National Weather Service Determination of Flood Stages for Small Fast Responding Streams in Complex Terrain

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Introduction

It is crucial to accurately assess flood stages for small streams, as the onset of flooding occurs quickly and can negatively impact many people with little advance warning. Understanding site specific characteristics and potential flooding dangers of a particular stream leads to enhanced knowledge of the area, and more accurate flooding level forecasts. The National Weather Service at Binghamton, NY has set flood stages for three small streams in the Catskill Mountains of Delaware County, all of which are prone to flash flooding. East Brook near Walton, Trout Creek near town of Trout Creek, and Tremper Kill near Andes were all visited during the summer of 2009 to set flood stages for minor, moderate and major flooding. This poster will present the methods utilized to determine where to set flood stages based on features of a particular stream. Existing bridges and structures can be used to determine the magnitude flow that would impact them, and set flood stages accordingly. Also historical flows are examined and often county or town supervisors are contacted to determine if a given flow has caused damage in the past, and where that damage may have occurred.

Flood Stages

Flood stages are set according to the determination of bankfull flow.

- **Action or Caution Stage-** defined as discharge of bankfull flow
- **Minor Flood Stage-** May be some nuisance flooding or basements, low lying fields
- **Moderate Flood Stage-** Flood waters begin to threaten homes or other structures such as bridges
- **Major Flood Stage-** Widespread flooding in area with many homes and roads affected and damaged

Determination of Bankfull Stage and Flow

Manning's Equation is used to determine channel capacity at a site.

$$Q = VA$$

$$V = \frac{1.49 R^{0.66} S^{0.5}}{n}$$

Where:
Q= stream discharge
V= stream velocity
A= cross-sectional area of stream
R= hydraulic radius
S= channel slope
n= Manning's n

For each stream where flood stages were set, field work was done to determine Manning's n. Also multiple cross sections were taken at bridge crossings. The depth to the bottom of the stream channel was measured along with distance that the channel spans under the bridge. The slope of the channel was calculated by examined USGS 1:24,000 topographic maps.

USGS Gage Record

For each of the streams presented here, the USGS gage record was examined to determine when the highest recorded flow occurred and what stage the stream was at. Very often in remote areas it is difficult to know if a certain magnitude flow had any impacts on any homes or businesses, especially if they happened many years ago. After finding the highest flows that occurred on a particular stream, it is invaluable to gather information from local homeowners and businesses on what may or may not have flooded during a particular event.

Case 1: East Brook near Walton, NY

Significant damage from flooding in June, 2006.

Photo courtesy of The Cooperstown Crier

Map of location of USGS gage on East Brook. From the map it can be seen that East Brook flows right through the town of Walton.

-East Brook flows under two different streets in Walton. The bridge capacity of Benton Ave and Griswold St. were calculated.

-Calculated flows then compared to historical flows to set flood stages

Stage	Description	Impacts
6.7 ft	Hurricane Ivan	-2nd largest recorded flow
7.0 ft	Bankfull (Alert)	-Water reaches top of channel at Benton Ave.
7.5ft	Minor Flood Stage	- ½ ft. above banks in vicinity of Benton Ave.
8.0 ft	Moderate Flood Stage	- 1 ft. above banks at Benton Ave. - Water at bottom of bridge at Griswold St.
9.0 ft	Major Flood Stage	- Both bridges overtopped - Other bridges likely flooded
9.95 ft	Flood of Record	- Recorded stage during June 2006 flood. Up to 4 ft of water above channel above banks at Benton Ave and Griswold St.

Case 2: Trout Creek near the town of Trout Creek, NY

Trout Creek is a case where stream flooding would generally not impact a great number of homes or businesses. It is a rural area and geographically the stream is located east of the general population of the town of Trout Creek.

In rural areas it is difficult to determine flooding impacts by simply contacting town supervisors or transportation authorities. In Trout Creek this is especially true as most of the land impacted is agricultural.

Photo from Google Earth

Consultation of aerial photography shows where flooding has occurred on the stream previously. Here we can see where there was damage to an agricultural field from a channel breakout, most likely during the flood of record in 2006.

Case 3: Tremper Kill near Andes, NY

In some cases the location of the USGS gage on the stream makes it more difficult to asses flood stages and potential impacts. In this case, the USGS gage was located a significant distance downstream from where it flowed through the town of Andes.

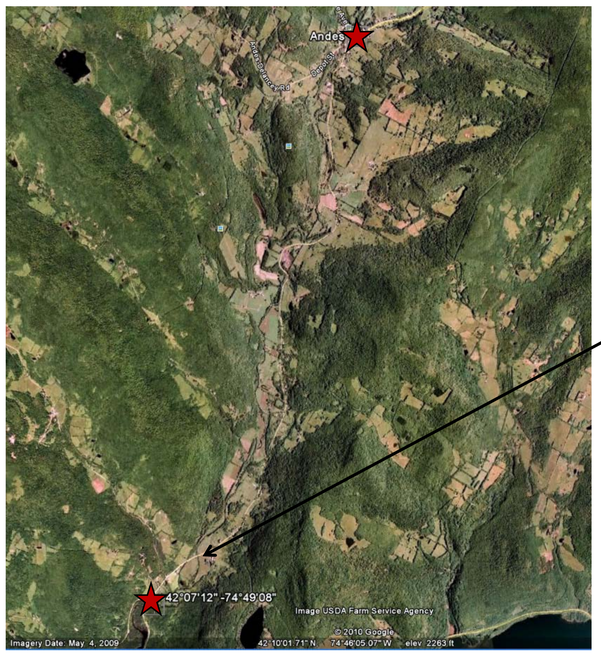

Photo from Google Earth

The two red stars on the map indicate the location of Andes, top of map, and the USGS gage, bottom of map. Arrow indicates where slope conveyance was used to estimate discharge at bridge crossing.

Most impacts of flooding on Tremper Kill affect agricultural land due to the rural nature of the area.