Appendix F1
Hydrology

HYDRAULIC REPORT FOR

SAN DIEGO STATE UNIVERSITY MISSION VALLEY

FENTON PARKWAY BRIDGE

October 2, 2023

Per Professional Engineers Act
Will Sign and Stamp upon Approval

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FOR REVIEW ONLY

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INTRODUCTION

The proposed Fenton Parkway Bridge project would connect Fenton Parkway, which currently terminates north of the San Diego River channel, with Camino del Rio North, south of the river channel. The Fenton Parkway Bridge would span the San Diego River in the Mission Valley community of the city of San Diego. The Board of Trustees of the California State University, which is the State of California acting in its higher education capacity, on behalf of San Diego State University (SDSU), is the lead agency responsible for certifying the adequacy and completeness of the environmental impact report (EIR).

The location of the proposed bridge is in the northeast portion of the Mission Valley Community, in the central portion of the city of San Diego metropolitan area (Figure 1, Project Location). The project site is situated south of Fenton Parkway and the Fenton Marketplace and north of Camino Del Rio North and would connect these two roadways. The San Diego River bisects the project site from east to west. Surrounding uses include commercial and residential uses to the north, SDSU Mission Valley (including Snapdragon Stadium) to the northeast, office and healthcare uses to the south, and open space, including the San Diego River. The bridge would be located within and adjacent to the City of San Diego's Multi-Habitat Planning Area as well as the City's Stadium Mitigation Site.

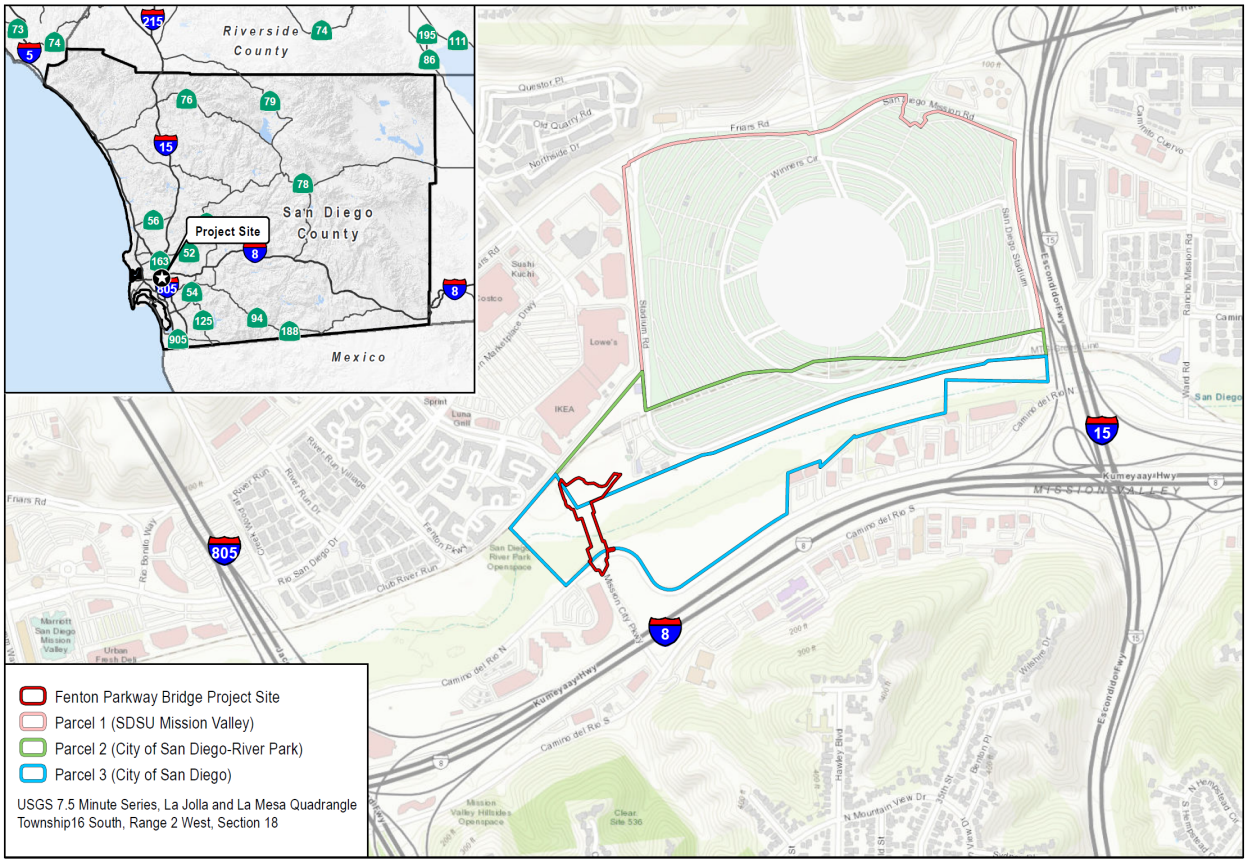


Figure 1. Project Location

The project site is surrounded by four major freeways – Interstate-15, Interstate-8, Interstate-805, and State Route 163 – accessed via Friars Road. The existing Metropolitan Transit System (MTS) Trolley Green Line and MTS Stadium Trolley Station are located northeast of the project site, as shown in Figure 1. The proposed project is located in unsectioned land of the La Jolla and La Mesa USGS 7.5-minute quadrangle.

The proposed project would involve construction of a vehicular and bicycle/pedestrian bridge spanning the San Diego River from north to south. The design and construction of the approach roadways and bridge would comply with applicable City, County of San Diego, and California Department of Transportation (Caltrans) design standards, as well as American Association of State Highway and Transportation Officials guidelines. The proposed design for the bridge is a conventional post-tensioned, trapezoidal, concrete box girder structure. The bridge would be approximately 450 feet long, 58 feet wide, and 7 feet, 6 inches deep, and would consist of up to four spans. The spans would be supported on concrete seat-type abutments in the river embankments at each end and two to three piers within the river channel, each consisting of two to three approximately 20-foot-tall, 6-foot-diameter circular concrete columns. The proposed project also includes relocation and/or extension of an existing 96-inch reinforced concrete pipe storm drain on the north side of the proposed bridge and a 54-inch storm drain along the proposed southern terminus of the bridge at Camino Del Rio North, both of which discharge directly into the San Diego River. The intersection of Fenton Parkway and River Park Road and the intersection of Mission City Parkway and Camino Del Rio North may also require updates.

The San Diego River flows in a westerly direction along Interstate 8. The Federal Emergency Management Agency's *Flood Insurance Rate Map* (FIRM) Panel No.'s 06073C1617G, 06073C1619G, 06073C1636H, and 06073C1638H, dated May 16, 2012, delineate a 0.2- and 1-percent-annual-chance Zone AE floodplain as well as a regulatory floodway along the San Diego River near the site. A FIRMette covering the Fenton Parkway Bridge location is included following this report text. The San Diego River regulatory floodway is generally along the natural river channel corridor and beyond the development area. However, the Fenton Parkway Bridge will encroach into the regulatory floodway since it crosses the San Diego River.

Conditional Letters of Map Revision (CLOMR) were prepared and processed through the City of San Diego and FEMA for the SDSU Mission Valley Campus project (Case No. 20-09-2222R) and the subsequent Fenton Parkway At Grade Crossing (Case No. 22-09-0389R). The Fenton Parkway Bridge project adds the bridge improvements to these prior CLOMR phases. This report provides a 1-percent-annual chance (100-year) hydraulic analysis and scour calculations for the proposed Fenton Parkway Bridge.

HYDRAULIC ANALYSES

Bridge Hydraulics

The most recent hydraulic analysis is the post-project HEC-RAS model prepared for the Fenton Parkway At Grade Crossing CLOMR. This includes the SDSU Mission Valley development and the subsequent Fenton Parkway At-Grade Crossing improvements. As mentioned above, the CLOMR was approved by the City of San Diego and FEMA, so its post-project HEC-RAS serves as the baseline hydraulic model.

The CLOMR HEC-RAS input parameters are as follows. The cross-sections reflect the SDSU Mission Valley development and Fenton Parkway At-Grade Crossing improvements from the approved grading plans. The topographic mapping and grading are on NGVD 29 (NAVD 88 = NGVD 29 + 2.08 feet). The downstream 100-year floodplain and floodway water surface elevations were set equal to the effective water surface elevation. The 100-year flow rate from the effective FEMA data is 36,000 cubic feet per second. The roughness coefficients were assigned based on a site visit, review of aerial photographs, and the proposed site plan. The natural San Diego River corridor contains a fairly uniform cover of grasses, weeds, brush, and trees. A roughness coefficient of 0.075 was assigned for these areas, while roughnesses from 0.030 to 0.060 were assigned in areas with lesser to no vegetation.

The CLOMR HEC-RAS model was revised to reflect the proposed Fenton Parkway Bridge. The bridge and associated grading were obtained from the Preliminary 30% Plan Set. Cross-sections 42650 and 43000 were added near the bridge. The bridge is located between cross-sections 42650 and 42754. The current bridge design is 58-feet wide, 5.4-feet deep, and contains three 2-column, 5-foot diameter piers across its 450-foot span. Riprap will be placed on a slope in front of each abutment.

Cross-section	CLOMR BFE, feet	F.P. Bridge BFE, feet	FPB – CLOMR BFE, feet
44853	59.17	59.17	0.00
44513	55.70	55.71	0.01
44233	54.88	54.90	0.02
43953	54.37	54.40	0.03
43703	54.25	54.28	0.03
43452	53.92	53.95	0.03
43163	53.14	53.18	0.04
43000	---	52.44	---
42873	51.74	51.57	-0.17
42754	51.25	50.98	-0.27
42650	---	50.45	---
42583	48.06	48.06	0.00

Table 1. Comparison of 1-Percent-Annual-Chance Base Flood Elevations

Table 1 compares the post-project CLOMR (SDSU Mission Valley development and Fenton Parkway At-Grade Crossing improvements) and proposed Fenton Parkway Bridge 100-year results near the crossing. The HEC-RAS output for both analyses is included in Appendix A and a work map is in the map pocket. Table 1 shows that the 100-year base flood elevations (BFE) match downstream and upstream by cross-section 44583. The bridge causes a minor decrease in BFEs in the immediate two cross-sections just upstream, then a slight increase from cross-sections 43153 to 44513. The decrease occurs because vegetative cover is reduced by the bridge shadow. The nearly negligible BFE increases are contained with the southerly San Diego River

channel bank, so do not cause adverse off-site impacts. In addition, the bridge has over 6 feet of freeboard over the BFE, and, therefore, can adequately convey the 100-year flow.

Bridge Abutment Riprap

The HEC-RAS results indicate that the 100-year flow velocity at the Fenton Parkway Bridge reaches 8.6 feet per second, which is erosive. Buried riprap will be placed at a 2:1 slope along the channel banks adjacent to the bridge abutments to protect against the erosive flow. The Caltrans *Highway Design Manual* provides a nomograph to size riprap on a bank. The nomograph is included after this report text. The bank angle and velocity are drawn on the right side of the nomograph to determine the point on the pivot line. A line is then drawn from the specific gravity of rock (2.65) to the pivot point. The resulting weight of rock is about 15 pounds, which corresponds to No. 2 Backing (25 pounds). Since No. 2 Backing is heavier than required, it will provide a factor-of-safety against higher flow velocities due to reduced vegetation. The riprap shall be at least No. 2 Backing with a thickness and filter material in accordance with the City of San Diego's *Drainage Design Manual*.

Bridge Local Scour

Local scour analyses were performed to determine the pier scour, which is associated with accelerated flow and the resulting vortices leading to a removal of material near a bridge pier. Local scour can also consist of abutment scour. However, the bridge does not contain abutments that encroach abruptly into the river channel, so abutment scour was not analyzed. The Colorado State University (CSU) equation from *Hydraulic Engineering Circular No. 18* (HEC-18) is the standard pier scour formula and has the following form:

$$y_s/a = 2.0\ K_1\ K_2\ K_3\ K_4\ (y_1/a)^{0.35}\ F_r^{0.43}$$

where,

y_s = scour depth, feet
y_1 = flow depth directly upstream of the pier, feet
a = pier width
K_1 = correction factor for pier nose shape
K_2 = correction factor for angle of attack of flow
K_3 = correction factor for bed condition
K_4 = correction factor for armoring by bed material size
F_r = Froude Number directly upstream of pier

The CSU equation input values are: y_1 = flow depth from HEC-RAS 100-year results at cross-section 42754, a = 5 feet, K_1 = 1.0 for a group of cylindrical piers, K_2 = 1.0 for no angle of attack, K_3 = 1.1 for a plane bed, K_4 = 1.0 for no bed armoring, and F_r = Froude number from the HEC-RAS results at cross-section 42754. Table 2 summarizes the pier scour input and results. A 25 percent factor-of-safety is included to account for some general scour.

Location	y_1, ft	a, ft	K_1	F_r	y_S, ft	ys × 1.25 FOS, ft
Fenton Parkway Bridge	15.62	5	1.0	0.40	11.1	13.8

Note: $K_2 = 1.0$, $K_3 = 1.1$, and $K_4 = 1.0$

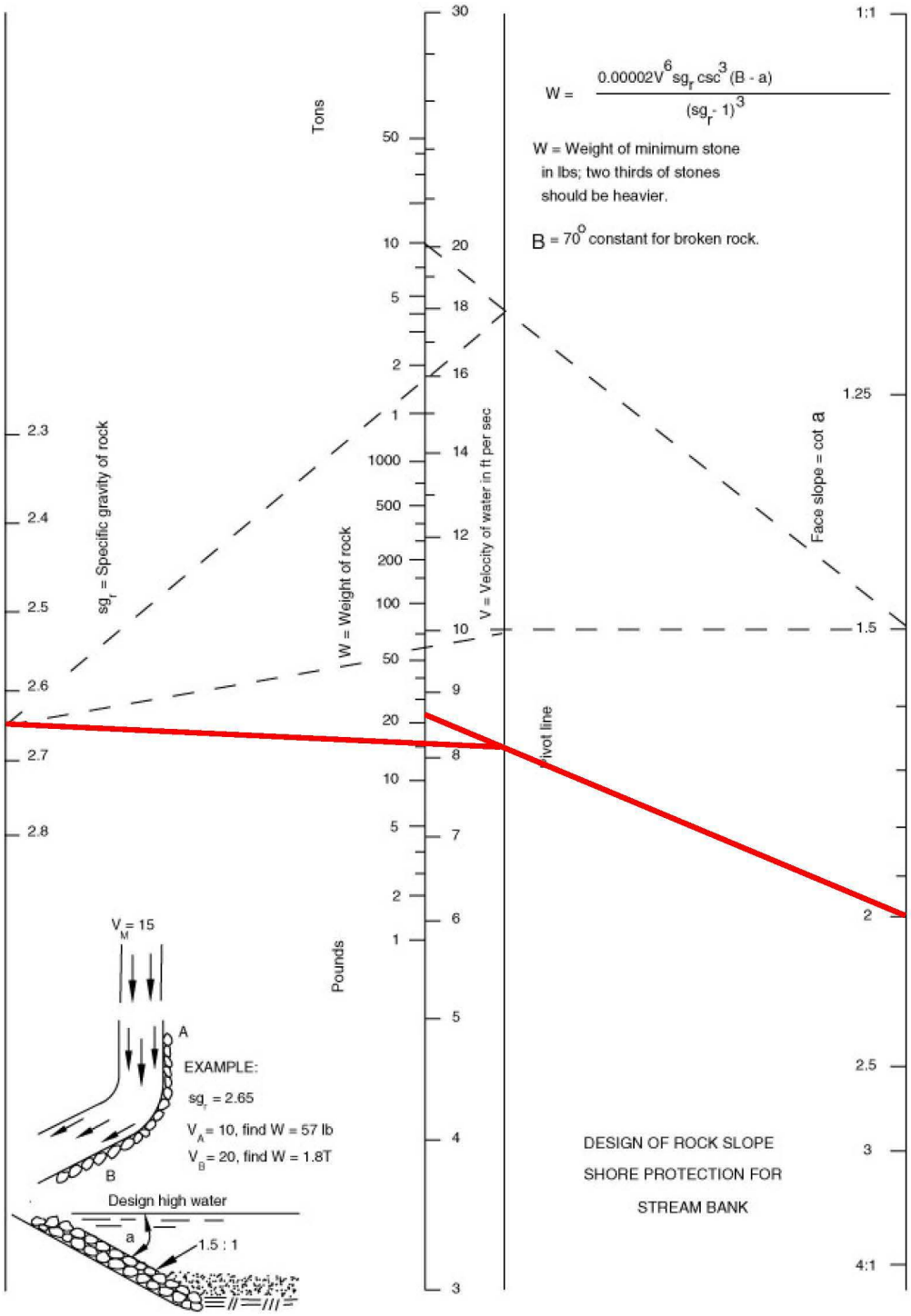
Table 2. Summary of Pier Scour

CONCLUSION

This hydraulic report has been prepared to analyze the proposed Fenton Parkway Bridge crossing of the San Diego River. The bridge is a stand-alone project and not part of the San Diego State University Mission Valley development. The 100-year HEC-RAS analyses show that the project will not cause adverse off-site hydraulic impacts and that it can convey the 100-year flow with several feet of freeboard. Buried riprap has been sized and will be placed along the adjacent channel banks to protect the abutments. In addition, the piers shall be designed to within the local scour with a factor-of-safety. This report is based on the Preliminary 30% Plan Set and is subject to updates as the plans progress towards final.

Figure 873.3A

Nomograph of Stream-Bank Rock Slope Protection



Red lines are for riprap sizing on new berm. Blue lines are for riprap sizing on existing berm.

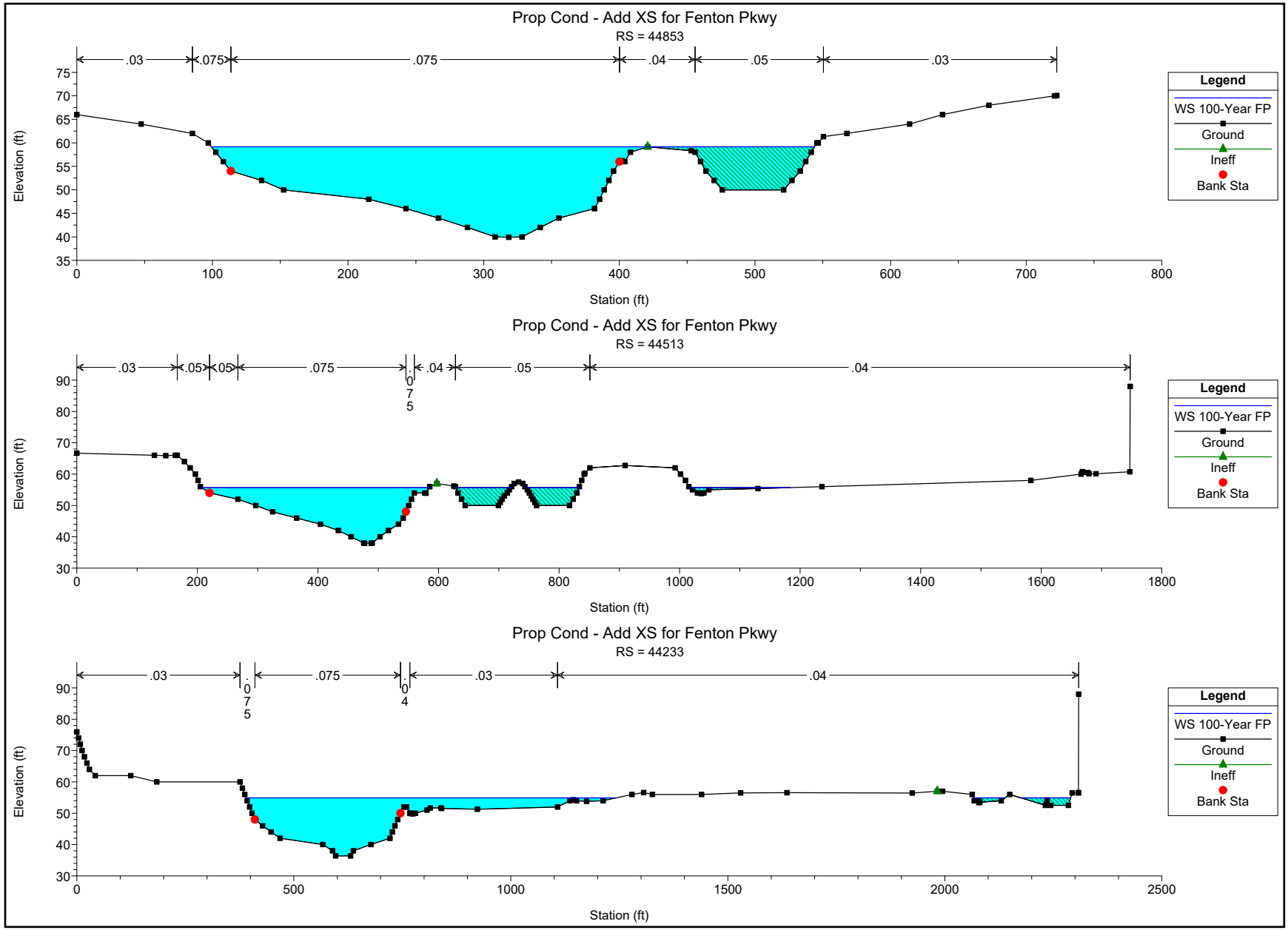
APPENDIX A

HEC-RAS ANALYSES

100-Year Fenton Parkway At Grade Crossing CLOMR HEC-RAS Results

HEC-RAS Plan: PC SDR Fenton Pkwy River: RIVER-1 Reach: Reach-1 Profile: 100-Year FP

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-1	44853	100-Year FP	36000.00	39.90	59.17		60.64	0.008243	9.76	3736.12	444.69	0.48
Reach-1	44513	100-Year FP	36000.00	37.90	55.70	52.60	57.50	0.012312	10.83	3381.89	723.38	0.60
Reach-1	44233	100-Year FP	36000.00	36.40	54.88	48.08	55.43	0.002831	6.05	6109.79	1039.02	0.29
Reach-1	43953	100-Year FP	36000.00	35.70	54.37	46.67	54.73	0.001449	4.46	7599.61	1277.93	0.21
Reach-1	43703	100-Year FP	36000.00	36.00	54.25		54.42	0.000615	2.87	11099.95	1188.28	0.13
Reach-1	43452	100-Year FP	36000.00	35.60	53.92	46.85	54.18	0.001148	3.58	9083.69	1271.03	0.18
Reach-1	43163	100-Year FP	36000.00	35.50	53.14		53.63	0.002537	5.47	6454.64	854.67	0.27
Reach-1	42873	100-Year FP	36000.00	35.40	51.74	45.85	52.54	0.004507	7.27	5044.65	488.57	0.36
Reach-1	42754	100-Year FP	36000.00	36.00	51.25		51.95	0.004084	6.82	5351.89	561.41	0.34
Reach-1	42583	100-Year FP	36000.00	35.30	48.06	46.64	50.34	0.019900	13.02	3098.54	391.11	0.72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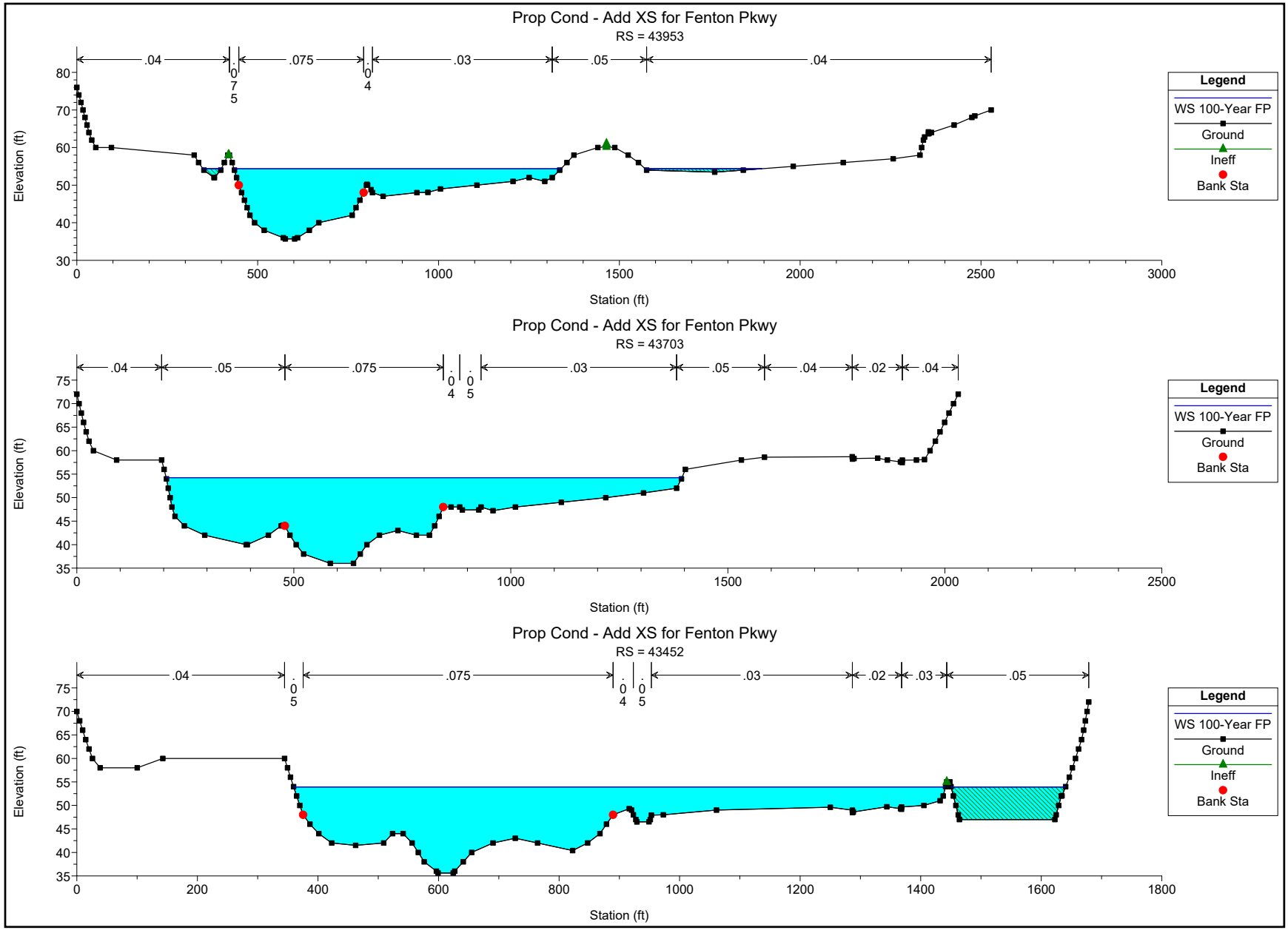
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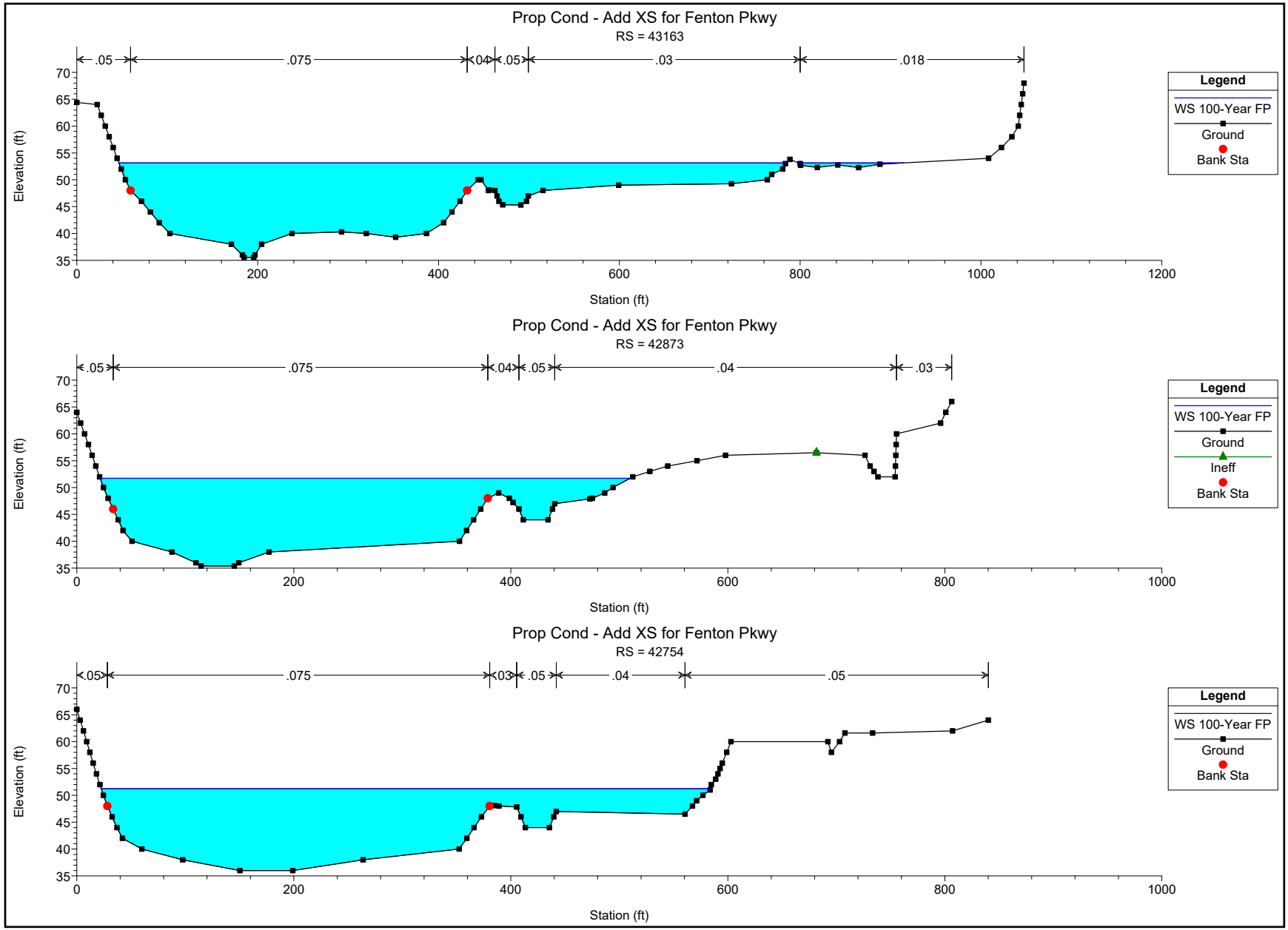
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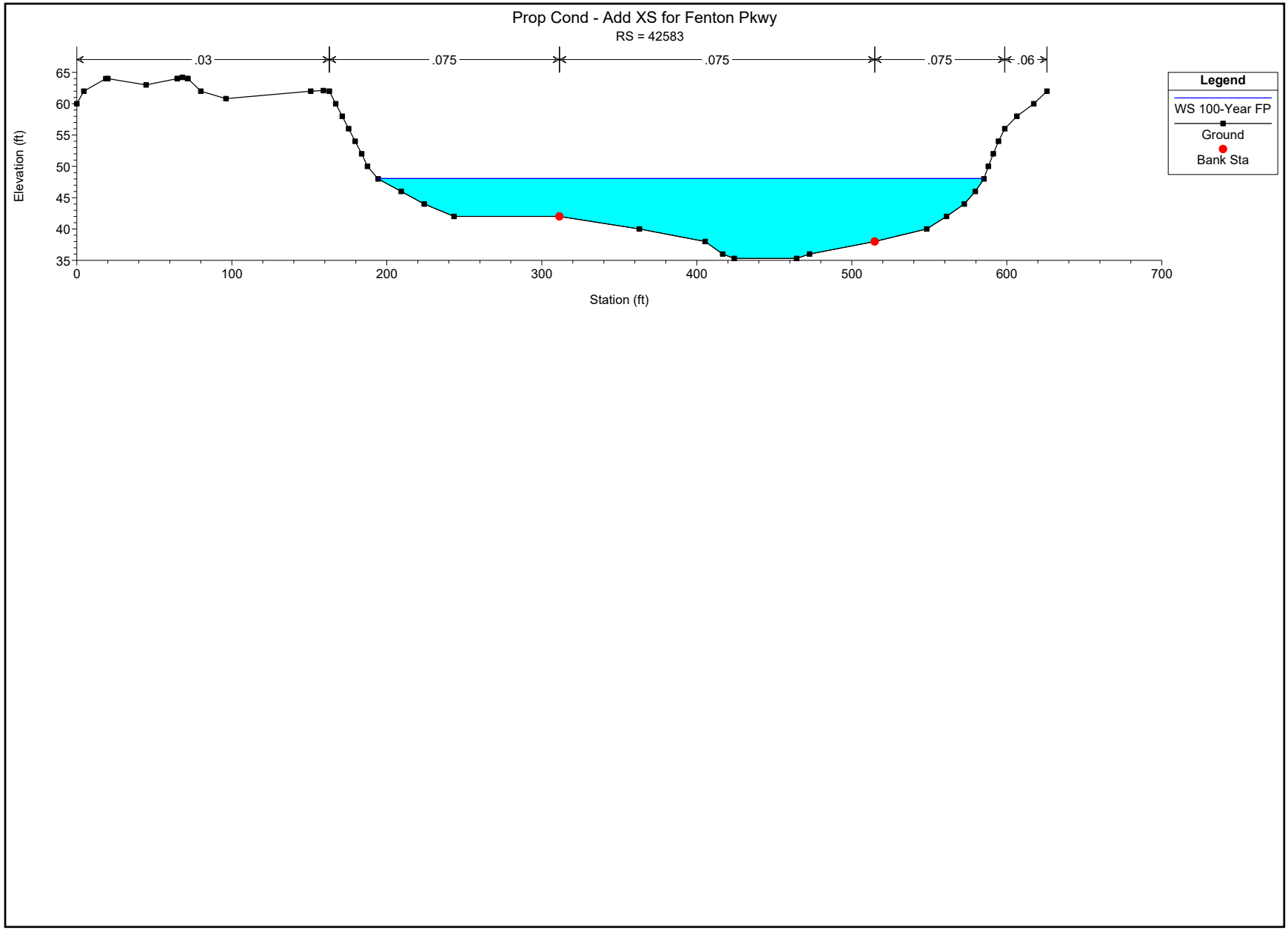
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WS 100-Year FP
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Bank Sta

100-Year Fenton Parkway Bridge HEC-RAS Results

HEC-RAS Plan: PC FPB 2023-0801 River: RIVER-1 Reach: Reach-1 Profile: 100-Year FP

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-1	44853	100-Year FP	36000.00	39.90	59.17		60.64	0.008241	9.76	3736.45	444.69	0.48
Reach-1	44513	100-Year FP	36000.00	37.90	55.71	52.60	57.50	0.012274	10.82	3385.31	725.22	0.60
Reach-1	44233	100-Year FP	36000.00	36.40	54.90	48.08	55.45	0.002808	6.03	6126.29	1040.45	0.29
Reach-1	43953	100-Year FP	36000.00	35.70	54.40	46.67	54.75	0.001434	4.44	7621.65	1282.20	0.21
Reach-1	43703	100-Year FP	36000.00	36.00	54.28		54.45	0.000609	2.86	11130.97	1188.47	0.13
Reach-1	43452	100-Year FP	36000.00	35.60	53.95	46.85	54.21	0.001134	3.57	9115.23	1271.31	0.18
Reach-1	43163	100-Year FP	36000.00	35.50	53.18		53.66	0.002496	5.44	6489.29	859.99	0.27
Reach-1	43000	100-Year FP	36000.00	35.45	52.44		53.15	0.003681	6.90	5378.96	576.70	0.33
Reach-1	42873	100-Year FP	36000.00	35.40	51.57		52.46	0.005060	7.64	4779.71	428.05	0.38
Reach-1	42754	100-Year FP	36000.00	35.36	50.98	45.50	51.97	0.003541	8.23	4594.44	420.22	0.40
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Reach-1	42650	100-Year FP	36000.00	35.34	50.45		51.54	0.004311	8.60	4398.60	432.07	0.43
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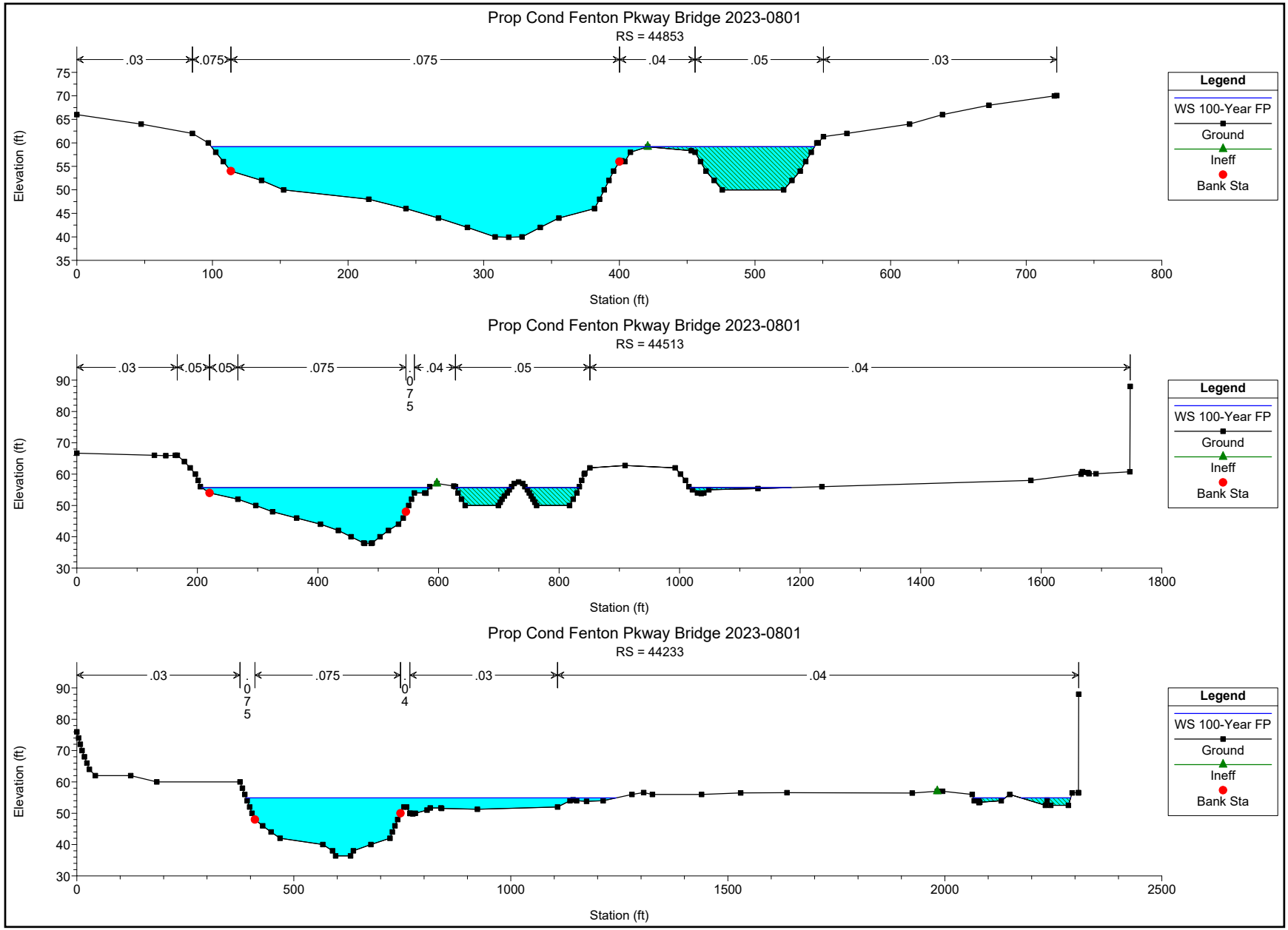
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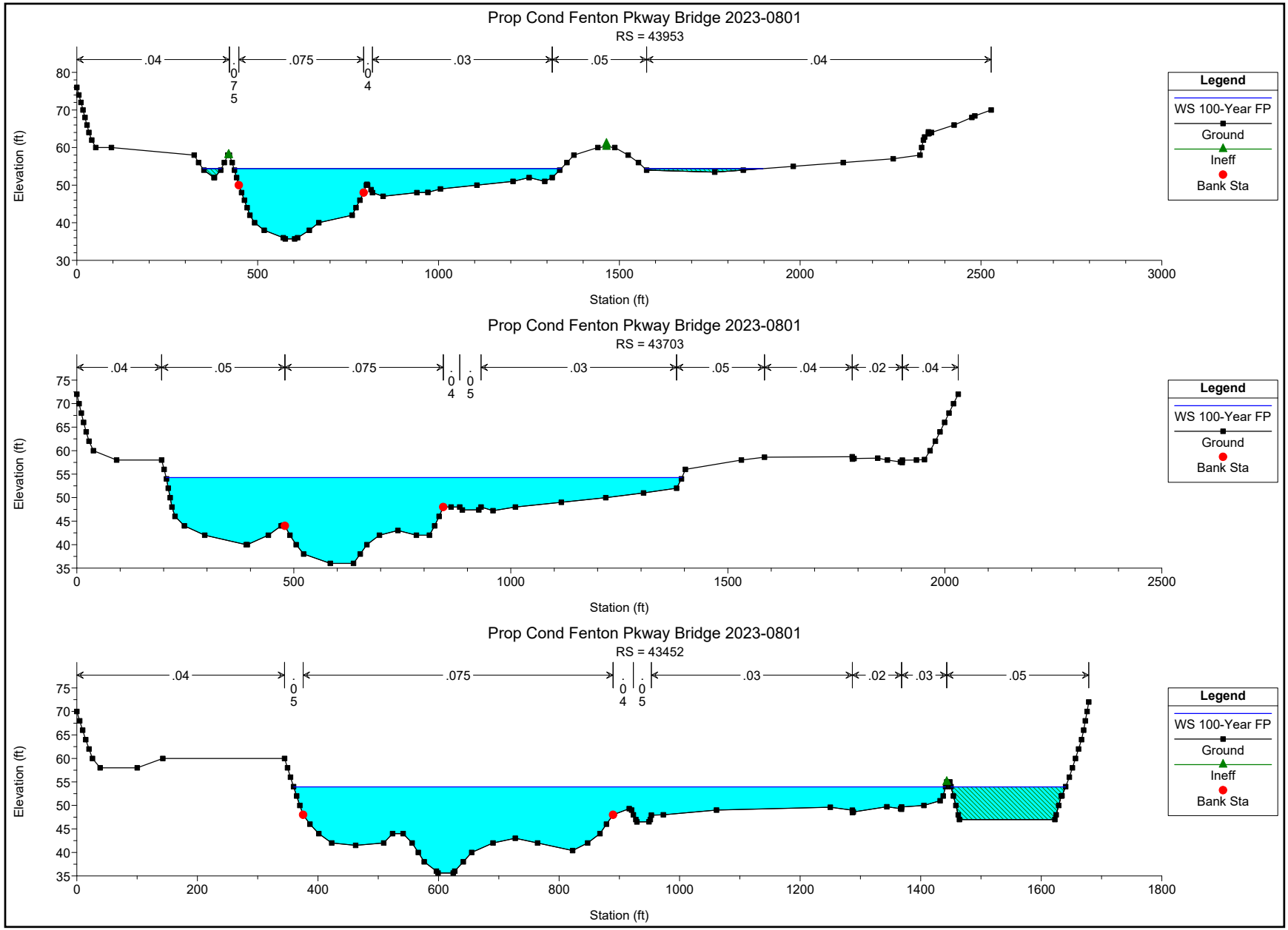
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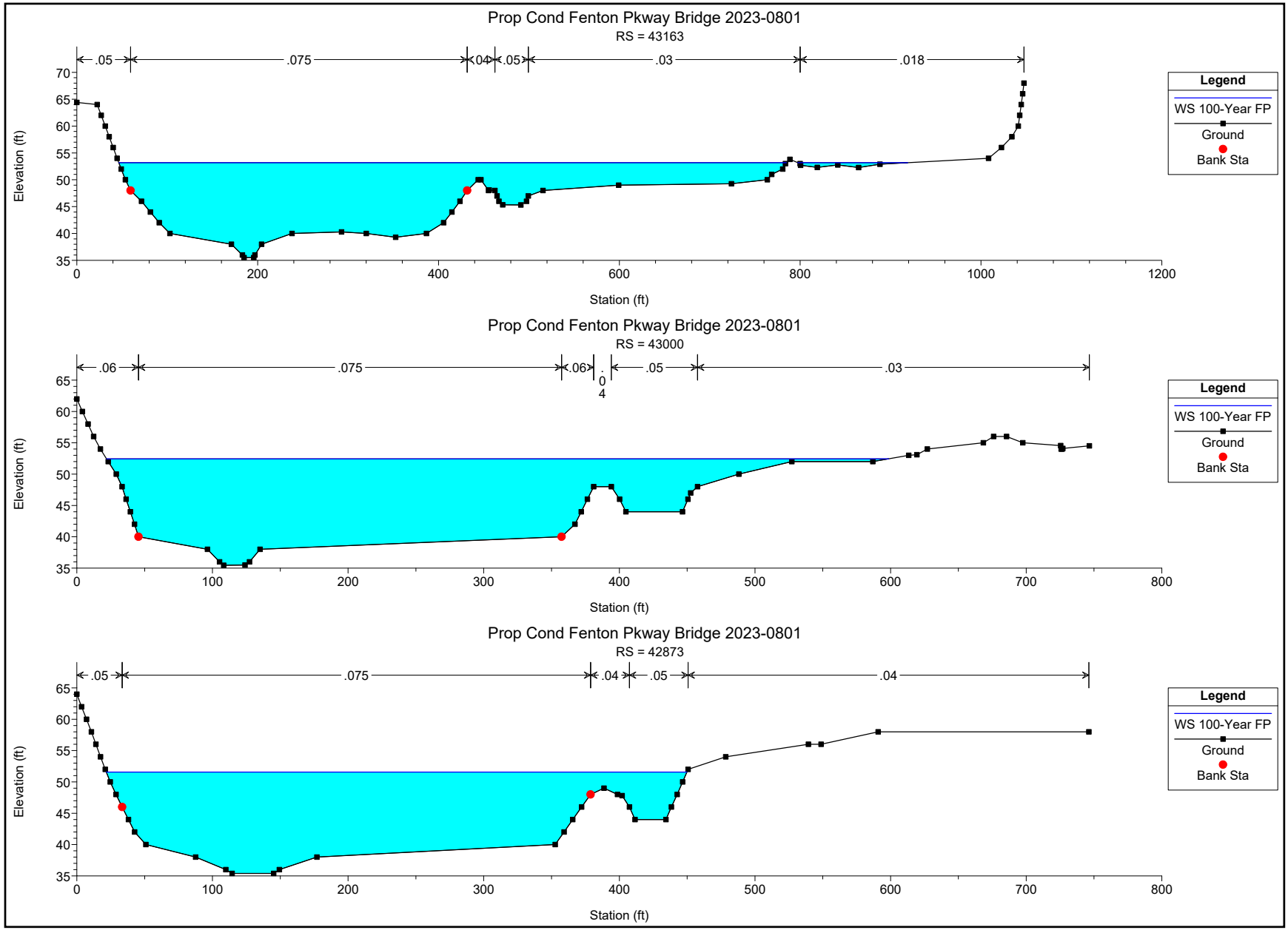
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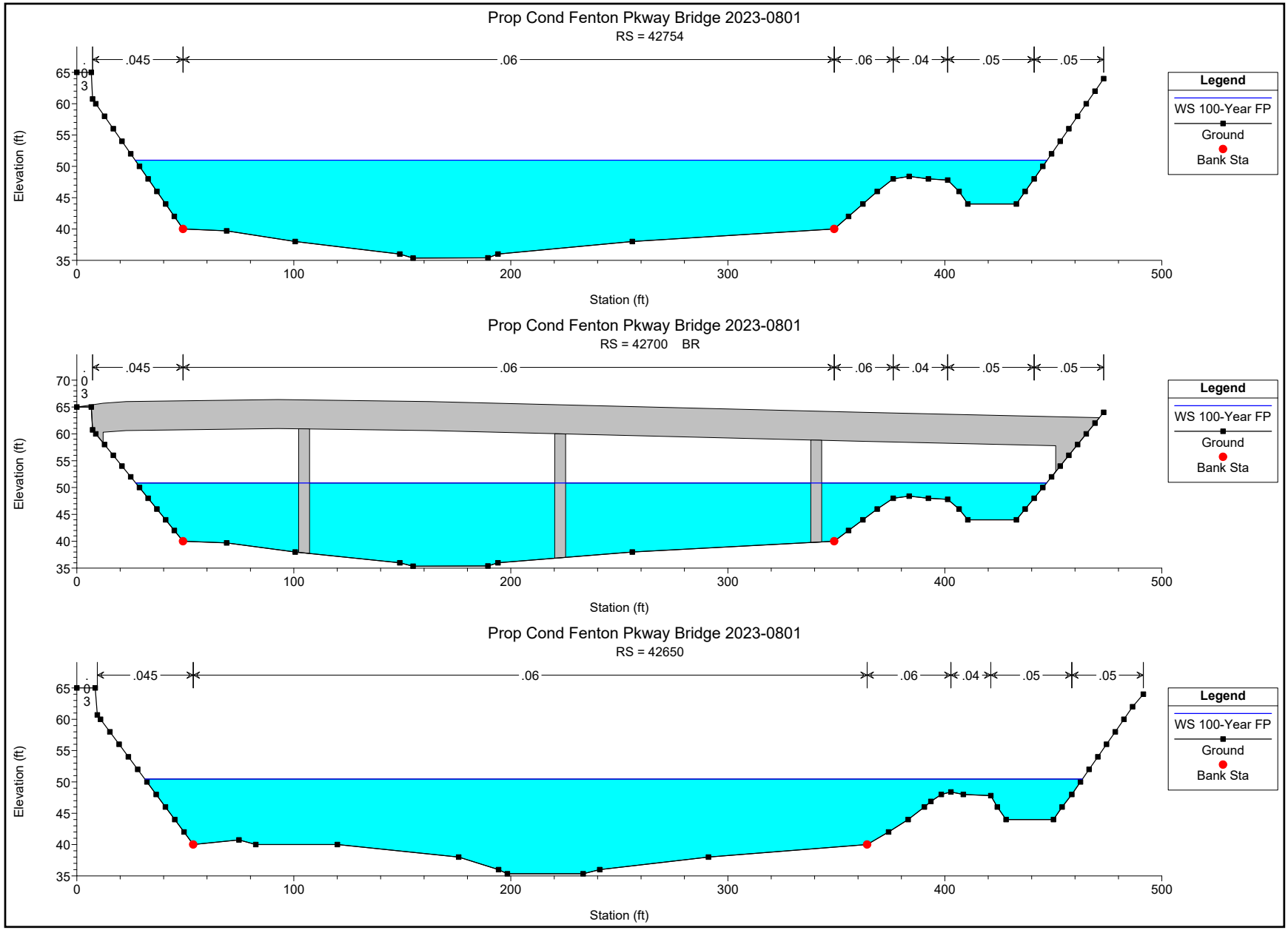
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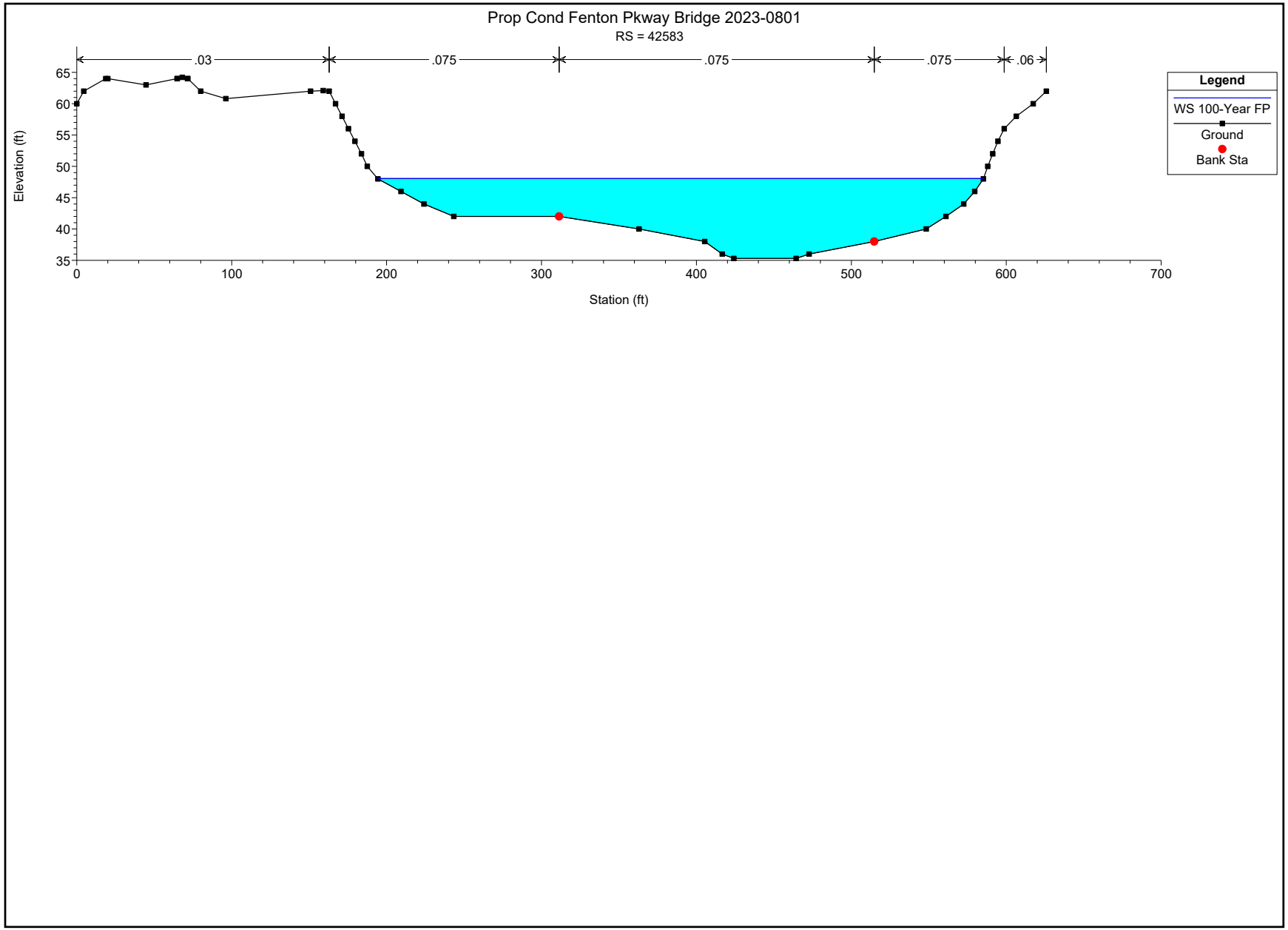
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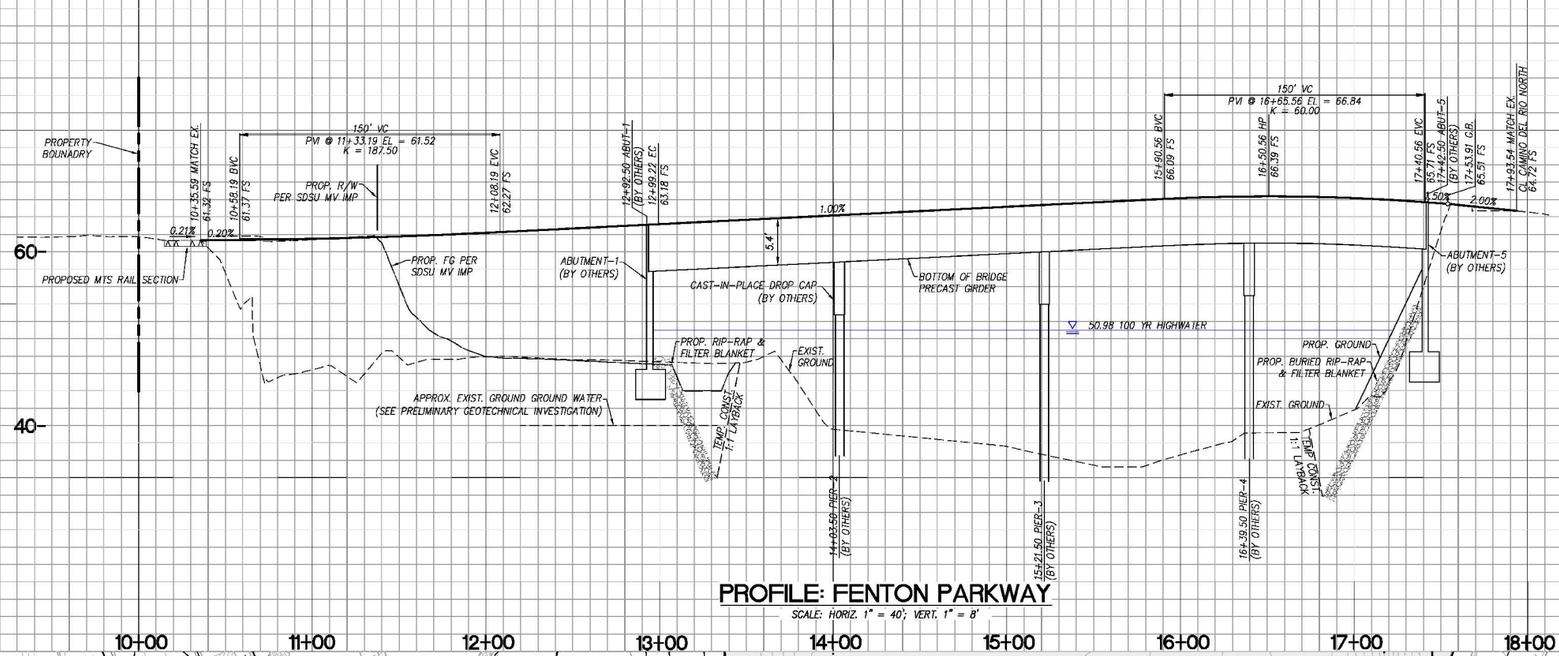
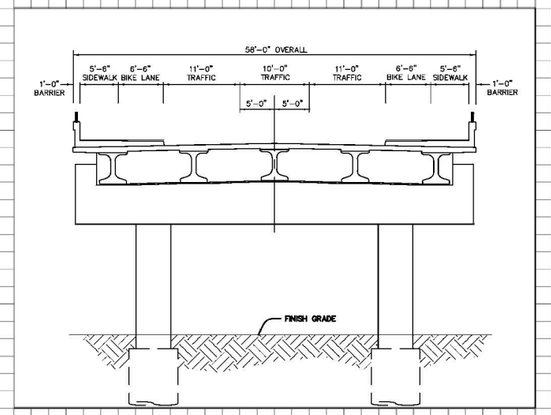


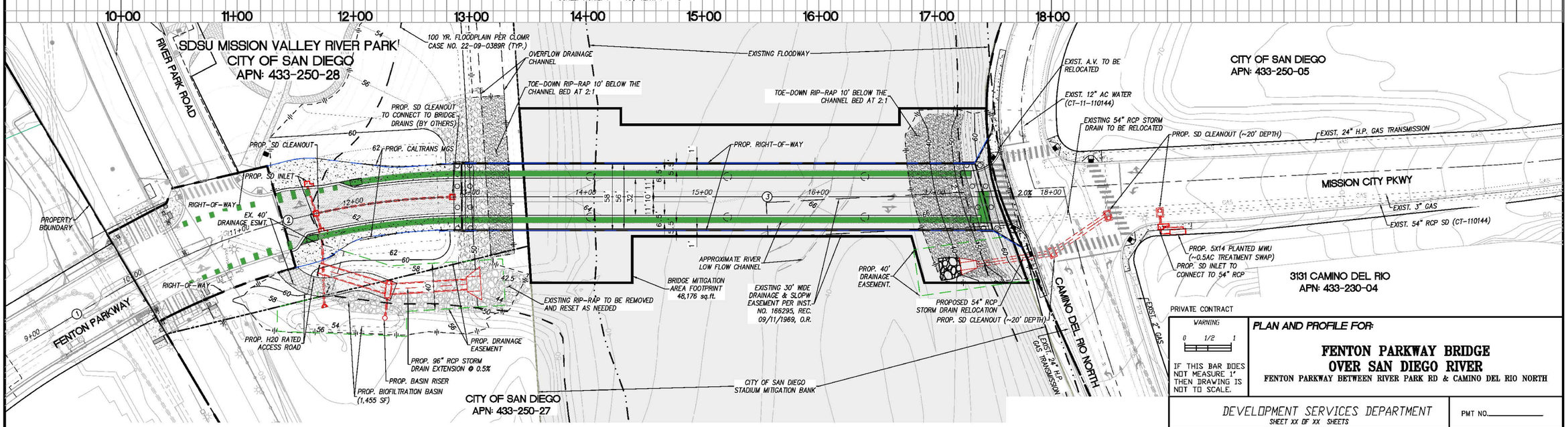
PROFILE: FENTON PARKWAY

SCALE: HORIZ. 1" = 40'; VERT. 1" = 8'



TYPICAL SECTION

NOT TO SCLAE



PLAN: FENTON PARKWAY

SCALE:1" = 40'

CENTERLINE DATA				
NO	BEARING/DELTA	RADIUS	LENGTH	REMARKS
1	N 49°34'39" W	--	84.80'	FENTON PARKWAY CL
2	Δ=29°31'58"	610.00'	314.42'	FENTON PARKWAY CL
3	N 19°04'34" W	--	512.86'	FENTON PARKWAY CL

40 20 0 40 80

SCALE: 1"=40'

PROJECT DESIGN CONSULTANTS
Planning | Landscape Architecture | Engineering | Survey
701 B Street, Suite 800 San Diego, CA 92101
619.235.6471 Tel 619.234.0349 Fax

REGISTERED PROFESSIONAL ENGINEER
MARTIN J. JONES
No. 78492
CIVIL
STATE OF CALIFORNIA

MARTIN J. JONES, R.C.E. 78492 DATE

DESIGNED BY: TAA

PRIVATE CONTRACT

WARNING
0 1/2 1
IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO SCALE.

PLAN AND PROFILE FOR:

FENTON PARKWAY BRIDGE OVER SAN DIEGO RIVER

FENTON PARKWAY BETWEEN RIVER PARK RD & CAMINO DEL RIO NORTH

DEVELOPMENT SERVICES DEPARTMENT
SHEET XX OF XX SHEETS

PMT NO._____

APPROVED:
FOR CITY ENGINEER DATE

PRJ NO. XXXXXXX

DESCRIPTION	BY	APPROVED	DATE
ORIGINAL	PDC		
AS BUILTS			

XXXX-XXXX NAD83 COORDINATES

XXX-XXXX LAMBERT COORDINATES

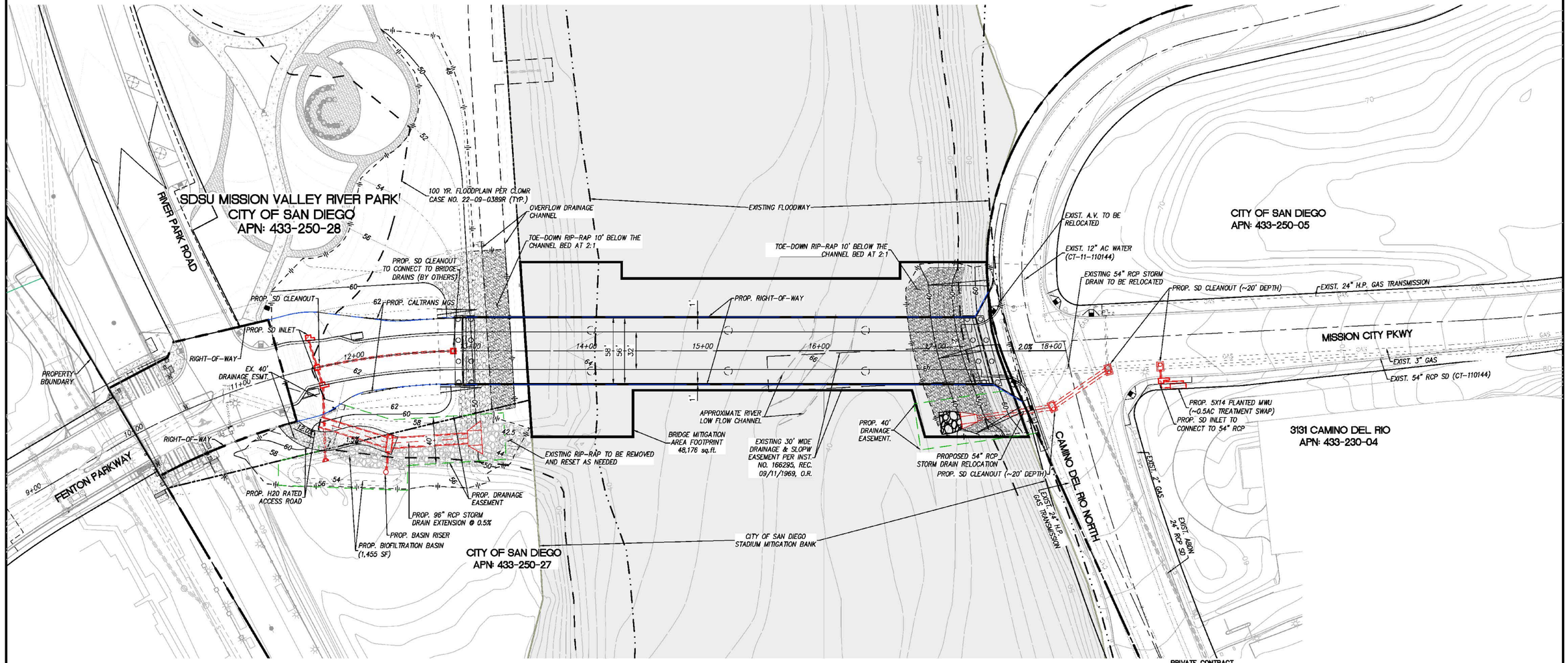
DRAWING NO. C1

XXXXXX-XX-D

CONTRACTOR_____ DATE STARTED_____
INSPECTOR_____ DATE COMPLETED_____

30% PLAN(S) - NOT FOR CONSTRUCTION

File Name P:\4497.00\Engr\Exhibits\Prelim Fenton Bridge\Fenton Bridge_Prelim.dwg, Date Last Saved 6/27/2023 6:09:13 PM, Date Plotted Last 8/29/2023 12:46:20 PM



EARTHWORK QUANTITIES (CY):

CUT 200
FILL 13,600
NET 13,400 (FILL)

EARTHWORK NOTE: QUANTITIES ARE PRELIMINARY AND PRIOR TO COMPLETE GEOTECHNICAL INVESTIGATION.

RIP-RAP LEGEND:

- BURIED FACING CLASS RIP-RAP (75LB, D50=1.0 FEET). RIP RAP TO BE 1.5 THICK OVER EITHER ¾" GRAVEL (1' THICK) FILTER BLANKET OR PER GEOTECHNICAL RECOMMENDATION.
- FACING CLASS RIP-RAP (75LB, D50=1.0 FEET). RIP RAP TO BE 1.5 THICK OVER EITHER ¾" GRAVEL (1' THICK) FILTER BLANKET OR PER GEOTECHNICAL RECOMMENDATION.
- SD OUT-FALL RIP-RAP ENERGY DISSIPATOR PER SDD-104.
- EXISTING RIP-RAP TO BE REMOVED AND REPLACED AS NEEDED.

N

40 20 0 40 80

SCALE: 1"=40'

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Planning | Landscape Architecture | Engineering | Survey
701 B Street, Suite 800 San Diego, CA 92101
619.235.6471 Tel 619.234.0349 Fax

REGISTERED PROFESSIONAL ENGINEER
MARTIN J. JONES
No. 78492
CIVIL
STATE OF CALIFORNIA

MARTIN J. JONES, R.C.E. 78492 DATE DESIGNED BY: TAA

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MASS GRADING PLAN FOR:

FENTON PARKWAY BRIDGE OVER SAN DIEGO RIVER

FENTON PARKWAY BETWEEN RIVER PARK RD & CAMINO DEL RIO NORTH

DEVELOPMENT SERVICES DEPARTMENT
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DESCRIPTION	BY	APPROVED	DATE
ORIGINAL	PDC		
AS BUILTS			

XXXX-XXXX
NAD83 COORDINATES

XXX-XXXX
LAMBERT COORDINATES

DRAWING NO. XXXXXX-XX-D C2

CONTRACTOR DATE STARTED
INSPECTOR DATE COMPLETED

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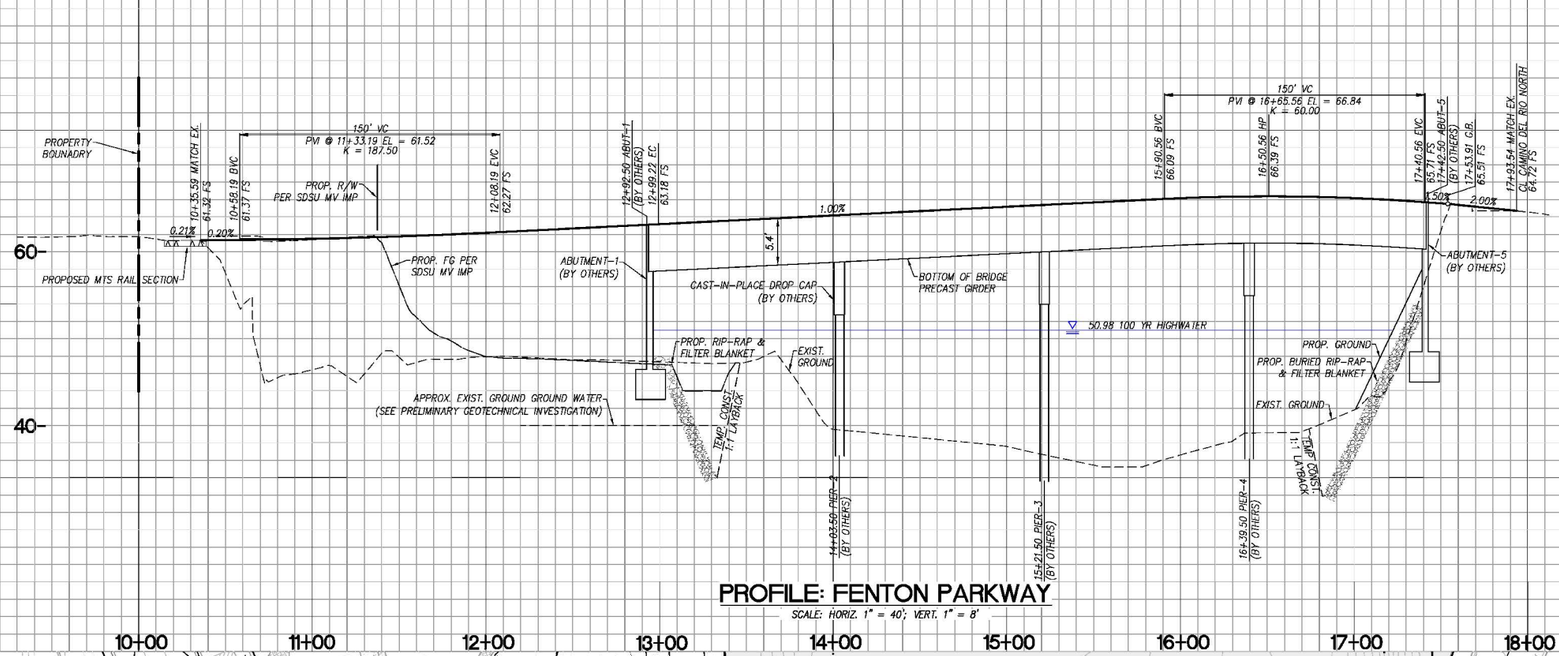
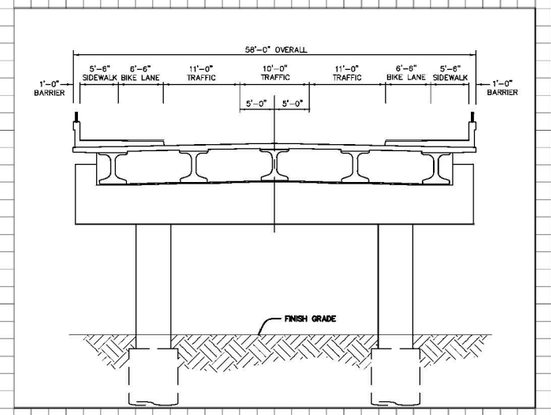


PROFILE: FENTON PARKWAY

SCALE: HORIZ. 1" = 40'; VERT. 1" = 8'



TYPICAL SECTION

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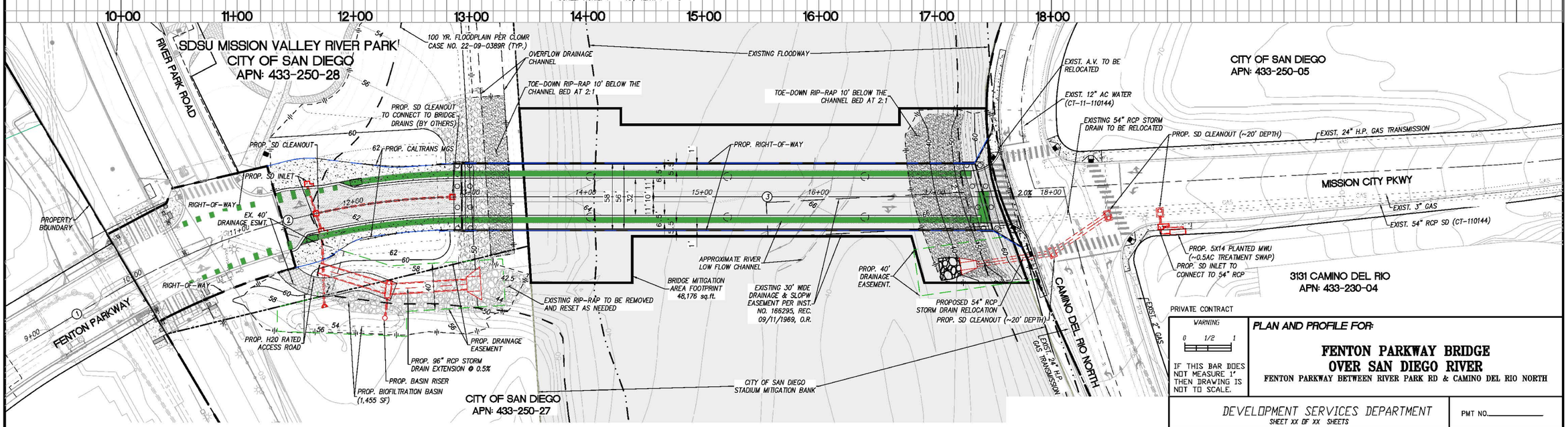

PLAN: FENTON PARKWAY

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SCALE: 1"=40'

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REGISTERED PROFESSIONAL ENGINEER
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STATE OF CALIFORNIA

MARTIN J. JONES, R.C.E. 78492 DATE

DESIGNED BY: TAA

PRIVATE CONTRACT

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PLAN AND PROFILE FOR:

FENTON PARKWAY BRIDGE OVER SAN DIEGO RIVER

FENTON PARKWAY BETWEEN RIVER PARK RD & CAMINO DEL RIO NORTH

DEVELOPMENT SERVICES DEPARTMENT
SHEET XX OF XX SHEETS

PMT NO._____

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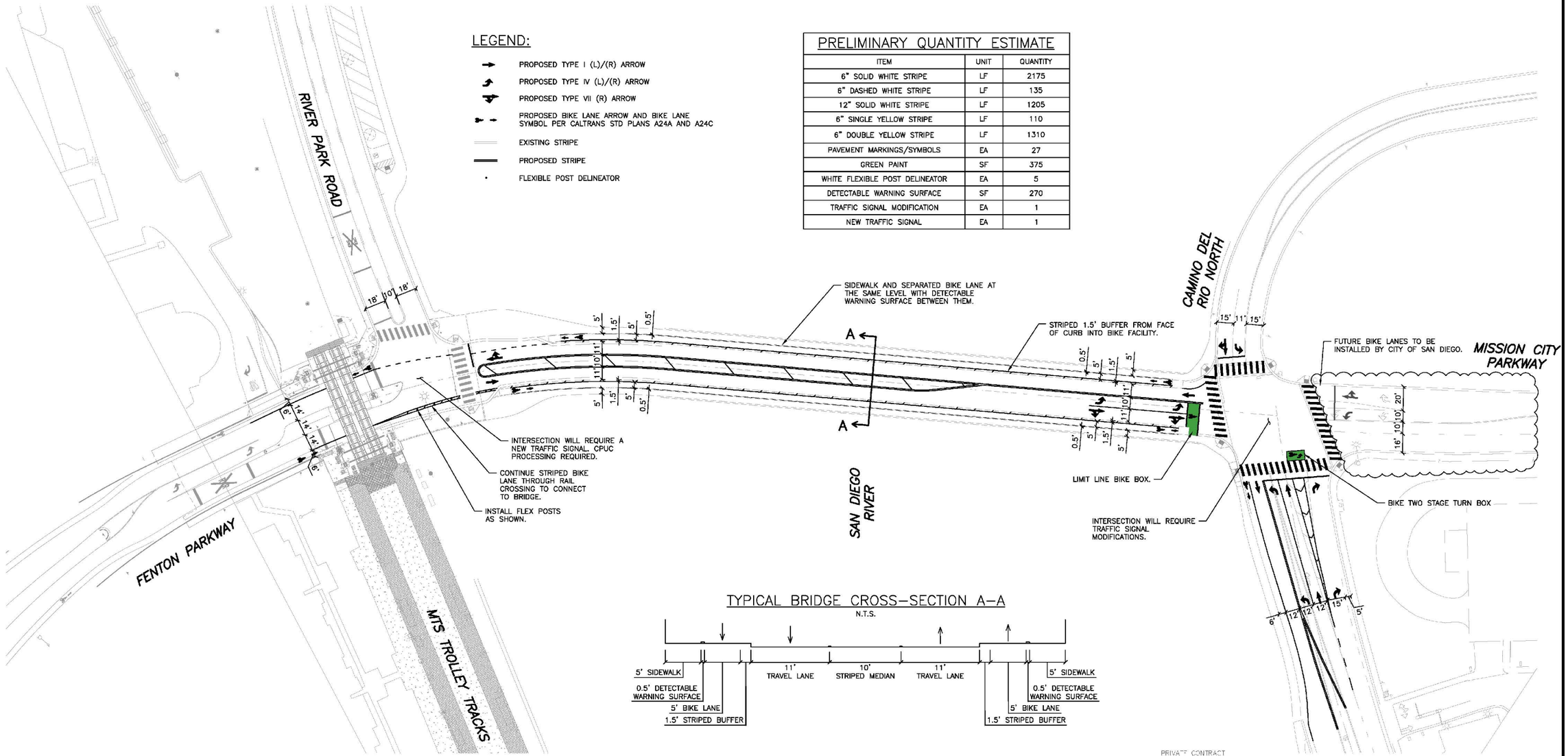
LEGEND:

- PROPOSED TYPE I (L)/(R) ARROW
- PROPOSED TYPE IV (L)/(R) ARROW
- PROPOSED TYPE VII (R) ARROW
- PROPOSED BIKE LANE ARROW AND BIKE LANE SYMBOL PER CALTRANS STD PLANS A24A AND A24C
- EXISTING STRIPE
- PROPOSED STRIPE
- FLEXIBLE POST DELINEATOR

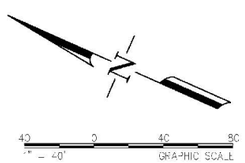
PRELIMINARY QUANTITY ESTIMATE

ITEM	UNIT	QUANTITY
6" SOLID WHITE STRIPE	LF	2175
6" DASHED WHITE STRIPE	LF	135
12" SOLID WHITE STRIPE	LF	1205
6" SINGLE YELLOW STRIPE	LF	110
6" DOUBLE YELLOW STRIPE	LF	1310
PAVEMENT MARKINGS/SYMBOLS	EA	27
GREEN PAINT	SF	375
WHITE FLEXIBLE POST DELINEATOR	EA	5
DETECTABLE WARNING SURFACE	SF	270
TRAFFIC SIGNAL MODIFICATION	EA	1
NEW TRAFFIC SIGNAL	EA	1



TYPICAL BRIDGE CROSS-SECTION A-A

N.T.S.



PRIVATE CONTRACT

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SIGNING AND STRIPING PLAN FOR:

FENTON PARKWAY BRIDGE OVER SAN DIEGO RIVER

FENTON PARKWAY BETWEEN RIVER PARK RD & CAMINO DEL RIO NORTH

DEVELOPMENT SERVICES DEPARTMENT
SHEET XX OF XX SHEETS

APPROVED:
FOR CITY ENGINEER DATE

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ORIGINAL	FP		

AS BUILTS

CONTRACTOR
INSPECTOR
DATE STARTED
DATE COMPLETED

PMT NO.
PRJ NO. XXXXXX
XXXX-XXXX NAD83 COORDINATES
XXX XXXX TAMERT COORDINATES
DRAWING NO. XXXXXX-XX-D CXX

FEHR & PEERS
555 West Beech Street, Suite 307 San Diego, CA 92101 (619) 294 3190

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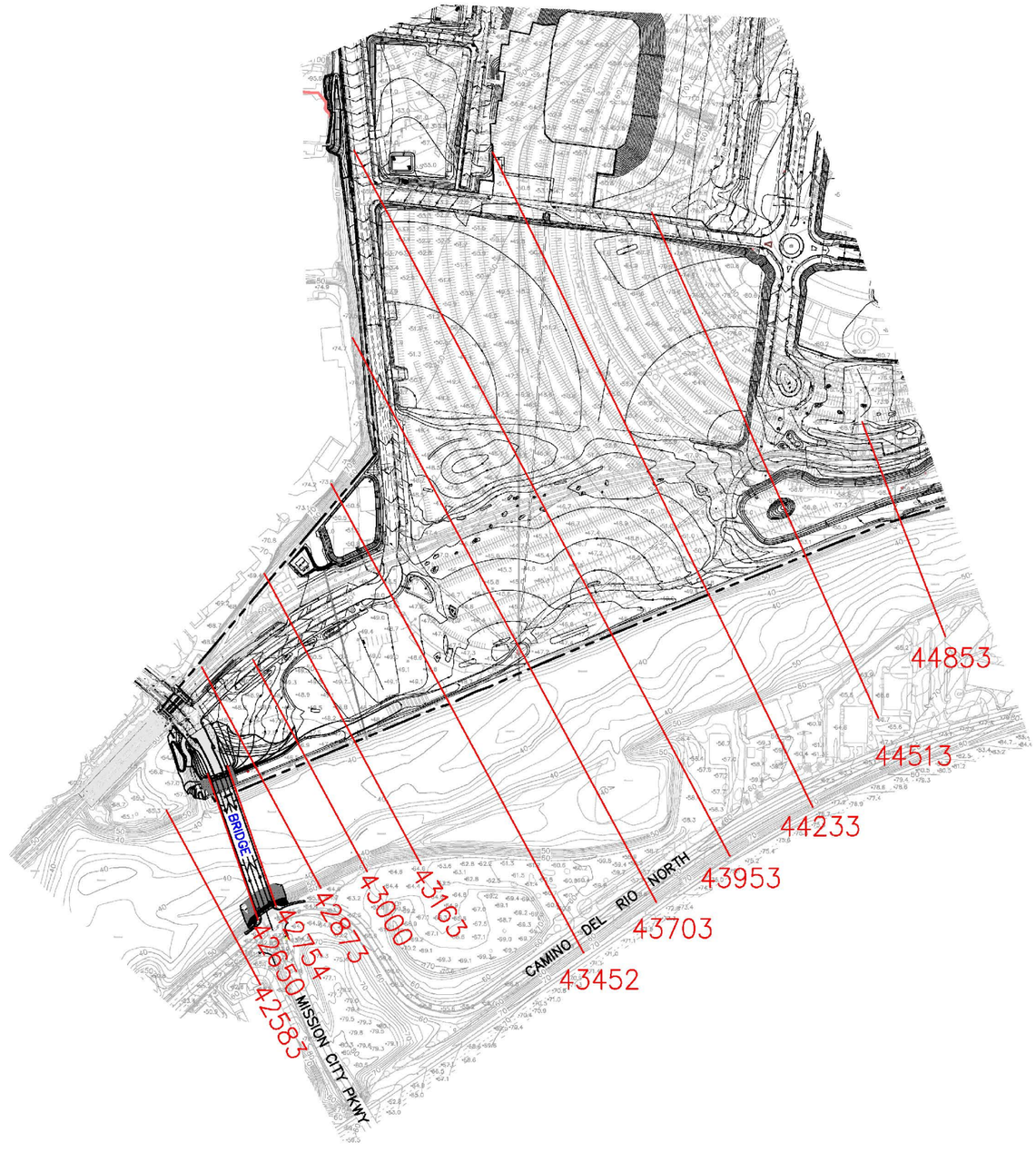

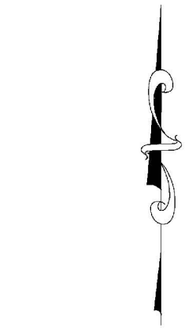

GRAPHIC SCALE

200 0 100 200 400 800

1 INCH = 200 FEET

HEC–RAS WORK MAP

FENTON PARKWAY BRIDGE