



M E M O R A N D U M

DATE: July 30, 2026

TO: Tennessee Department of Transportation

FROM: Gresham Smith

RE: TDOT Timber Bridge Bundle #2 – Bridge 20 (PIN: 137109.05) Hydraulic Summary

CC: Steve Sellers – Tennessee Department of Transportation
Derek Link – Tennessee Department of Transportation
David Flanders – HNTB
File

This memo presents the preliminary hydraulic modeling analysis findings for TDOT Timber Bridge Bundle #2 Contract DB2601, Bridge 20 (SR 196 over Cyprus Creek Tributary B, PIN: 137109.05). This portion of Cyprus Creek Tributary B is classified as a FEMA designated stream featuring an AE floodplain and an associated floodway, as identified on FEMA Flood Insurance Rate Map (FIRM) panel 47047C0290C, effective November 5, 2008. The goal of the analysis was to determine the approximate hydraulic impacts of performing a bridge replacement. All geometric structure data utilized in the modeling originated from the Bridge Concept Report unless noted otherwise.

Modeling Methodology: The hydraulic modeling is in accordance with the 2012 Design Procedures for Hydraulic Structures, consisting of Tennessee Hydraulics Memorandum (THM)-01 through THM-10. The modeling was conducted using Aquaveo SRH-2D within the SMS platform which allowed detailed simulation of flow and hydraulic conditions. Discharges were obtained from StreamStats mean discharge data and adjusted to make the upstream WSEL match more closely to FEMA XS D. The downstream boundary conditions were set to FEMA XS letter C's WSEL on the FIS Report. Site topography was based on field survey, and where available, Tennessee USGS 2015 LiDAR. Superstructure elevations were recorded from field survey data.

Existing Conditions: The existing structure was modeled as a four-span bridge with span lengths of 28.5 ft, 28.5 ft, 28.5 ft, and 28.5 ft, for an overall structure length of 115 ft and a clear span of 113 ft between front faces of the piles at the abutments. The structure was modeled with an out-to-out width of 25.25 ft. The piers consist of timber caps on piles with dimensions of 12"x14" for the caps and 12" diameter for the piles. The structure depth was modeled at 1.64 ft, measured from profile grade to the bottom of beam. The downstream boundary condition for the 2D model was set as a fixed water surface elevation of 326.7 feet, matching the FEMA Published Cross Section Letter C. This stage boundary ensures the model's hydraulic grade line aligns with the FEMA flood profile, allowing accurate upstream flow adjustments and maintaining consistency with regulatory floodplain mapping.

Natural Conditions: The natural conditions were modeled by duplicating the existing terrain, removing SR 196, and removing the existing structure to simulate the floodplain without the influence of the roadway and structural components.

Proposed Conditions: The proposed structure was modeled as a three-span bridge with a structure depth of 3.38 ft and a total length of 128 ft. The structure was modeled with a clear span of 122 ft and 3 ft wide abutments. The proposed roadway profile was increased 2.04 ft compared to existing condition. The structure depth is a deviation from the concept report and utilizes 27"x36" box beams instead of 28" box beams as the concept report proposed. Given the 128 ft total structure length, a box beam configuration can provide adequate strength and serviceability while also providing the necessary clearance as discussed below with the 2.04' proposed grade raise. The out-to-out bridge width was modeled as 31.25 ft. The model shows minor grading at the ends of the bridge to accommodate the longer bridge in the concept design. The hydraulic model represents clean conditions and does not account for debris accumulation or blockage within the bridge opening.

Hydraulic Summary: The proposed structure results in a backwater of 1.36 ft, which does exceed TDOT's recommended 1 ft maximum per THM-03. The proposed structure has decreased velocities compared to the existing and has a clearance of 4.48 ft above the proposed 50-year water surface elevation, which satisfies the 1' minimum TDOT requirement.



Hydraulic Summary Table

	Natural	Existing	Proposed
Drainage Area		3.95 mi ²	
Design Discharge (50 Year)		3,488 cfs	
Span Arrangement	-	28.5'-28.5'-28.5'-28.5'	29'-70'-29'
Structure Depth	-	1.64'	3.38'
Out-to-Out Width	-	25.25'	31.25'
Finish Grade Elevation at Sta. 113+32.78	-	337.93'	339.97'
Low Girder Elevation at Sta. 113+32.78	-	336.29'	336.59'
Profile Grade Increase	-	-	2.04'
50 Year WSEL Under Bridge	-	332.30'	332.11'
50 Year Clearance Under Bridge	-	3.99'	4.48'
50 year WSEL-Upstream Face	333.08'	334.60'	334.44'
100 year WSEL-Upstream Face	333.24'	334.99'	334.84'
50 year Freeboard at Upstream Face	-	1.69'	2.15'
Water Area Provided Below 50 yr WSEL	-	522.66 ft ²	568.94 ft ²
50 Year Velocity	3.59 fps	6.40 fps	5.56 fps
50 Year Bridge Backwater	-	1.52 ft @ El. 334.60'	1.36 ft @ El. 334.44'
100 Year Discharge		3,921.5 cfs	
Roadway Overtopping El.	-	337.32'	338.94'

Note: Elevations provided are in feet in the NAVD88 vertical datum.