Leveraging High-Resolution LiDAR and Stream Geomorphic Assessment Datasets to Expand Regional Hydraulic Geometry Curves for Vermont

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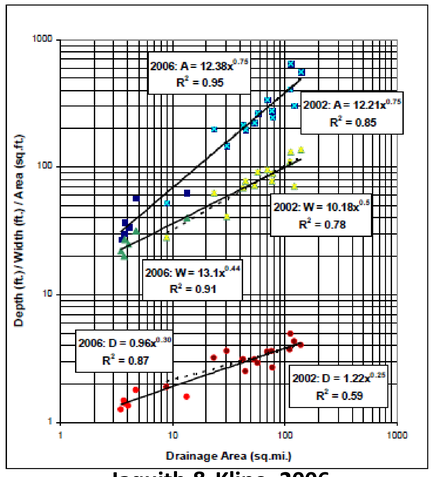
Background & Project Need

In the decade since Regional Hydraulic Geometry Curves (RHGCs) were first developed for Vermont streams (Jaquith and Kline, 2006), new remote-sensing data have become available (including Light Detection and Ranging [lidar] data), and field-based stream geomorphic assessment (SGA) data have been collected for more than 1,500 miles of river. Our objective is to improve the RHGC's prediction of stream width, depth, and cross-sectional area using SGA data to expand the number of observations, and by exploring additional predictor variables to refine regression estimates and reduce uncertainty.



Jaquith & Kline, 2006

Figure 1. RHGCs (at right) are used to predict width, depth, and cross sectional area of the bankfull discharge (R.I. of Q1.5), to support flood-resilient sizing of infrastructure and permit passage of aquatic organisms (above).

Methods

Task 1. Compile Expanded Set of Observation Sites.

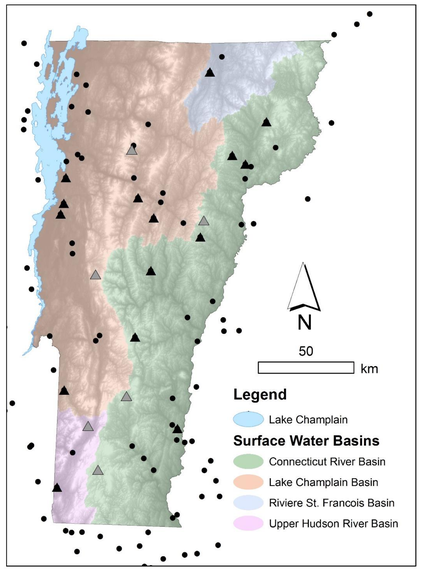


Figure 2. Up to 70 new sites proximal to USGS streamflow gauging stations (black circles) will be evaluated to complement 21 sites comprising the original (2001: n = 15; black triangles) and updated (2006: n = 6; gray triangles) Vermont RHGCs.

Task 2. Compile Regression Variables.
Possible predictor variables, along with drainage area, include: main-channel slope, elevation, mean annual precipitation/ snowfall / runoff, % carbonate bedrock, % basin storage (lakes, ponds, wetlands), and % land cover.

Next Steps

Task 3. Statistical Analysis

Applying advanced statistical techniques (e.g., clustering, penalized logistic regression, multiple linear regression, Bayesian inference), we will develop and explore additional predictor variables that may better refine regression estimates. Observation sites may be stratified by biogeophysical region, hydrologic landscape region, EPA Level III Ecoregion, or reach-based geomorphic stream type.

Broader Impacts

Updated curves will support sizing of stream crossing structures as well as embankment design for roads and rails that share narrow valleys with rivers. Geomorphically-compatible structures will have greater resilience to extreme flood events and will support aquatic organism passage objectives.

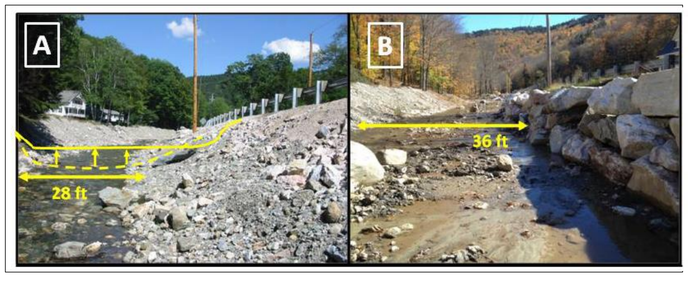


Figure 3. (A) Channel straightened and windrowed after Tropical Storm Irene is restored with (B) near-vertical stacked wall to accommodate bankfull channel width (Schiff et al., 2015)

Acknowledgments

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References

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