

IV. HYDRAULIC EVALUATION

The existing structure is on a straight alignment on an east-west roadway with a zero degree skew. The upstream channel flows from the north where it meets the existing structure at a zero (0) degree skew. HEC-RAS was used for the hydraulic analysis of the existing bridge, existing site without a road or bridge and the alternate evaluation.

The criteria and assumptions used to evaluate the existing bridge and new combination of culverts were as follows:

- 1.) The new combinations of culverts were analyzed using a 15-year design discharge.
- 2.) The head water for the 15-year design discharge shall not exceed 1.5 pipe diameters as per ND Century Code 89-14-01-05.
- 3.) A field survey of the upstream and downstream channel sections were used in the analysis.
- 4.) The channel slope at the structure was assumed to be 0.0013ft/ft with a Manning's n-value of 0.35.
- 5.) The overflow elevation for the existing bridge was based on the existing road profile with an overtopping elevation of 999.89.
- 6.) The overflow elevation for alternate #1 was based on an overflow section that is 1.89 feet lower than the existing roadway low point. The length of the overflow section is 200 feet long. The overtopping elevation is 998.00'.

The analysis shows that the existing roadway elevation is below the 10-year headwater elevation for this site without a bridge or roadway in place. This indicates that the existing roadway would require a grade raise in order to meet the 15-year design discharge, without overtopping the roadway. The grade raise creates concerns for the upstream residents due to the potential increase in headwater for high flood events. Analysis of the existing bridge shows that the roadway is overtopped between the 2-year and 5-year event.

One corrugated steel pipe (CSP) was evaluated for replacement at this site, see Table 2 below. This culvert was analyzed using HEC-RAS with the inlet elevation set at 12.79' below the existing bridge deck and the outlet elevation set at 12.99' below the existing bridge deck. These inverts are approximately 1.0 feet below the natural stream channel to allow siltation to cover the rock riprap and bottom of the new culvert, which will recreate the natural stream bottom and mitigate any wetland loss. **The results show that a single 10' CSP with a 200' overflow section will handle the 15-year discharge with a headwater stage that closely matches the existing conditions, see Table 2 below.**