

# Stream Crossing Guiding Design Principles

## Vermont Standard River Management Principles and Practices

May 1, 2014

**Principal River and Floodplain Functions**  
**Equilibrium (EQU)**  
**Hydrology and Hydraulics (HYD)**  
**Longitudinal Connectivity (LNG)**  
**Sediment (SED)**  
**Debris (DEB)**

**VT GP Design Requirements**  
 $W_{\text{structure}} = 1.0 \times W_{\text{bankfull channel}}$   
 $H_{\text{opening}} = 4 \times D_{\text{bankfull channel}}$   
 $D_{\text{embed}} = 30\% H_{\text{opening}}$  or  $D_{84}$  for boulder bed, whichever larger  
 • Match channel profile and create uniform longitudinal transitions at inlet and outlet.  
 • Structure shall not obstruct aquatic organism passage.

**General Design Considerations**

- Retain sediment throughout structure and maintain natural sediment transport.
- Avoid backwatering at inlet and naturalize the movement of large woody debris and ice.
- Design Q and Hw/H<sub>opening</sub> from state hydraulic standards\*.
- Match channel hydraulic conditions for design flood, fish passage, and low flows\*.
- Align structure parallel to flow in channel.
- Maximize fish and wildlife passage\*.

**Possible Special Exceptions**

**SMALLER WIDTH ALLOWED\*\***  
 ( $W_{\text{structure}} < 1.0 \times W_{\text{bankfull channel}}$ )

- Channels designated by the River Management Engineer as having a **‘Modified Reference Stream Type’** (VTANR, 2009)\*\*:
- Confined or constrained by unmovable public infrastructure;
- Confined or constrained by unmovable habitable structures; and
- Functioning as a sediment transport reach due to a pre-existing channelized condition (i.e., moderately entrenched and having a steeper slope).

**SMALLER HEIGHT ALLOWED\*\***  
 ( $H_{\text{opening}} < 4 \times D_{\text{bankfull channel}}$ )

- Low risk of impeding design flows and the passage of sediment and debris.
- Aquatic organism passage can be achieved.
- Larger streams.

**LESS EMBEDDEDNESS ALLOWED\*\***  
 ( $D_{\text{embed}} < 30\% H_{\text{structure}}$ )

- Channel slope < 0.5%.
- Structure under outlet control, or backwatered.
- Sediment retention sills not needed to keep bed in place.

**LARGER WIDTH REQUIRED**  
 ( $W_{\text{structure}} \geq 1.2 \times W_{\text{bankfull channel}}$  or  $W_{\text{structure}} = W_{\text{floodprone}}$ )

- Sediment transport dominated reaches with large volume of coarse bedload.
- Actively incising sediment production reaches with or without slope failures.
- Confinement of floodplain flows in the structure leading to high velocity and shear.
- Channel/structure with long damage history.
- Structure located near breaks in valley slope that is prone to clogging with sediment, woody debris, or ice.
- Wandering, braided, or fan stream types with frequently adjusting channel alignment.
- Channels with wide floodplain flow that would impact improved property if conveyance area blocked.

\*See the VTrans Hydraulics Manual for hydraulic standards and methods. See the Vermont ANR Natural Resources Atlas for existing geomorphic and structure assessment data. See the Vermont Fish and Wildlife Guidelines for the Design of Stream/Road Crossings for Passage of Aquatic Organisms in Vermont for fish passage standards and methods.

\*\*Requires approval from the Secretary of the Vermont Agency of Natural Resources.

\*\*\*Assignment of the ‘Modified Reference Stream Type’ is typically limited to encroached situations where removal of structures or infrastructure in the river corridor is impractical or a confined, steep valley exists with unmovable improved property.