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SUMMARY REPORT

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Modeling of Floods in Piedmont Streams

The passage of flood through a natural waterway is essentially an unsteady flow phenomenon. However, the standard practice in analyzing flood flow is to consider the flow to be steady with simultaneous peak discharge from all of the contributing sub-watersheds. The South Carolina Department of Transportation used such an approach in modeling design flood in the Buffalo Creek located in the Cherokee County. While the steady model is expected to provide a conservative estimate of the actual flow, the study found that the computed water level at the location of a bridge crossing over the creek was 10 ft below the observed high water mark during a simulated 100-year flood event. Such a discrepancy between the observed and computed water levels raised the question as to whether steady models are a valid predictive tool in an unsteady flow situation especially in Piedmont area characterized by relatively steep slope. The present paired study of modeling flood as both steady and unsteady flow under similar geometric, and hydrologic conditions is conducted in order to address this concern. Detailed hydrologic analysis is carried out for a 16.65 mile stretch of the Buffalo Creek between the King Mountain reservoir near Shelby, North Carolina, and Broad River near Blacksburg, South Carolina. A total of 96 model runs are made to pinpoint the role of individual input parameters on the model outcome. It is found that an unsteady model can replicate the observed high water mark with reasonable boundary conditions. But the model is sensitive to downstream water level. The steady model slightly over-predicts the observed high water mark but is less sensitive to variation in boundary conditions. Even though various scenarios were considered in the study, it was limited to a single creek in a specific physiographic area. To obtain more specific guidelines for the selection criteria of hydraulic models for flood flow analysis in rivers and streams in the State of South Carolina, it is suggested that the study be extended for streams of different scales, gradients, and boundary conditions. Tidally influenced streams make a good candidate for such study. This not withstanding, the following general recommendations can be made for streams having similar size and controls as the Buffalo Creek.

1. Use an appropriate hydrologic method to generate synthetic hydrograph to be used as input in both steady and unsteady models. The method used in this study has

been found to give conservative estimate of peak flow in the Piedmont watersheds during storm events.

2. Obtain sufficient field data on channel geometry, and boundary conditions in order to achieve meaningful model prediction.
3. Use an unsteady model e.g. HEC-UNET to simulate flood flow in streams if sufficient information on the controls are available.
4. Use a steady model such as HEC-RAS if reasonable estimate of the downstream water level can not be obtained from field data and the study site is far upstream from a natural or man-made control.
5. Make a number of model runs to obtain a range of simulated flood stage by varying different parameters such as downstream water level, channel and floodplain roughness coefficient, and storm return period and select the design stage based on the most realistic input conditions.

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