Dillon County S-17-45 (Lester Rd) over Little Pee Dee River (Main), Little Pee Dee Swamp Washout (Relief Bridge) and Little Pee Dee Swamp Overflow (Relief Bridge) Replacements:

The 555 square mile drainage area of the Little Pee Dee River crosses S-17-45 via three bridges: one main and two reliefs. The Main, Washout Relief and Overflow Relief bridges are to be replaced as per scope identified for the project.

The Main bridge is intact but is in close proximity to the Washout Relief bridge and hence is required to be replaced. The proposed Minimum Roadway Centerline Finished Grade elevation of 81.6' raised bridges by 2.8' and hence necessitated the replacement of Overflow Bridge to tie in with the existing roadway.

Alex Weaver conducted the hydrologic analysis and determined the discharge values utilizing a stream gage located upstream at SC-9. The discharges were estimated using PEAKFQ software.

The HDS7 and HEC-RAS identifies that wide floodplains with multiple openings and meandering channels should be modelled utilizing 2D bridge hydraulic analysis approaches. However, due to time and cost constraints theses bridges were analyzed using simplistic and approximate HEC-RAS 1D steady flow multiple opening analysis approach.

The site visit conducted on 1/17/2017 by Anjana Sidhu, Alex Weaver and Stan Roof determined the manning's roughness coefficients for the main channel, creeks and floodplain. The lengths and span arrangements of existing 150' (10@15') main, 90' (6@15') washout relief and 60' (4@15') overflow relief bridges were confirmed. In addition, tape down measures from the bridges were taken to determine the ground profiles along the north and south end of the bridges. There is significant debris found within the channels and floodplains due to the October 2016 flood.

The old plans for the bridges are not available. The main bridge over the Little Pee Dee River has channel meandering at the bridge site location. The bridge skew angle is approximately 35^0 with the direction of the flow; however the floodplain is aligned with the bridge and has no skew. Hence no skew angle was considered for the main bridge. The existing main, washout relief and overflow relief bridges need to be raised by 2.8' to meet the current freeboard requirements.

Existing Conditions (High Flow Analysis Energy vs Pressure and Weir Method)

The analysis showed that under existing conditions the bridges do not pass 100-year discharge. However, since Y_3/Z is less than 1.1 and there is no overtopping flow, energy method is more appropriate for High flow conditions compared to Pressure and Weir Flow. The comparison of two analyses showed that energy method was providing conservative results and hence was utilized.

Proposed Conditions (High Flow Analysis Energy vs Pressure and Weir Method)

The analysis showed that under proposed conditions the bridges do not pass 500-year discharge. Since, we are required to compare analyses for 100-year for backwater comparison the energy method and pressure weir both had similar results. Hence Energy Method was utilized to determine the water surface elevations for the proposed conditions.

Proposed Bridge Span Arrangements:

The ITMS showed that the Future AADT in Year 2035 for these bridges on S-17-45 is 1536 which is less than 3000 vehicles per day. Therefore, both Cored slab and Flat slab bridge span arrangements are viable options for S-17-45 bridges and were examined as discussed below.

Option 1: Cored Slab

In order to minimize impacts to the channel and to avoid placing piers in the channel 60' and 70' Cored Slab span arrangements for main and washout relief bridges were explored. The proposed main Cored Slab bridge is 210' (3@70'), washout relief Cored Slab bridge is 180' (3@60') and overflow relief Cored Slab bridge is 70' (1@70') long.

The proposed Cored Slab bridges with low steel elevation of 79.4' will have Minimum Roadway Centerline Finished Grade Elevation of 82.1'

Option 2: Flat Slab

The proposed Flat Slab main bridge is 180' (6@30'), washout relief bridge is 120' (3@40') and overflow relief bridge is 90' (3@30') long. The proposed bridge width is 44', Minimum Roadway Centerline Finished Grade elevation is 81.6' and minimum low steel elevation is 79.40'.

Recommendation

The comparison shows that Cored Slab bridges are longer in length than the Flat Slab bridges. Since the superstructure depth for Cored Slab is greater than the Flat Slab, the calculated Minimum Roadway Centerline Finished grade elevation is higher for Cored Slab bridges. Hence the Flat Slab bridges would require to be raised by 2.8' and Cored Slab bridges would need 3.4' to meet requirements. The comparison shows that the Flat Slab Bridge Span arrangement is a better option and is hence recommended.

The proposed S-17-45 main (180'), washout relief (120') and overflow relief (90') bridges are Flat Slab with 20" pier widths. The HEC-RAS analysis showed that the bridge would cause backwater of 0.16' for 25-year and 0.24' for 100-year and hence meets the criteria.

The convergence criteria, for the proposed bridges were utilized for water surface elevation varying in increments of 1' from the normal water surface elevations for 25-year and 100-year discharges. The downstream cross section is located approximately at 3.5 miles from the proposed bridge site. The downstream S-22 Bridge is located 0.5 miles from the downstream cross section. In order to minimize impact of backwater from S-22 Bridge the last cross section location was finalized.