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Memorandum

Date: August 21, 2020

To: Rosa Griggs and Tim Osterkamp – Dokken Engineering

From: Han-Bin Liang and Wana Chiu – WRECO

Project: Matilija Dam Ecosystem Restoration Project

Subject: Hydraulic Assessment

INTRODUCTION

The Ventura County Watershed Protection District (District) is proposing the Matilija Dam Ecosystem Restoration Project. The Camino Cielo Bridge Replacement, which is part of the overall Matilija Dam Ecosystem Restoration Project, will be referred to as the Bridge Project. The current Ventura River structure at Camino Cielo Road is a low water crossing (see Photo 1). The Bridge Project proposes to replace the low water crossing with a two-span bridge that crosses Ventura River at an alignment upstream (northwest) of the low water crossing. The purpose of this *Memorandum* is to present the hydraulic modeling for the Bridge Project.

Photo 1. Camino Cielo Low Water Crossing Looking Upstream (February 26, 2019)
Source: WRECO

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GEOGRAPHIC SETTING

The existing low water crossing is located at 34°28'58.26" North latitude and 119°17'46.89" West longitude, and the Bridge Project is located approximately 1 mile (mi) downstream of Matilija Dam in Ventura County (see Figure 1). Matilija Lake is the impoundment formed by Matilija Dam. Matilija Creek flows in the easterly direction downstream of the dam for approximately 0.6 mi, roughly paralleling Matilija Hot Springs Road until its confluence with North Fork Matilija Creek. The two creeks form the Ventura River, which flows in the easterly direction approximately 0.3 mi before reaching the low water crossing at Camino Cielo Road. Ventura River flows in a southeast direction through the Bridge Project.

Figure 1. Bridge Project Location Map

Source: Google Earth

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VENTURA COUNTY FLOODPLAIN DATA

Typically, each county (or community) has a Flood Insurance Study (FIS), which is used to locally develop Flood Insurance Rate Maps (FIRM) and Base Flood Elevations (BFE). The flood profiles for Ventura River are included in FIS Number 06111CV004D (Federal Emergency Management Agency [FEMA] 2018a). Ventura County is a participating community in the National Flood Insurance Program (NFIP) and the Bridge Project is located within FIRM Map Number 06111C0560E (FEMA 2010). The Bridge Project is located in an area categorized by FEMA as Zone AE (see Figure 2), which represents an area that is subject to inundation by the 1-percent-chance flood event determined by detailed methods and where BFEs are shown. The BFE is depicted as 888 feet (ft) North American Vertical Datum of 1988 (NAVD 88) just upstream (northwest) of the existing low water crossing. The reach of Ventura River at the Bridge Project is also within a regulatory floodway.

FEMA DEFINITIONS AND STANDARDS

FEMA defines a regulatory floodway as:

> "the channel of a river or other watercourse and the adjacent land areas that must be reserved in order to discharge the base flood without cumulatively increasing the water surface elevation more than a designated height. Communities must regulate development in these floodways to ensure that there are no increases in upstream flood elevations." (FEMA 2020a)

According to Title 44, Section 60f.3(d)(3) of the Code of Federal Regulations (CFR), a community shall:

> "prohibit encroachments, including fill, new construction, substantial improvements, and other development within the adopted regulatory floodway unless it has been demonstrated through hydrologic and hydraulic analyses performed in accordance with standard engineering practice that the proposed encroachment would not result in any increase in flood levels within the community during the occurrence of the base flood discharge" (United States, Federal Emergency Management Agency, Department of Homeland Security 2019).

The community is responsible for reviewing and maintaining record of the documentation demonstrating that any permitted floodway encroachment meets NFIP requirements. A "no-rise certification" for floodways may be used to document the analyses. Per Title 44, Section 60.3(d)(4) of the CFR, floodway encroachments that cause an increase may be permitted, provided the community first applies for a conditional FIRM and floodway revision and fulfills the requirements for such revisions as established under the provisions of Title 44 Section 65.12 of the CFR and receives the approval of the Floodplain Administrator (United States, Federal Emergency Management Agency, Department of Homeland Security 2019).

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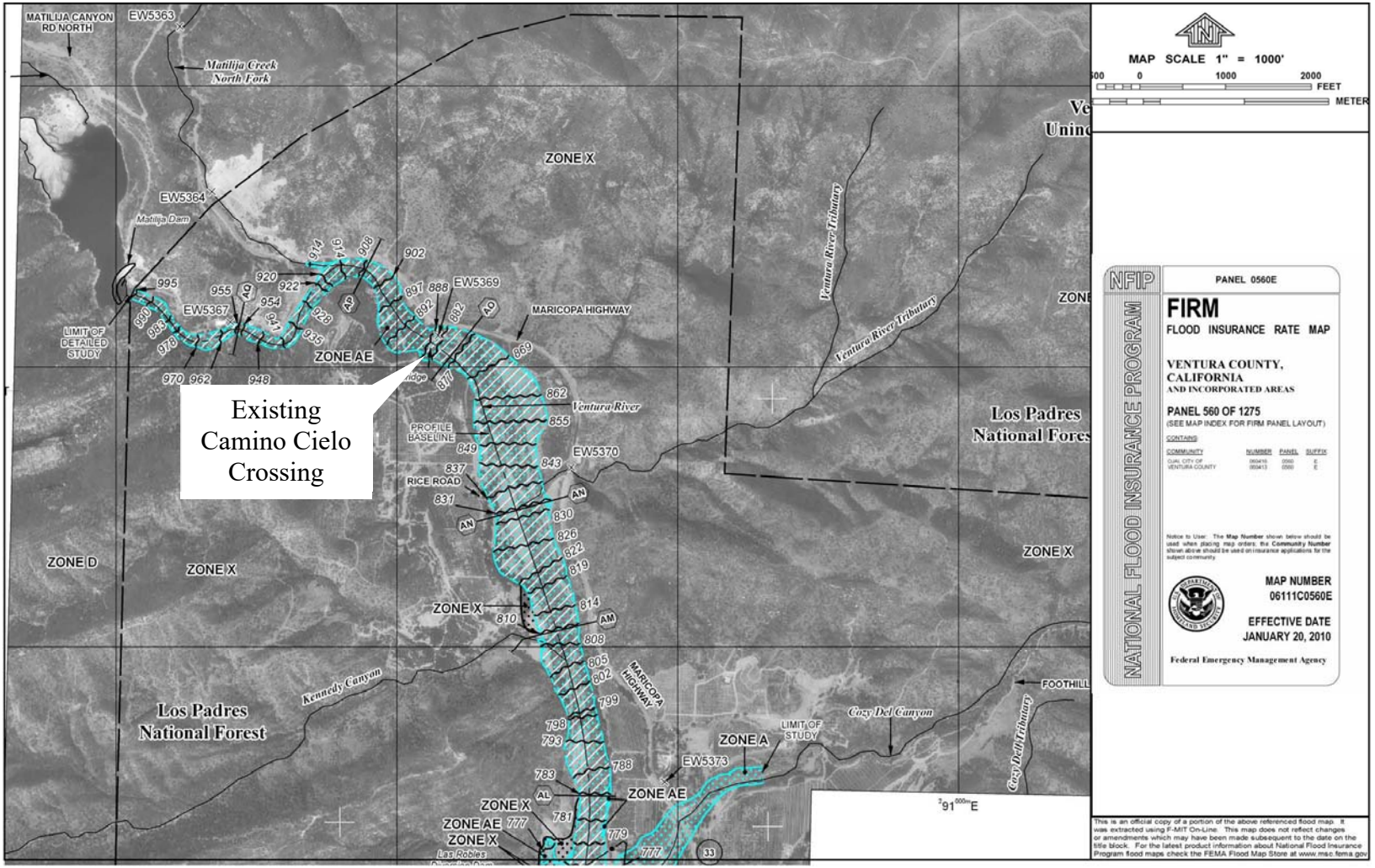

Figure 2. Floodplains within Bridge Project Vicinity

Source: FEMA 2010

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PREVIOUS STUDIES

Previous hydrologic, hydraulic, and sediment studies were performed by AECOM and Stillwater Sciences as part of a Bureau of Reclamation (BOR) project. The BOR project covered the entire Ventura River watershed from Matilija Dam to the Pacific Ocean. The Bridge Project is located within this BOR project. For the BOR project, Stillwater Sciences developed the hydrologic and hydraulic models of the Ventura River for AECOM (Stillwater Sciences 2020).

HYDROLOGIC SUMMARY

Peak flows were estimated in the BOR project using gaging station data. The BOR project presented peak flows for various return periods at six locations. The peak flows associated with the reach of the Ventura River applicable to the Bridge Project are presented in Table 1.

Table 1. Peak Flows from Stillwater Sciences

Return Period (year)	Peak Flow (cubic feet per second [cfs])
100-year	27,100
50-year	24,000

Source: Stillwater Sciences

FEMA also presents peak flows for Ventura River for various return periods and locations within Ventura County. The peak flows associated with the reach of the Ventura River applicable to the Bridge Project are presented in Table 2. These peak flows are presented in the effective FIS for Ventura County (FEMA 2018b). There is also a preliminary FIS for Ventura County (FEMA 2020b), which lists the same peak flows for Ventura River as those listed in the effective FIS.

Table 2. Peak Flows from FEMA

Return Period (year)	Peak Flow (cfs)
100-year	34,500
50-year	30,000

Source: FEMA 2018b and FEMA 2020b

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HYDRAULIC ASSESSMENT

The hydraulic analyses were performed for the existing and proposed conditions using the United States Army Corps of Engineers' (USACE) Hydrologic Engineering Center's River Analysis System (HEC-RAS) modeling software version 5.0.7 (2019).

The proposed bridge alignment was originally considered to be at different locations along the stream reach: approximately 0.2 mi upstream and 0.4 mi downstream of the current low water crossing. The current alignment alternative is located just upstream of the low water crossing (see Figure 3).

A HEC-RAS model was prepared by Stillwater Sciences as part of the BOR project, which covered the entire Ventura River watershed from Matilija Dam to the Pacific Ocean. The HEC-RAS model utilized Light Detection and Ranging (LiDAR) from 2005. WRECO updated the cross section data using a combined 2018 LiDAR with survey cross section data in the vicinity of the Bridge Project provided by Guida Surveying (2020), and also added new cross sections in the vicinity of the new alignment. The elevation data referenced NAVD 88. The HEC-RAS model for the Bridge Project encompasses a reach along the Ventura River approximately 1.8-mi-long starting upstream at the Matilija Dam.

The results of the hydraulic model prepared for the Bridge Project indicate an increase in the design flow water surface elevations from the pre-Bridge Project to post-Bridge Project conditions. Figure 4 shows the study reach water surface profile along the Ventura River for the 100-year FEMA flow. The other flow profiles (50-year FEMA, 100-year Stillwater Sciences, and 50-year Stillwater Sciences flows) result in similar results: increases in the design flow water surface profile from the pre-Bridge Project to post-Bridge Project condition. The increases in water surface elevations are attributed to the fill in the floodplain due to the new bridge structure. The water surface elevations along the study reach are presented in Table 3 through Table 6. Note, the FEMA FIS shows a water surface elevation of 888 ft NAVD 88 just upstream of the low water crossing, which is approximately 2 ft higher than the results of the hydraulic model for the pre-Bridge Project conditions.

The maximum increase in water surface elevation occurred at River Station 15.385, which is approximately 100 ft upstream of the existing low water crossing and 20 ft upstream of the proposed bridge (see Table 7).

The cross sections at the upstream faces of the structures are shown in Figure 5 for the pre-Bridge Project existing low water crossing and Figure 6 for the post-Bridge Project proposed bridge. The low water crossing is overtopped during the evaluated design storm events. The proposed bridge would not be overtopped during the evaluated design storm events, but the bridge would undergo pressure flow conditions because soffit of the bridge would be below the design storm events.

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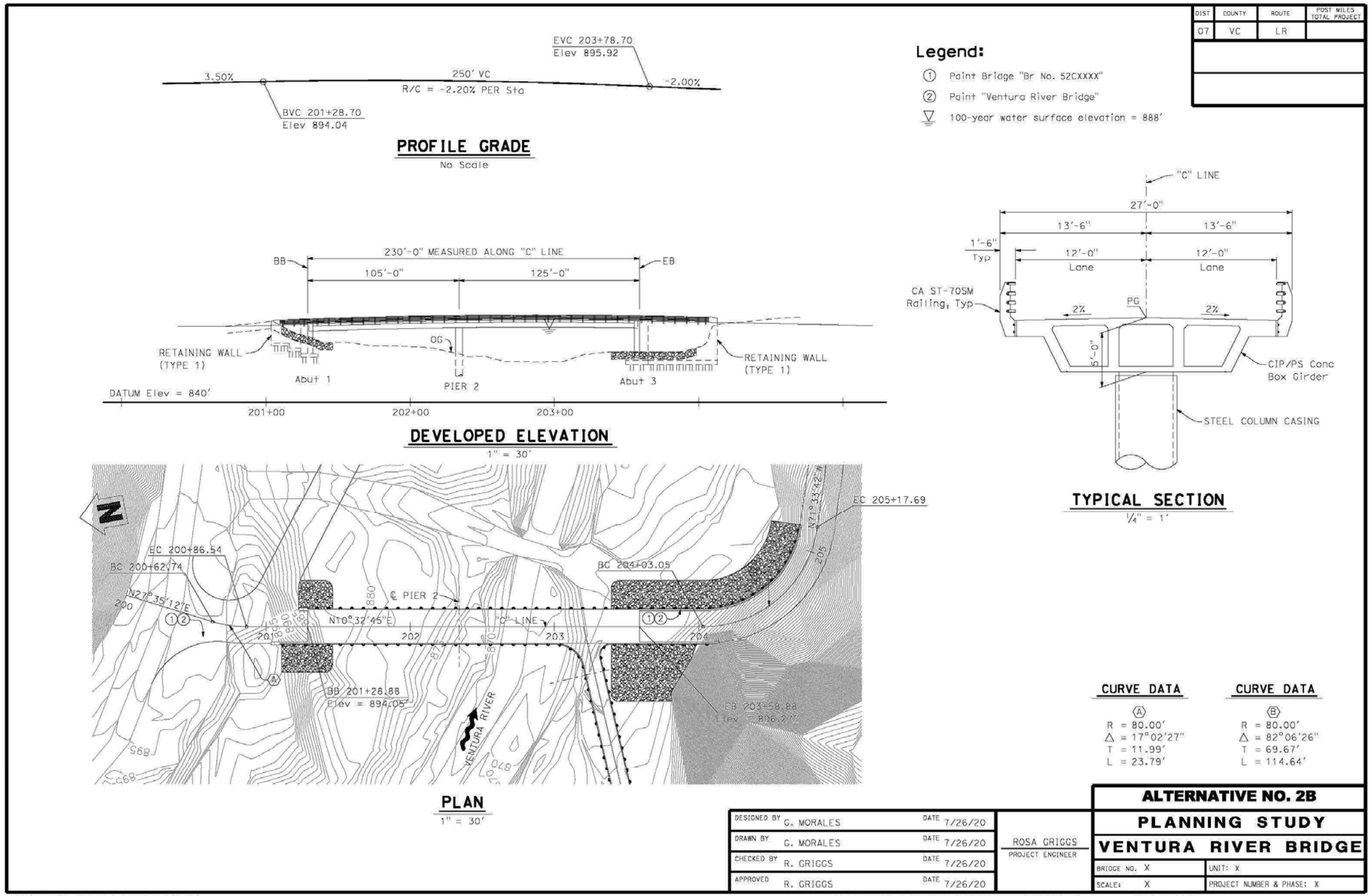

Figure 3. Proposed Bridge Planning Study

Source: Dokken Engineering 2020

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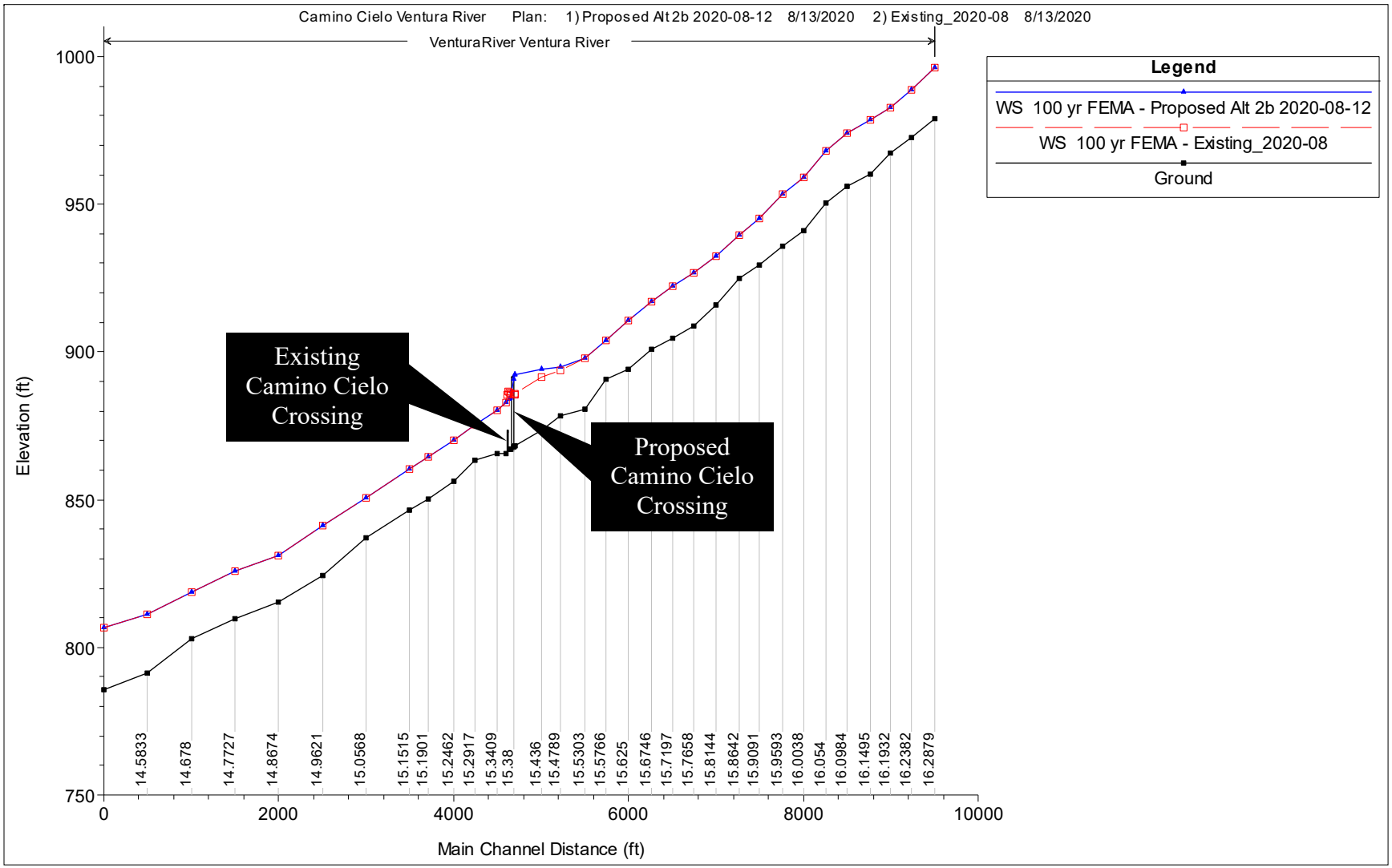

Figure 4. 100-year FEMA Flow Water Surface Profile Comparison

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Table 3. 100-Year FEMA Flow Water Surface Comparison

River Station	Description/Distance from Existing Structure Centerline	Water Surface Elevation (ft NAVD 88)	
		Existing	Proposed
15.5766	0.2 mi upstream	904.0	904.0
15.5303	0.2 mi upstream	897.7	897.8
15.4789	0.1 mi upstream	893.6	895.0
15.436	0.1 mi upstream	891.6	894.2
15.386	107 ft upstream	885.7	892.1
15.385	101 ft upstream	885.5	892.2
15.38 BR U	Upstream proposed bridge	--	890.8
15.38 BR D	Downstream proposed bridge	--	886.7
15.37	22 ft upstream	886.0	884.6
15.3675	9 ft upstream	886.3	884.0
15.3658 BR U	Upstream low water crossing	886.5	--
15.3658 BR D	Downstream low water crossing	885.6	--
15.3591	35 ft downstream	882.8	882.8

Table 4. 50-Year FEMA Flow Water Surface Comparison

River Station	Description/Distance from Existing Structure Centerline	Water Surface Elevation (ft NAVD 88)	
		Existing	Proposed
15.5766	0.2 mi upstream	903.0	903.0
15.5303	0.2 mi upstream	896.9	896.8
15.4789	0.1 mi upstream	892.5	893.6
15.436	0.1 mi upstream	890.3	892.5
15.386	107 ft upstream	885.0	890.6
15.385	101 ft upstream	884.9	890.7
15.38 BR U	Upstream proposed bridge	--	889.9
15.38 BR D	Downstream proposed bridge	--	885.7
15.37	22 ft upstream	885.1	883.7
15.3675	9 ft upstream	885.3	883.3
15.3658 BR U	Upstream low water crossing	885.5	--
15.3658 BR D	Downstream low water crossing	884.2	--
15.3591	35 ft downstream	881.9	881.9

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Table 5. 100-Year Stillwater Sciences Flow Water Surface Comparison

River Station	Description/Distance from Existing Structure Centerline	Water Surface Elevation (ft NAVD 88)	
		Existing	Proposed
15.5766	0.2 mi upstream	902.3	902.3
15.5303	0.2 mi upstream	896.3	896.2
15.4789	0.1 mi upstream	891.8	892.7
15.436	0.1 mi upstream	889.3	891.4
15.386	107 ft upstream	884.5	889.6
15.385	101 ft upstream	884.5	889.7
15.38 BR U	Upstream proposed bridge	--	889.1
15.38 BR D	Downstream proposed bridge	--	885.0
15.37	22 ft upstream	884.5	883.2
15.3675	9 ft upstream	884.8	882.7
15.3658 BR U	Upstream low water crossing	884.9	--
15.3658 BR D	Downstream low water crossing	883.3	--
15.3591	35 ft downstream	881.0	881.0

Table 6. 50-Year Stillwater Sciences Flow Water Surface Comparison

River Station	Description/Distance from Existing Structure Centerline	Water Surface Elevation (ft NAVD 88)	
		Existing	Proposed
15.5766	0.2 mi upstream	901.6	901.6
15.5303	0.2 mi upstream	895.7	895.5
15.4789	0.1 mi upstream	890.9	891.7
15.436	0.1 mi upstream	888.2	890.3
15.386	107 ft upstream	884.3	888.5
15.385	101 ft upstream	884.2	888.6
15.38 BR U	Upstream proposed bridge	--	888.1
15.38 BR D	Downstream proposed bridge	--	884.1
15.37	22 ft upstream	884.2	882.5
15.3675	9 ft upstream	884.4	882.1
15.3658 BR U	Upstream low water crossing	884.5	--
15.3658 BR D	Downstream low water crossing	881.8	--
15.3591	35 ft downstream	880.4	880.4

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Table 7. Maximum Increase in Water Surface Elevation

Design Flow	Water Surface Elevation (ft NAVD 88)		Increase in Water Surface Elevation (ft)
	Existing	Proposed	
100-Year FEMA	885.5	892.2	6.8
50-Year FEMA	884.9	890.7	5.8
100-Year Stillwater Sciences	884.5	889.7	5.1
50-Year Stillwater Sciences	884.2	888.6	4.3

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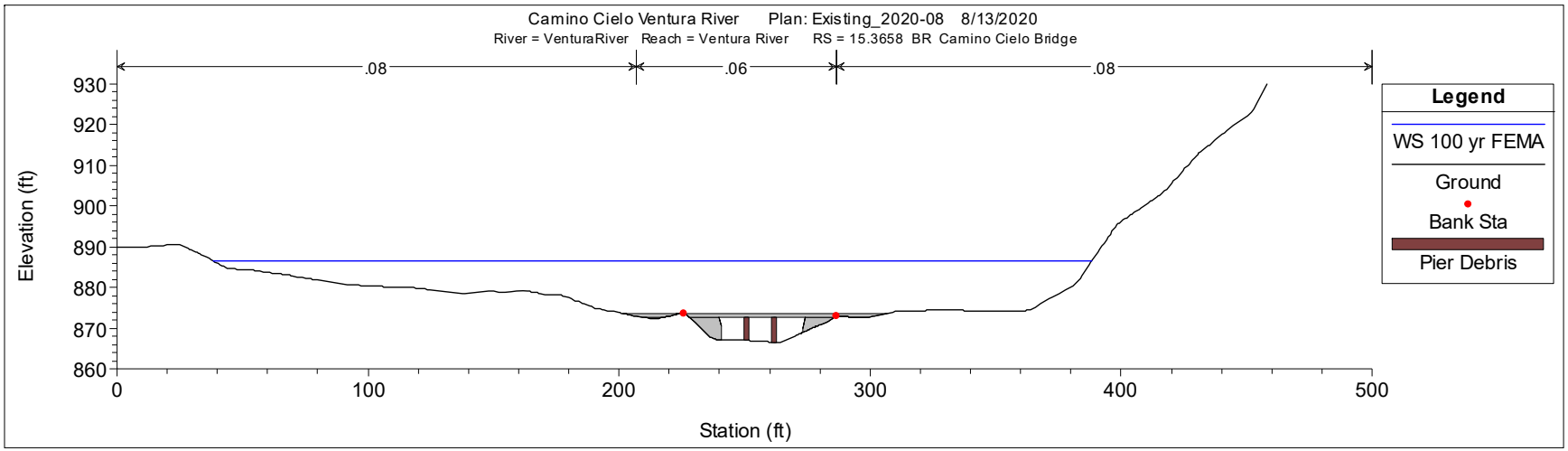

Figure 5. Pre-Bridge Project (Existing Low Water Crossing) Cross Section

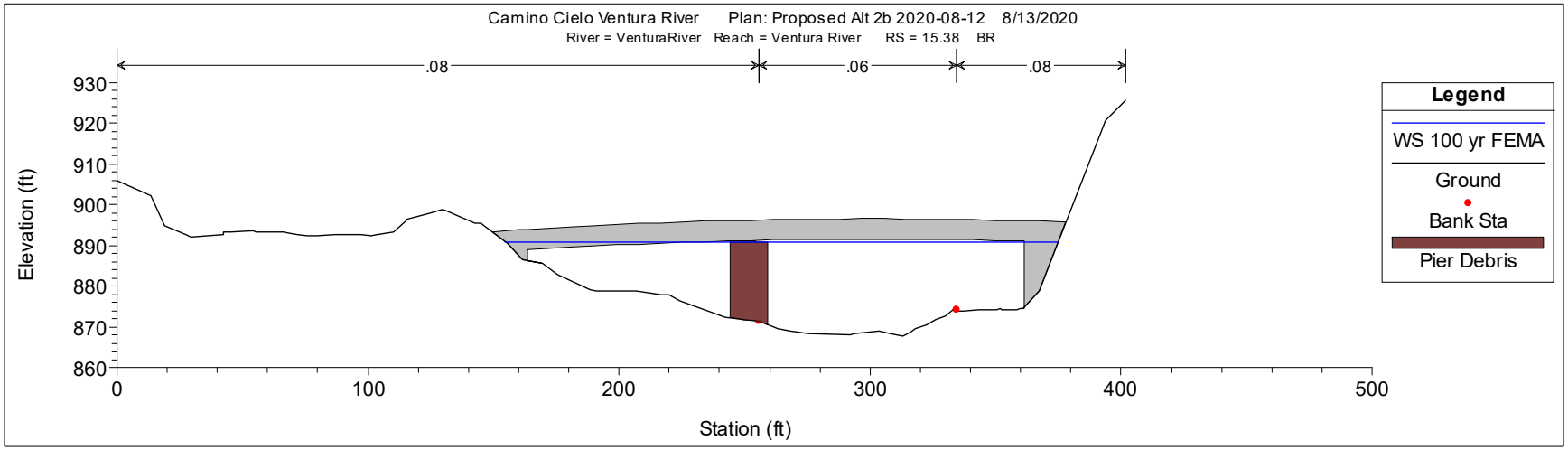

Figure 6. Post-Bridge Project (Proposed Bridge) Cross Section

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CONCLUSION

Based on the results of the HEC-RAS analysis, the post-Bridge Project condition would result in an increase in water surface elevations for the evaluated design storm events (see Table 7). Because the Bridge Project would result in increases in the water surface elevation for the 100-year storm event, the County of Ventura would need to apply for a conditional FIRM and floodway revision, and would need the approval of the Floodplain Administrator per Title 44 Sections 60.3(d)(4) and 65.12 of the CFR.

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