



Memo

Project: SCDOT CLRB Package 21

Subject: Preliminary Hydraulic Analysis

Route: Road S-37-51 (Snow Creek Rd.) Bridge over Snow Creek (Asset ID 1892)

Date: March 25, 2025

To: SCDOT

McCormick Taylor is providing preliminary hydrologic and hydraulic assessment of the Snow Creek Bridge Replacement along Road S-37-51 (Snow Creek Rd.) in Oconee County, South Carolina. Snow Creek Road in the vicinity of Snow Creek is designated as a Secondary Route and provides access to residential and rural areas. The Flood Insurance Study (FIS) for Oconee County and Flood Insurance Rate Map (FIRM) Panel No. 45073C0430C (attached) indicates the project is located in a Special Flood Hazard Area Zone AE without regulatory floodway.

Model Setup:

A HEC-RAS model provided by the SCDOT was used for the existing conditions and unrestricted conditions of Snow Creek. The model extends approximately 4,300 feet downstream and approximately 500 feet upstream of the bridge. The main channel roughness was assumed to be $n=0.04$. Manning's roughness in the floodplain was determined to be 0.11 from the FEMA model.

The USGS Rural and Urban regression equations using the StreamStats web application was used to estimate flow rates for a drainage area of 4.48 square miles at the bridge. The SCS Unit Hydrograph method was used to develop the watershed flows using land cover and soils data from the NLCD and USDA, respectively, to compare with the USGS flow rates. The flows used for this analysis are shown in Table 1.

Table 1: Comparison of flows

Design Event (% AEP)	FEMA Effective (cfs)	SCS Unit Hydrograph (cfs)	USGS StreamStats (cfs)
2 YR (50% AEP)	-	304	393
10 YR (10% AEP)	-	838	920
25 YR (4% AEP)	-	1,263	1,230
50 YR (2% AEP)	-	1,691	1,510
100 YR (1% AEP)	1,341	2,140	1,790
500 YR (0.2% AEP)	-	-	2,440

The USGS flows were used for the analysis.

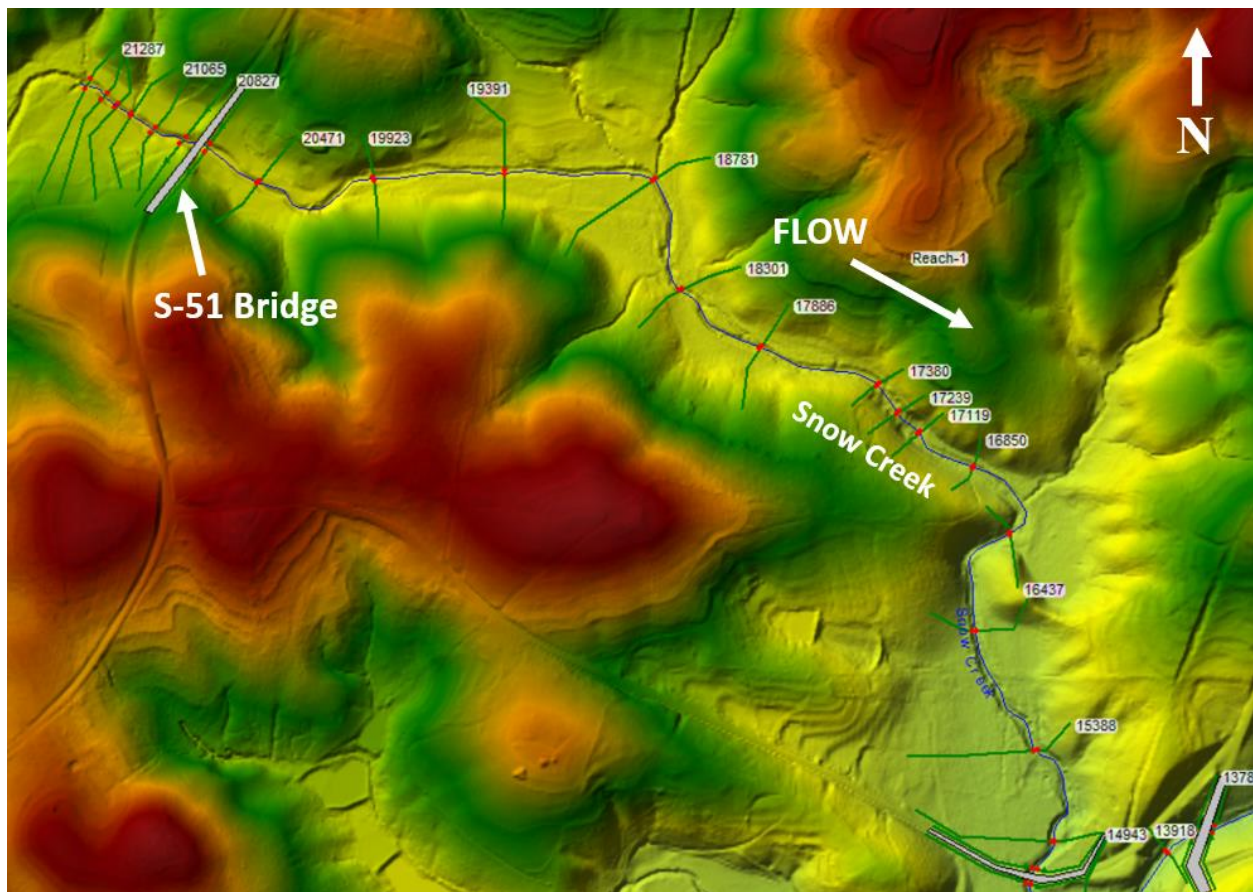


Figure 1: Snow Creek model layout (S-37-51)

Design Criteria:

Snow Creek Rd. is classified as a secondary route. Secondary route crossings should be designed based on the 25-year design event as indicated in the *SCDOT Requirements for Hydraulic Design Studies*. Based on the Flood Insurance Study (FIS) for Fairfield County and Flood Insurance Rate Map (FIRM) Panel No. 45073C0430C the project is located in a Special Flood Hazard Area Zone AE without regulatory floodway. The bridge will therefore be designed based on the following criteria:

1. The minimum low chord elevation shall be the 25-year (4% AEP) water surface elevation plus 2-ft of freeboard.
2. The 100-year (1% AEP) should not overtop, while maintaining free-surface flow.
3. The backwater for the 100-year (1% AEP) design event is one (1) foot or less when compared to the unrestricted or natural conditions.
4. The proposed bridge should not create more backwater than the existing bridge.

It is preferred by the SCDOT that all structures and roadway components meet the requirements for a finding of “No Impact”. The S-51 bridge over Snow Creek is located within a FEMA Flood Zone AE without floodway. Thus there can be no increase in the 1% AEP flood profile at published and unpublished cross sections.

Model Summary:

The preliminary bridge analysis was performed using an existing effective FEMA model. A “Corrected Effective” geometry was created to reflect existing conditions around the S-51 crossing. The following changes were made to the FEMA model for this analysis:

1. The bridge geometry was updated based on project survey and existing plans.
2. Bridge internal cross section data was updated to reflect project survey.
3. The Snow Creek reach was extended upstream to allow for proper upstream analysis.
4. Added additional cross sections at RS 20956, 21134, 21199, and 21287

Existing Bridge Analysis:

The existing bridge consists of three (3) 30 ft spans for a total bridge length of 90 ft. The bridge had a breadth of 25.9 ft and a deck thickness of 2.6 ft, supported by 1 ft diameter timber piers. Ineffective flows upstream and downstream of the proposed bridge were set based on assumed 1.5:1 expansion and 1:1 contraction ratio.

The existing roadway profile was extracted from surveys provided by SCDOT. Based on the project surveys and existing bridge plans, the existing bridge low chord was estimated as 795.36.

Preliminary Bridge Analysis:

A two-span bridge with total length of 140 ft is proposed consisting of a 100 ft box beam span across the main channel (Span B) and a cored slab span of 40 ft (Span A). The

preliminary bridge has a width of 36 ft and the low chord was set to an elevation of 803.00. The Road S-37-51 crossing is located at RS 20765.

Ineffective flows upstream and downstream of the proposed bridge were set based on assumed 1.5:1 expansion and 1:1 contraction ratios and sloping abutments were added.

Table 3 shows the resulting water surface elevations in the project area for the existing and preliminary bridge for the 25-year (4% AEP) event.

The resulting water surface elevation upstream of the bridge was used to check the required minimum bridge low chord elevation for the preliminary bridge vs the existing low chord elevation.

Existing minimum low chord (795.36) > 788.33 + 2.0 ft F.B.

Proposed minimum low chord (803.00) > 788.18 + 2.0 ft F.B.

In addition to the freeboard requirement, the *SCDOT Requirements for Hydraulic Design Studies* states that the proposed bridge must not be subject to pressurized flow for the 100-year design event and produce less than 1' of backwater over natural (unrestricted) conditions. The resulting water surface elevations along the stream are presented in Table 4.

Table 3: 25-year design event water surface elevations

25-Year (4% AEP) Design Event			
RS	Existing 90' Bridge WSE (ft)	Preliminary 140' Bridge WSE (ft)	Difference (ft)
21287	790.54	790.47	-0.07
21199	790.16	790.06	-0.10
21134	789.79	789.66	-0.13
21065	788.55	788.16	-0.39
20956	788.52	788.38	-0.14
20827	788.33	788.18	-0.15
Road S-37-51			
20722	787.74	787.74	0.00
20471	786.26	786.26	0.00
19923	783.37	783.37	0.00
19391	779.54	779.54	0.00
18781	775.39	775.39	0.00
18301	772.44	772.44	0.00
17886	769.21	769.21	0.00
17380	763.26	763.26	0.00
17239	757.32	757.32	0.00
17119	746.78	746.78	0.00
16850	742.90	742.90	0.00
16437	737.69	737.69	0.00

Table 4: 100-year water surface elevations and backwater comparison

100-Year (1% AEP) Design Event					
RS	Natural WSE (ft)	Existing 90' Bridge WSE (ft)	Existing Backwater (ft)	Preliminary 140' Bridge WSE (ft)	Preliminary Backwater (ft)
21287	791.82	791.82	+0.00	791.82	+0.00
21199	791.52	791.52	+0.00	791.52	+0.00
21134	791.31	791.31	+0.00	791.31	+0.00
21065	790.12	790.12	+0.00	790.12	+0.00
20956	789.10	789.55	+0.45	789.46	+0.36
20827	788.87	789.30	+0.43	789.20	+0.33
Road S-37-51					
20722	788.58	788.60	+0.02	788.60	+0.02
20471	787.63	787.63	+0.00	787.63	+0.00
19923	784.38	784.38	+0.00	784.38	+0.00
19391	780.12	780.12	+0.00	780.12	+0.00
18781	776.77	776.77	+0.00	776.77	+0.00
18301	773.55	773.55	+0.00	773.55	+0.00
17886	770.55	770.55	+0.00	770.55	+0.00
17380	764.85	764.85	+0.00	764.85	+0.00
17239	758.47	758.47	+0.00	758.47	+0.00
17119	747.94	747.94	+0.00	747.94	+0.00
16850	744.73	744.73	+0.00	744.73	+0.00
16437	739.21	739.21	+0.00	739.21	+0.00

Since the S-37-51 bridge is located within a FEMA Flood Zone AE without regulatory floodway, to meet the FEMA "No Impact" criteria there cannot be an increase in the 1% AEP flood profiles. The preliminary study found there was no increase in the water surface elevation for the 1% AEP flood profile at published and unpublished cross sections. The FEMA floodplain analysis is summarized in Table 5. The existing and proposed 100-year backwater along with the low chord criteria checks are summarized in Table 6.

Table 5: FEMA 100-year design event water surface elevations

FEMA 100-Year (1% AEP) Design Event			
RS	Existing 90' Bridge WSE (ft)	Preliminary 140' Bridge WSE (ft)	Difference (ft)
21287	790.90	790.85	-0.05
21199	790.53	790.48	-0.05
21134	790.24	790.16	-0.08
21065	788.87	788.45	-0.42
20956	788.87	788.79	-0.08
20827	788.69	788.60	-0.09
Road S-37-51			
20722	788.10	788.10	0.00
20471	786.56	786.56	0.00
19923	783.60	783.60	0.00
19391	779.67	779.67	0.00
18781	775.68	775.68	0.00
18301	772.75	772.75	0.00
17886	769.49	769.49	0.00
17380	763.61	763.61	0.00
17239	757.62	757.62	0.00
17119	747.06	747.06	0.00
16850	743.24	743.24	0.00
16437	737.89	737.89	0.00

Table 6: Design criteria summary

Design Criteria Summary							
Prelim. Bridge (4% AEP) WSE (ft)	Minimum Required Freeboard (ft)	Prelim. Bridge Min. Low Chord (ft)	Existing Low Chord Elevation (ft)	Prelim. Bridge (1% AEP) WSE (ft)	Prelim Bridge (1% AEP) Backwater (ft)	Existing (1% AEP) Backwater (ft)	500-Year (0.2% AEP) WSE Check (ft)
788.18	2.0	803.00	795.36	789.46	+0.36	+0.45	790.31

The preliminary bridge configuration meets SCDOT design criteria for freeboard based and the requirement of 1 ft maximum increase in water surface elevations when compared to natural (unrestricted) conditions. The results of the preliminary bridge analysis support the finding of “No-Impact” in accordance with the SCDOT Requirements for Hydraulic Design Studies and HDB 2019-4. The preliminary bridge low chord elevation is controlled by the roadway grade and structure depth.

Design Considerations:

In the preliminary analysis, channel bathymetry downstream of the survey limits was approximated using published LiDAR, FEMA Flood Insurance Study (FIS) report profiles, and channel characteristics within the surveyed area. Consideration should be made as to the need for additional bathymetric survey to support design calculations. Additionally, scour protection should be provided on both abutments and scour potential due to flow contraction as well as local scour at internal bents should be evaluated and included with the final design.

[illegible]

A detailed map of the S-37-51 Bridge area, showing various zones (ZONE X, ZONE AE, ZONE AI) and roads. The map includes a grid with coordinates (e.g., 140000 FT, 142000 FT, 144000 FT) and a scale bar. A red circle highlights the bridge location. The map also shows the 'Oxone County Unincorporated Areas 480157' and 'LIMIT OF STUDY'.


[illegible]

DNR

This digital Flood Insurance Rate Map (FIRM) was produced through a unique cooperative partnership between the State of South Carolina and the Federal Emergency Management Agency (FEMA). The State of South Carolina has implemented a long term approach of floodplain management to decrease the costs associated with flooding. This is demonstrated by the State's commitment to map floodplain areas at the local level. As a part of this effort, the State of South Carolina has joined in a Cooperating Technical State agreement with FEMA to produce and maintain this digital FIRM.

<http://www.dnr.state.sc.us/>

NATIONAL FLOOD INSURANCE PROGRAM	PANEL 0430C	
	FIRM	
	FLOOD INSURANCE RATE MAP	
	OCONEE COUNTY,	
	SOUTH CAROLINA	
AND INCORPORATED AREAS		
PANEL 430 OF 505		
(SEE MAP INDEX FOR FIRM PANEL LAYOUT)		
CONTAINS:		
CONVEYANCE:	NUMBER PANELS SHEETS	
OCONEE COUNTY	450713C 3433 C	
<p> Note: In this Map Number, the first three digits are used to identify the map, the last two digits are used to identify the sheet. The map number is used to identify the map in the National Flood Insurance Program. </p>		
<div style="display: flex; justify-content: space-between; align-items: center;"> <div>  </div> <div> <p> MAP NUMBER 45073C0430C </p> </div> </div>		
<p> EFFECTIVE DATE SEPTEMBER 11, 2009 </p>		
Federal Emergency Management Agency		