VERMONT
AGENCY OF TRANSPORTATION

FACT SHEET

2019 Research Showcase & STIC Annual Meeting

Identifying Sensitive Structural and Hydraulic Parameters in a Bridge-Stream Network for Flood Mitigation Planning

RESEARCH PROJECT TITLE

VTRC017-003 and TIDC 4.4: *Bridge-stream network assessment to identify sensitive structural and hydraulic parameters for flood mitigation planning*

STUDY TIMELINE

January 2018 – January 2020

INVESTIGATORS

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Funding provided by the Transportation Infrastructure Durability Center at the University of Maine by a grant from the U.S. DOT's UTC program.

MORE INFORMATION

This fact sheet was prepared for the 2019 VTrans Research Showcase & STIC Annual Meeting held at the Dill Building in Berlin, VT, on September 11, 2019 from 8:30 am– 1:00 pm.

Fact sheets can be found for additional projects featured at the 2019 Symposium at http://vtrans.vermont.gov/planning/research/2019showcase

Additional information about the VTrans Research Program can be found at http://vtrans.vermont.gov/planning/research

Additional information about the VTrans STIC Program can be found at http://vtrans.vermont.gov/boards-councils/stic

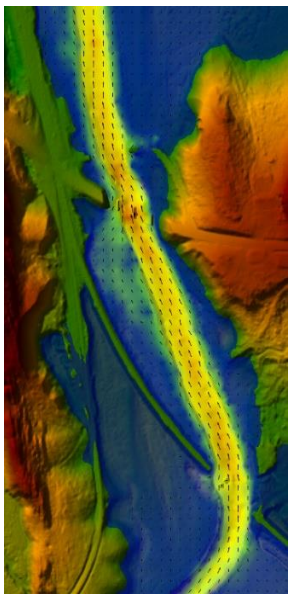
Additional information on this project can be found at http://www.tidc-utc.org

Introduction

The Northeast is experiencing a trend of more frequent precipitation events of longer duration. Consequently, infrastructure must withstand more frequent extreme flood events of greater magnitude. Satisfying the rigorous hydraulic demands these floods impose upon all bridges and structures is not feasible, so prioritizing resources to maximize flood hazard mitigation in a watershed is critical for efficient rehabilitation projects. Studies are generally limited in scope to steady-state analyses in the immediate vicinity of a specific structure or feature, and far-reaching impacts up- and downstream are often not considered. Specific structural or geological features may attenuate and/or intensify hazards on the network scale; by quantifying the dynamic interactions between a river and its surrounding infrastructure under high-risk, transient conditions, we may improve the efficiency of flood mitigation strategies.

Methodology

A 2D HEC-RAS hydrologic model was developed for the Otter Creek between the USGS flow gauges at Rutland and Middlebury on a LiDAR terrain model, incorporating sonar-derived bathymetry of the river channel. The model is calibrated to Tropical Storm Irene flows and surveyed high-water marks. In the domain, there are over 100 culverts, 12 road and eight rail bridges, and the Proctor Falls hydropower station. An additional 2D HEC-RAS hydrological model is currently being developed for the Mad River.



Plot of TS Irene peak velocity through three consecutive bridge crossings

Next Steps

A transient hydraulic model will be developed for two other locations. Perturbations will be applied to a variety of features that include manipulating the terrain and grade elevation, increasing bridge span lengths, removing berms, adding relief structures, and recreation of natural conditions. All three of the HEC-RAS models will be evaluated to better understand reach-scale hydraulic response to structural changes in rivers with low, moderate and high gradients. A probabilistic network model will then be developed and calibrated for application to similar geographic and climatic conditions across the Northeast.

Potential Impacts and VTrans Benefits

By identifying critical structural and geological features in a bridge-stream network, a network-level infrastructure resiliency analysis is possible. This may help prioritize limited resources available for bridge and river rehabilitations, holistic design of bridges, and address stakeholder concerns raised in response to planned bridge and infrastructure alterations.