = 360.00'
L = 241.37'
T = 125.42'
E = 21.22'

LAKEVIEW ROAD
CURVE DATA #5
PI = 28+03.86
D = 7°54'10.3"
Δ = 13°33'11.2" Rt.
R = 725.00'
L = 171.50'
T = 86.15'
E = 5.10'

Sta. 103+60,
24' Lt.
Proposed
Utility Pole
(By Others)

Remove
Utility Pole
(By Others)

PC = STA. 104+03.54

N 87°23'12.59" W

104+00

Match Existing Gravel
Shoulder (Typ.)

PT = STA. 103+28.89

103+00

MEDFORD ROAD
CURVE DATA #1
PI = 102+57.46
D = 0°34'22.6"
Δ = 0°49'06.8" Rt.
R = 10000.00'
L = 142.87'
T = 71.43'
E = 0.26'

PLAN

25 0 25 50
Scale of Feet

HNTB

STATE OF MAINE
DEPARTMENT OF TRANSPORTATION

2262701

WIN
022627.01

BRIDGE NO. 3244

BRIDGE PLANS

PROJ. MANAGER	A. Lathel		
DESIGN-DETAILED	C. Hémick	P. Bishop	08\20
CHECKED-REVIEWED	L. Driscoll	R. Hanf	08\20
DESIGN2-DETAILED2			
DESIGN3-DETAILED3			
REVISIONS 1			
REVISIONS 2			
REVISIONS 3			
REVISIONS 4			
FIELD CHANGES			

SIGNATURE

P.E. NUMBER

DATE

PLEASANT RIVER BRIDGE
PLEASANT RIVER
MILO PISCATIQUIS

GENERAL PLAN 3

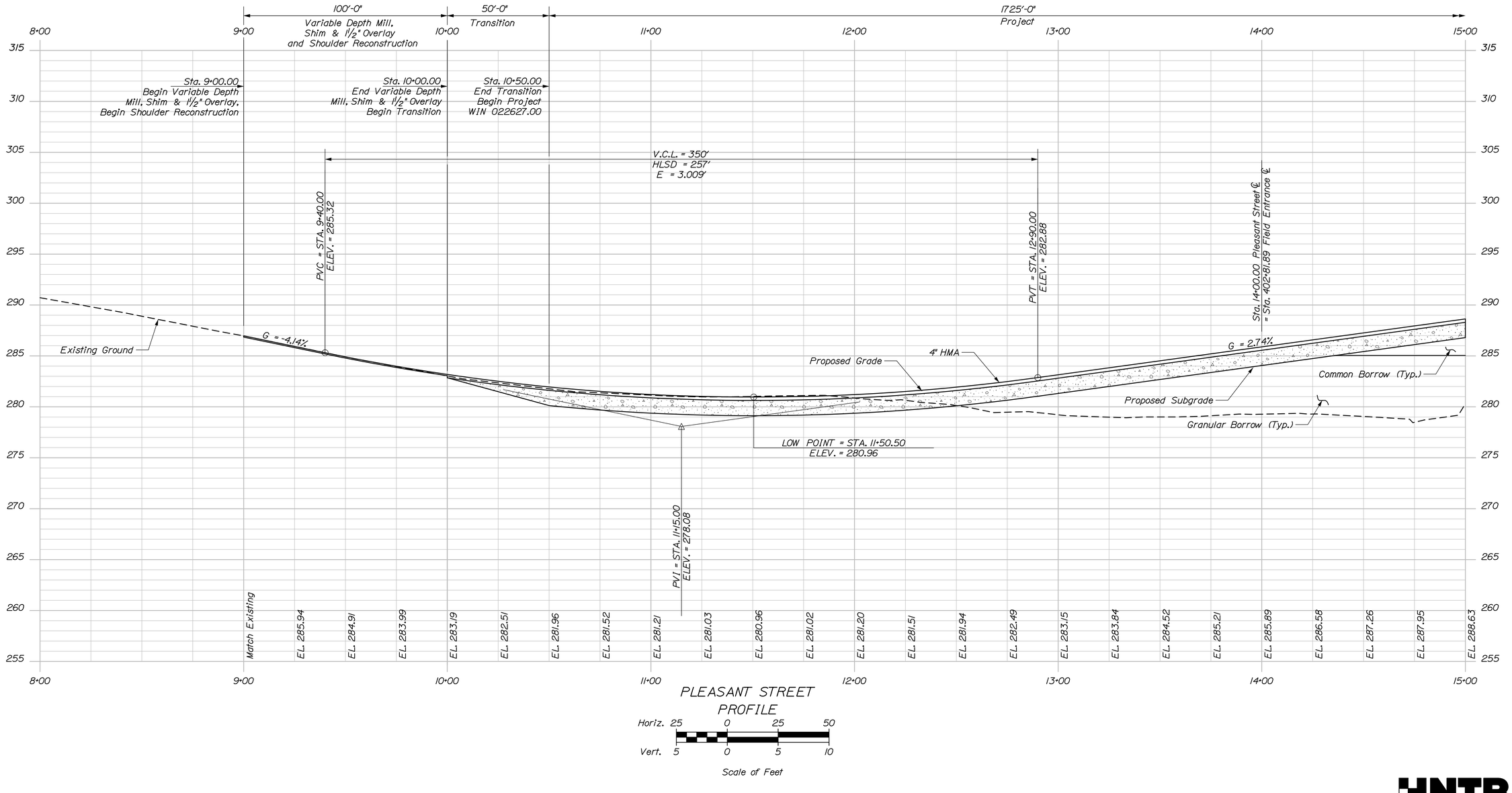
SHEET NUMBER

6

OF 90

Date:7/26/2020
Username:
Division:
Filename: 006_BDPlan_03.dgn

98% PS&E
June 17, 2020



PLEASANT STREET
PROFILE

Horiz. 25 0 25 50
Vert. 5 0 5 10
Scale of Feet

HNTB

STATE OF MAINE
DEPARTMENT OF TRANSPORTATION

2262701

WIN 022627.01

BRIDGE NO. 3244

BRIDGE PLANS

PROJ. MANAGER	A. Lathel	BY	DATE
DESIGN-DETAILED	C. Helmick	P. Bishop	08\20
CHECKED-REVIEWED	L. Driscoll	R. Hanf	08\20
DESIGN2-DETAILED2	ED2		
DESIGN3-DETAILED3	ED3		
REVISIONS 1			
REVISIONS 2			
REVISIONS 3			
REVISIONS 4			
FIELD CHANGES			

SIGNATURE

P.E. NUMBER

DATE

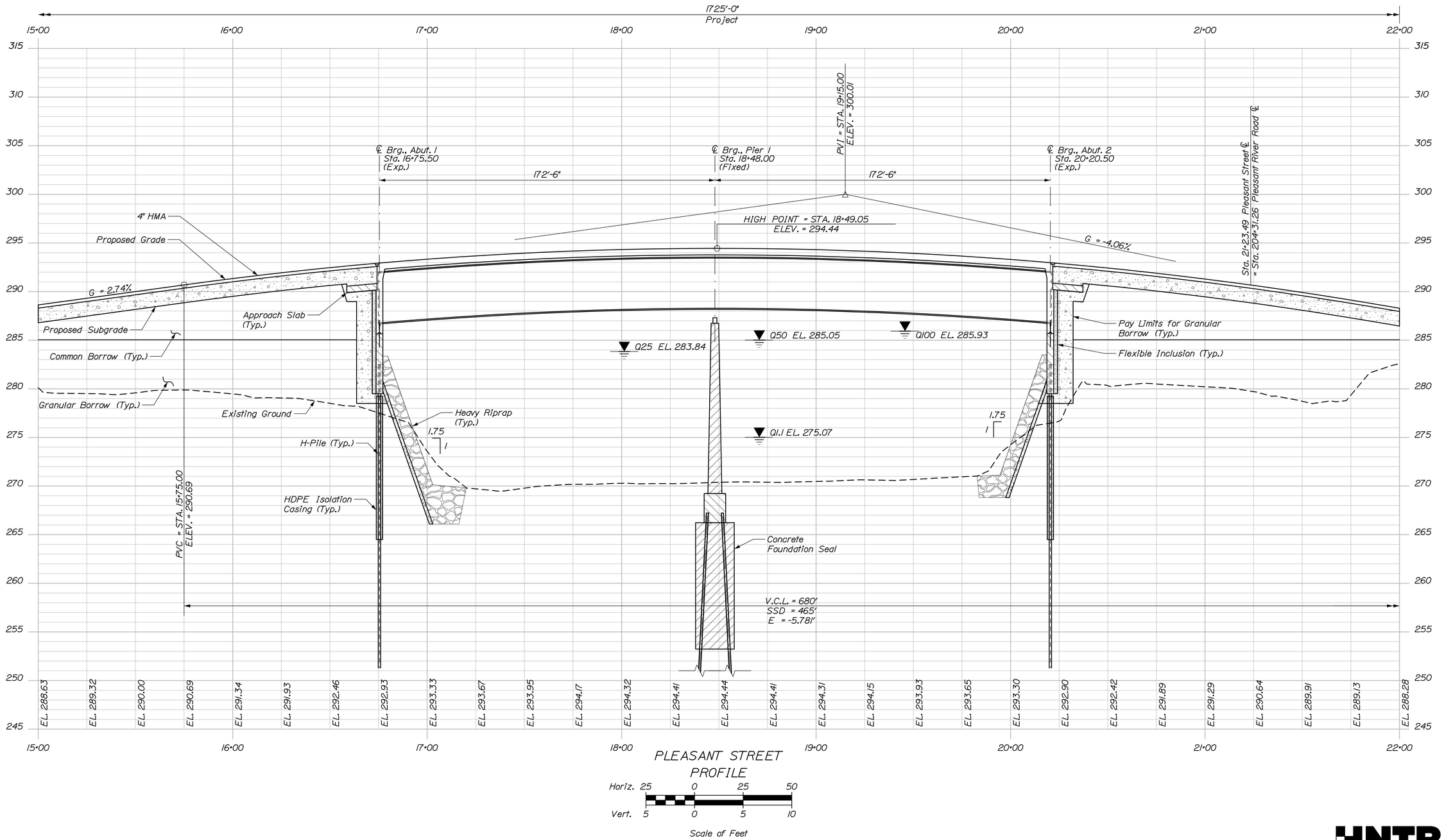
PLEASANT RIVER BRIDGE
PLEASANT RIVER
PISCATIQUIS
MILO

PROFILE 1

SHEET NUMBER
7
OF 90

Username:
Division:
Date:7/26/2020
Filename: 007_Profile_01.dgn

98% PS&E
June 17, 2020



PLEASANT STREET
PROFILE

Horiz. 25 0 25 50
Vert. 5 0 5 10
Scale of Feet

HNTB

STATE OF MAINE
DEPARTMENT OF TRANSPORTATION

2262701

WIN 022627.01

BRIDGE NO. 3244

BRIDGE PLANS

		BY	DATE
PROJ. MANAGER	A. Lothel		
DESIGN-DETAILED	C. Helmick	P. Bishop	08\20
CHECKED-REVIEWED	L. Driscoll	R. Hanf	08\20
DESIGN2-DETAILED2			
DESIGN3-DETAILED3			
REVISIONS 1			
REVISIONS 2			
REVISIONS 3			
REVISIONS 4			
FIELD CHANGES			

SIGNATURE

P.E. NUMBER

DATE

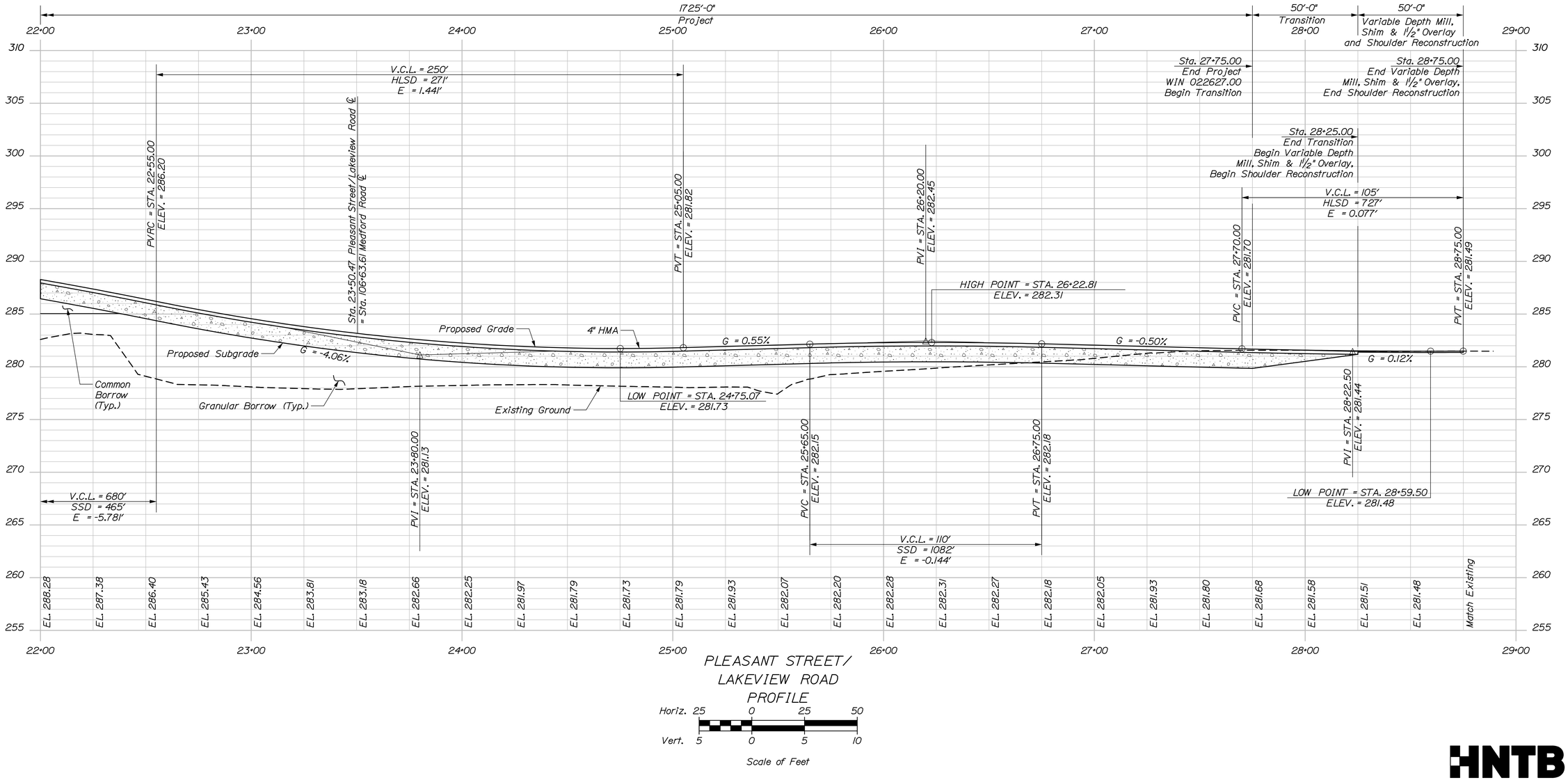
PLEASANT RIVER BRIDGE
PLEASANT RIVER
MILO PISCATIQUIS

PROFILE 2

SHEET NUMBER
8
OF 90

Username:
Division:
Date:7/26/2020
Filename: 008_Profile_02.dgn

98% PS&E
June 17, 2020



PLEASANT STREET/
LAKEVIEW ROAD
PROFILE

Horiz. 25 0 25 50
Vert. 5 0 5 10

Scale of Feet

HNTB

Date:7/26/2020
Username:
Division:
Filename: 009_Profile_03.dgn

STATE OF MAINE
DEPARTMENT OF TRANSPORTATION

2262701

WIN 022627.01

BRIDGE NO. 3244

BRIDGE PLANS

	BY	DATE
PROJ. MANAGER	A. Lathe	
DESIGN-DETAILED	C. Helmick	08\'20
CHECKED-REVIEWED	L. Driscoll	08\'20
DESIGN2-DETAILED2	P. Bishop	08\'20
DESIGN3-DETAILED3	R. Hanf	08\'20
REVISIONS 1		
REVISIONS 2		
REVISIONS 3		
REVISIONS 4		
FIELD CHANGES		

SIGNATURE

P.E. NUMBER

DATE

PLEASANT RIVER BRIDGE
PLEASANT RIVER
MILO PISCATIQUIS

PROFILE 3

SHEET NUMBER

9

OF 90