

VT AGENCY OF TRANSPORTATION PROGRAM DEVELOPMENT DIVISION
HYDRAULICS UNIT

TO: Chris Taft, District 1 Project Manager
Lissa Stark, Town Administrator

FROM: Leslie Russell, P.E., Hydraulics Project Manager

DATE: 27 July 2016

SUBJECT: Winhall TH 27 Culv 8 (Raspberry Hill Road) over Red Brook
GPS coordinates: N 43.15383° W 72.87755°

We have completed our hydraulic study for the above referenced site, and offer the following information for your use:

Hydrology

This site has a hilly to mountainous drainage basin. It is a mixture of forest and fields with a large pond. The total contributing drainage area is about 2.0 sq. mi. There is an overall length of 23,745 feet from the divide to the site, with a 980 foot drop in elevation, giving an average overall channel slope of 4.1%. The stream slope at the site was estimated to be about 2%. Using several hydrologic methods, we selected the following design flow rates:

<u>Annual Exceedance Probability</u> <u>(% AEP)</u>	<u>Flow Rate in Cubic Feet per Second</u> <u>(CFS)</u>
43	110
10	220
4	270 - Local Road Design Flow
2	330
1	400 - Check flow

Channel Morphology

This is a perennial brook. The channel is moderate gradient and incised and alluvial. There is likely some coarse sediment transport at the site. Field measurements of bankfull width varied from 16' to 20'. The Vermont Hydraulic Geometry Relationships anticipate a bankfull width of 18' for stream channels in equilibrium at this watershed size. Those curves may not be valid for this size drainage area.

Existing Conditions

The existing structures are 2 – 5' diameter pipes that provide a waterway area of 39.2 sq. ft. The pipes are rusted and deteriorating under the road.

Our calculations, field observations and measurements indicate the existing structures do not meet the current standards of the VTrans Hydraulic Manual nor does the existing structure meet state stream equilibrium standards for bankfull width (span length). The existing structures constrict the channel width, resulting in an increased potential for debris blockage. Headwater to depth ratios exceed allowable values established in the current VTrans Hydraulics Manual. Water does not overtop the road due to the high roadway fill.

This structure results in a headwater depth of 5.7' at 4% AEP and 8.6' at 1% AEP.

Replacement Recommendations

In sizing a new structure we attempt to select structures that meet both the current VTrans hydraulic standards, state environmental standards with regard to span length and opening height, and allow for roadway grade and other site constraints.

Based on the above considerations and the information available, we recommend any of the following structures as a replacement at this site:

1. A concrete box with a 16' wide by 8' high inside opening. The box invert should be buried 3'. That will result in a 16' wide by 5' high waterway opening above streambed, providing 80 sq. ft. of waterway area. Bed retention sills should be added in the bottom. Sills should be 12" high across the full width of the box. So the top of the sills will be buried 24" and not be visible. Sills should be spaced no more than 8'-0" apart throughout the structure with one sill placed at the inlet and one at the outlet. The box should be filled up to the stream bed level with stone graded to match the natural stream bed material. This structure will result in a headwater depth of 2.9' at 4% AEP and of 3.9' at 1% AEP, with no roadway overtopping up to 1% AEP.
2. Any similar structure with a minimum clear span of 16' and at least 80 sq. ft. of waterway area, that fits the site conditions, could be considered. Any structure with a closed bottom should have bed retention sills and a buried invert as described above.

Prior to any further action toward implementation of any of the above recommendations, structure size and type must be confirmed, and may be modified, by the VT ANR River Management Engineer to ensure compliance with state environmental standards for stream crossing structures.

Other regulatory authorities including the US Army Corps of Engineers may have additional concerns or requirements regarding replacement of this structure.

General Comments

If a new box is installed, we recommend it have full headwalls at the inlet and outlet. The headwalls should extend at least four feet below the channel bottom, or to ledge, to act as cutoff walls and prevent undermining.

It is always desirable for a new structure of this size to have flared wingwalls at the inlet and outlet, to smoothly transition flow through the structure, and to protect the structure and roadway approaches from erosion. The wingwalls should match into the channel banks. Any new structure should be properly aligned with the channel, and constructed on a grade that matches the channel. A new structure should span the natural channel width.

Stone Fill, Type III should be used to protect any disturbed channel banks or roadway slopes at the structure's inlet and outlet, up to a height of at least one-foot above the top of the opening. The stone fill should not constrict the channel or structure opening.

Please note that while a site visit was made, these recommendations were made without the benefit of a survey and are based on limited information. The final decision regarding replacement of this structure must comply with state regulatory standards, and should take into consideration matching natural channel conditions, roadway grade, environmental concerns, safety, and other requirements.

Please contact us if you have any questions or if we may be of further assistance.

LGR