INTRODUCTION

1. Regionalized regression relationships (regional curves) that predict bankfull discharge (Qbf) and associated channel hydraulic geometry (Wbf, Dbf, Abf) as a function of drainage area (DA) are widely used in applied fluvial geomorphology.

2. Miller and Davis (2003) utilized 18 USGS gaged reaches to create initial regional curves for the Catskill Mountain region. In addition to an unstratified curve for the Catskills, hydraulic geometry and Qbf data were stratified by hydrologic region (Lumia 1991), and mean annual runoff. By 2015, 21 additional USGS stream gages were eligible for potential inclusion in the regional curves.

3. This study adds seven sites (4 new and 1 surveyed in 2004) to the existing regional curves, revisits potential stratifying covariables, and evaluates the merit of periodic updating of regional curves.

METHODS

1. USGS gage record assessment: Log Pearson Type III flood frequency statistics were computed for all existing and eligible USGS stream gages in the regional curve data set. We evaluated whether the 2003 Qbf recurrence intervals changed, and (b) evaluate how flood frequency changed over time and with record duration.

2. USGS gage site selection: All eligible gaged reaches needed to (a) have periods of record >10 years; (b) have reasonably stable alluvial boundaries over a length at least 20Wbf; (c) not be impacted by upstream flow regulation; and (d) have no obvious bankfull stage indicators. Preference was for sites representing needed DA values.

3. Site revisitation: Initial site visits confirmed or rejected sites from further assessment. Reconnaissance assessment included flagging bankfull morphology indicators and high water marks, test cross sections, and photo documentation. Sites were scored based on initial selection criteria and quality of bankfull morphology.

4. Bankfull discharge calibration surveys: Longitudinal profile and cross section surveys were conducted in 2015 for each of the 28 gaged sites. Stream bed particle-size distribution was estimated using pebble counts.

5. Data analysis and quality assurance: Hydraulic geometry data were analyzed in RHEM software. Qbf values were chosen by plotting best-fit lines in longitudinal profiles through stream gage locations and using stage-discharge rating tables to obtain discharge. Calculated Qbf values were checked using Manning’s equation at surveyed cross sections.

RESULTS

1. 2016 Unstratified Catskill Regional Curves

Dotted lines represent 2003 Catskill Regional Curve trends on all graphs.

Comparison to 2003 Study

Coefficients of determination (R² values) marginally decreased in all stratified regressions except for Hydrologic Region 4. Increasing sample size in Hydrologic Region 4 from 10 to 14 sites, covering underrepresented drainage areas, improved regression statistics. Slopes increased and slope intercepts decreased in each stratification with the exception of Dbf relationships in HR4 and MAR<2 which remained the same. Channel dimensions increase at a greater rate of change than previously predicted; however, channel dimensions for small drainage areas are less than previously predicted.

2. Stratified by Hydrologic Region

3. Stratified by Mean Annual Runoff

DISCUSSION

1. Increased number of sample sites allowed evaluation of further refined MAR classes of <2cfs, 2MAR<3cfs, and >3cfs. Refinement of discrete MAR classes provides generally improved relationships.

2. Bankfull hydraulic geometry values from unaged reaches in the Neversink watershed were plotted on the MAR=1.0 curve to test predictive validity. Points show a reasonable fit and are within the SEE. Validation tests for the other MAR stratified curves also produced a good match between observed and predicted values. The USGS StreamStats application can be used to obtain MAR values for use in applying the MAR stratified curves.

Conclusion: Periodic revision of Catskill Mountain regional curves is useful for stream management applications.

Recommendations for Future Study

1. Revise sites with significant changes in return period flow statistics or sites with >2.5 year return period limits from 2004‐2015.

2. Prioritize future sites that represent drainage area gaps in existing predictive relationships.

3. Test hydrologic region values of Q2 as predictors of bankfull channel geometry in the Catskills (He and Wilkerson 2011). Preliminary test indicates this is an improvement over DA as a predictor variable.

4. Limit hydrologic region delineation to low return period flow statistics, and test for suitability for bankfull regional curve stratification.

5. Expand use of bankfull stage indicator ranking index for site suitability evaluation.

6. Further investigate combining hydrologic regions 4a and 5 for use in the Catskills.

7. Develop multivariate regression relationships to test available covariables, e.g. mean annual precipitation and mean basin slope, in addition to drainage area.

REFERENCES


Lumia, Richard, 1991, Regionalization of flood discharges for rural, unregulated streams in New York, excluding Catskills (He and Wilkerson 2011). Preliminary test indicates this is an improvement over DA as a predictor variable.


ACKNOWLEDGEMENTS

We thank all who contributed to this project, especially the Watershed Conservation Corps coordinated by Emily Smith, Mark Van for excellent geomorphological site visits, and the New York City Department of Environmental Protection and Student Conservation Association. We also thank the New York City Department of Environmental Protection for sponsoring this research and the New York City Department of Environmental Protection for providing financial support.