

## HYDROLOGY AND HYDRAULICS REPORT

### Overview-

Nutter's Bridge in Alfred is currently a single span steel girder bridge. The bridge allows traffic to pass over the Littlefield River on the Back Road. Although the existing structures are adequate to handle the calculated flows, the existing structure is beginning to become structurally unsound and should be replaced.

### Hydrology-

A hydrologic analysis has been performed for Nutter's Bridge to determine the design flood flows for the proposed structure.

The contributing drainage area measures 19.85 square miles with 18.7% wetlands. The USGS Hodgkin's method was used to determine the following peak flows, which are shown in the following table.

Q <sub>10</sub>	=	692 ft <sup>3</sup> /sec
Q <sub>50</sub>	=	991 ft <sup>3</sup> /sec
Q <sub>100</sub>	=	1130 ft <sup>3</sup> /sec
Q <sub>500</sub>	=	1460 ft <sup>3</sup> /sec

## Hydraulic Report-

According to the 1998, Flood Insurance Rate Map (FIRM) of Falmouth shows a 100-year flood elevation of roughly 233.34 ft upstream of the bridge and 232.34 ft downstream of the bridge. The Flood Insurance Study of 1998 also shows the headwater elevation roughly 232.94 ft and a tail water at 231.84 ft for 100-year event, the study did not have any information on any other event.

A Hydraulic analysis also was performed on the existing and proposed structures for sizing using the US Army Corp of Engineering HEC-RAS program and using the flows from the hydrology report. The 100-year event was the only event with data available to calibrate the model. The value found for the existing structure is approximately 0.95 ft off from the FIS value. As this is a low volume road, and our intent is to lengthen the span, this was considered adequate for the project.

According to the FIS, the existing bridge has a free board of roughly 2 ft at the 100-year event, which is the required free board at the 50-year event according to the BDG.

For the analysis two proposed structures and the existing structure were used. The two proposed structures investigated were the 32 ft conspan arch and a 40 ft span with integral abutments and an assumed superstructure depth of 3 ft.

	Existing Structure	32 ft Conspan Arch	40 ft Span
Bottom of Superstructure(ft)*	Approx 234.53	233.92	233.70
Depth of Superstructure (ft)*	Approx 2.25 ft	3 ft	3ft
Ordinary High Water $Q_{1.1}$ (ft)	NA	NA	NA
Headwater Elevation $Q_{50}$ (ft)	NA	NA	NA
Headwater Elevation $Q_{100}$ (ft)	231.99	231.88	231.88
Control Depth $Q_{100}$ (ft)	7.67	7.56	7.56
Freeboard $Q_{100}$ (ft)*	2.0+	2.04	1.82
Discharge Velocity $Q_{1.1}$ (ft/sec)	NA	NA	NA
Discharge Velocity $Q_{50}$ (ft/sec)	NA	NA	NA
Discharge Velocity $Q_{100}$ (ft/sec)	7.39	5.86	5.31

Note: All elevations are in North American Vertical Datum 1988 (NAVD88). Elevations based on National Geodetic Vertical Datum 1929 (NGVD29) were converted to NAVD88 by the appropriate shift (-0.656 ft) using the NGS Vertcon Program

\* It should be noted that the elevations for the bottom of superstructure, which relates to the depth of superstructure and the freeboard were located at different areas for the two proposed structures. For the 40 ft span, it was based on the lowest point on the superstructure. For the 32 ft Conspan, it was based on the center of the buried structure, which is effectively the highest point in the structure.

As shown on the above table both proposed options would allow for better hydraulics at the site, with the 40-foot span having the greatest reduction in outlet velocities.

#### Scour-

The existing foundation is a mix of stacked granite and concrete, it is currently unknown what the foundation is bearing on. According to maintenance reports, some undermining has occurred along the abutments primarily the downstream ends. Also, there has been some loss of the existing bank protection.

The proposed foundations are spread footings on concrete seals founded on soil. The seals shall be buried at least 3 ft below streambed with the channel pre armored for scour. If scour occurs below the bottom of the footing, the riprap will be allowed to fall into the scour hole preventing any scour action on the soil below the footings. Heavy riprap shall be used as well. The velocities found in the hydraulic report indicate that regular riprap is adequate for the site but due to the limited hydraulic information, the Heavy riprap will be used.