Strengthening resilience to flooding events through bankfull width estimation at culverts Katie Budreski¹, Lauren Padilla¹, Hendrik Rathjens¹, Dan Currier²

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percent bankfull width - <= 30% - 30 - 50% 50 - 75% > 75% FEMA flood zone

STONE ENVIRONMENTAL INC for more information contact Katie Budreski at katie@stone-env.com Bankfull width is the water level at which a body of water is at the top of its banks and any further rise would result in water moving into the flood plain. Understanding bankfull width at culvert locations helps determine whether the sizing of the culvert is appropriate under bankfull or flooding conditions. To prepare for flooding events, municipalities and other entities can target culvert upgrades using modeled bankfull width calculations at culverts.

500-year 100-year The Mad River Valley in Central Vermont was hit by tropical storm Irene in late summer of 2011, flooding rivers and taking out two bridges and nineteen town roads. The damage isolated the community from emergency resources, slowing the recovery effort. Calculating bandfull width at bridges and culverts helps communities prioritize infastructure upgrades to reduce risk of failure during extreme weather.

Calculating percent bankfull width

Bankfull width in feet was calculated based on the area draining to the structure and hydraulic geometry curves developed for Vermont streams (Vermont DEC 2006). The curves are most representative for streams with drainage areas ranging between 1 and 150 square miles.

Using a digital elevation model to derive the flow direction and then watershed area for each structure, the bankfull width is calculated as:

13.1 * (Drainage Area Square Miles ^ 0.44)

Percent bankfull width is the ratio of the structure width divided by bankfull width and is an indicator of how well a structure is able to conduct flows in flood conditions. Structures at 50% bankfull width and less are likely undersized and at risk for failure in extreme rain events. Percent bankfull width is calculated as:

([Culvert Width]/[Bankfull Width]) *100



Reference: Vermont Department of Environmental Conservation (VT DEC), 2006. Vermont Regional Hydraulic Geometry Curves. River Management Program, VT DEC, January 2006.