

Proposal NY13G
U.S. Geological Survey
New York Water Science Center
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Flood-Inundation Maps for Fall Creek and Sixmile Creek,
Tompkins County, New York

Proponent's Information –

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Cooperator(s) – Potential cooperators include Tompkins County Planning Department, City of Ithaca, Town of Ithaca, Town of Caroline, Tompkins County Soil and Water Conservation District

Problem – Flooding is an annual problem along the major streams in Tompkins County. Flood maps for extreme floods are available through the effective FEMA flood insurance studies (dated 1985), but similar data for lower, intermediate, and higher floods are non-existent. Emergency responders and the public would benefit from a series of flood-inundation maps for selected reaches of Fall Creek and Sixmile Creek.

These flood-inundation maps would depict incremental increases in flood stage and associated flood extents. The maps would be referenced to the stage recorded at a USGS streamgage (or alternatively to a stage-monitoring device located within the study reach). Specific reaches of Fall Creek and Sixmile Creek will be selected for flood-inundation mapping on the basis of (1) population density and development in flood-prone areas; (2) availability of an existing hydraulic model from which elevation data for structures in or spanning the study reaches can be obtained; and (3) proximity to a USGS streamgage or possible use of a USGS streamgage as a flood-warning site for a downstream reach and presumption that the observed stage at a USGS streamgage will have a meaningful relation to water levels in the mapped reaches (otherwise an alternate stage monitoring device will be proposed).

Background – The geomorphology of the creeks in Tompkins County are greatly influenced by the glacial history of the area. Cayuga Lake and its main tributary, Cayuga Inlet, follow a north-south glacial trough. All lateral tributaries flow from hanging valleys, through narrow gorges, and over waterfalls before entering the flat Cayuga Lake floodplain. This floodplain is highly developed and is a main concern for flooding from Fall Creek and Sixmile Creek; two of the main westward-flowing tributaries that cut through the City of Ithaca to their confluences with Cayuga Lake and Cayuga Inlet, respectively. Two of the reaches proposed for flood-inundation mapping are the downstream ends of Fall Creek and Sixmile Creek within the City of Ithaca. These reaches would extend upstream only as far as the first waterfall or the downstream end of the gorge through which the stream flows.

Objective – The objective of this project is to generate a series of flood-inundation maps at 1-ft intervals of stage for selected reaches of Fall Creek and Sixmile Creek in Tompkins County using water-surface elevations computed by a hydraulic model, a digital elevation model (DEM) produced from LiDAR data, and a geographical information system (GIS). Water depths also will be computed for each flood stage, so that flood extent and depth can be evaluated simultaneously.

Scope – Flood maps will be generated at 1-ft intervals of stage (as referenced to a USGS streamgage), and will range from the top of bank to a stage greater than that associated with the 500-year flood and/or the maximum recorded stage. The project scope is divided into 3 segments on the basis of the reaches that are proposed to be mapped and include (1) the downstream end of Fall Creek; (2) the downstream end of Sixmile Creek; and (3) Sixmile Creek from German Cross Road to just upstream from NY Route 79 in Slaterville Springs (fig. 1).

Reach 1 and 2 cover the portions of Fall Creek and Sixmile Creek that flow across the Cayuga Lake/Inlet valley bottom. Reach 1 is about 0.9 mile long and extends from the mouth of Fall Creek upstream to Ithaca Falls. Upstream from this point, the creek flows through a gorge, which negates the need for, and value of, flood-inundation maps. The gorge ends upstream from Beebe Lake, at the approximate location of a USGS streamgage (number 04234000; 88 years of record). This gage is a river-stage forecast point of the National Weather Service (NWS) and would be used as a warning station for the downstream mapped reach. Also the gage would provide the stage to which the downstream flood-inundation maps would be referenced (unless an alternate stage-monitoring device was installed within the study reach).

Reach 2 is about 1.3 mi long and extends from the mouth of Sixmile Creek to the downstream end of the Sixmile Creek gorge (approximately at the Ferris Place – Giles Street footbridge). Upstream from this point, the creek flows through a discontinuous gorge; the steep valley sides of which prevent development (except for a series of water-supply reservoirs) at least as far upstream as Burns Road. A USGS streamgage (number 04233300; 17 years of record) is located at the next road crossing upstream (at German Cross Road). This gage is not a river forecast point of the NWS (only observed stages are posted on the NWS Advanced Hydrologic Prediction Service) and would be used as a warning station for the downstream mapped reach. Also the gage would provide the stage to which the downstream flood-inundation maps would be referenced (unless an alternate stage-monitoring device was installed within the study reach).

Reach 3 is about 7.2 mi long and includes two USGS streamgages—one near the downstream end of the study reach at German Cross Road (no. 04233300) and one near the mid-point of the study reach in Brooktondale (no. 04233286; 10 years of record). The upstream end of the study reach will be just upstream from the Route 79 bridge in Slaterville Springs. Stages are not predicted by the NWS at either of the USGS streamgages. Flood maps will be referenced to stages at both gages; but only one gage will reflect a 1-ft increment of stage, whereas the increment of stage at the second gage will vary depending on that gage's stage-discharge relation.

Benefits – These maps will provide valuable information to emergency-response personnel, who might be charged with notification and evacuation of people living in a floodplain. With access to an index stage from a nearby USGS gaging station or a river staff gage, and predicted peak stage from the National Weather Service (if available), emergency-response personnel can consult the map library of flood-inundation and water-depth maps to assess the severity of a given flood, and to decide whether emergency announcements need to be broadcast, or evacuations ordered for the safety of people in the floodplain.

This project will meet the USGS goals of:

- advancing knowledge of the regional hydrologic system through improved delineation of flood-prone areas;
- advancing understanding of hydrologic processes by providing a series of flood-inundation maps that will show how the areal extent of flooding changes with an increase in flood stage; and
- furnishing hydrologic data that contribute to protection of life and property by providing the basis for emergency responders to make decisions regarding flood-protection measures and evacuation plans.

Approach –

The guidelines for creation of flood-inundation map libraries that have been jointly developed by the NWS and the USGS (2008) will be followed. The Approach is divided into 3 segments on the basis of the reaches that are proposed to be mapped and include (1) the downstream end of Fall Creek; (2) the downstream end of Sixmile creek; and (3) Sixmile Creek from German Cross Road to just upstream from NY Route 79 in Slaterville Springs (fig. 1).

- Reach 1: Downstream end of Fall Creek (from Ithaca Falls to its mouth; 0.9 mi)
 - The hydraulic model that was used for the effective FEMA flood insurance study (FIS; dated 1981) would be obtained from FEMA. Pertinent data contained therein would be transferred to a HEC-RAS hydraulic model.
 - The geometric data for any bridges in the study reach would be reviewed and if changes to bridge openings have been made since 1981, revised data will be sought from State, County, and/or City of Ithaca Departments of Transportation. If data are unavailable, then structural geometry will be surveyed in the field.
 - LiDAR data will be used to create a digital elevation model (DEM) from which cross-section elevations will be extracted using a GIS and imported to the hydraulic model.
 - The newly created model will be calibrated to the 10-, 50-, 100-, and 500-year water-surface profiles contained in the FIS.
 - The calibrated model will then be run with flows that correspond to 1-ft increments of stage at the USGS streamgage (04234000). The stages will cover the range from top of bank in the floodplain reach to a stage greater than the 500-year flood. The flood flows used in the model will be taken from the most recent stage-to-discharge relation at the USGS gage. An alternative means of

referencing the flood maps to an observed stage would be to install a stage-monitoring device at a bridge in the study reach and reference the maps to stages recorded or read at this location (rather than to stages recorded at the USGS gage). The installation and maintenance of an alternative stage-monitoring device is not included in the scope of this proposal.

- Water-surface profiles for each flood flow will be imported to a GIS program, which, along with the previously developed DEM, will be used to create flood-inundation polygons and water-depth grids.
 - Flood polygons will be overlain on the most recent low-altitude orthophotographic imagery available and will be presented in PDF format on the USGS Publications Warehouse website. Flood polygons and depth grids will be presented on the interactive USGS Flood Mapper website, and with NWS approval, on the NWS Advanced Hydrologic Prediction Service (AHPS) webpage for the river forecast point co-located with the USGS streamgage (04234000).
 - A USGS scientific-investigations map report that documents the process used to generate the flood-inundation and flood-depth maps for Fall Creek will be written.
2. Reach 2: Downstream end of Sixmile Creek (from its mouth to the downstream end of the Sixmile Creek gorge; approximately at the Ferris Place – Giles Street footbridge; 1.3 mi)
- The approach for this reach is the same as that described for Reach 1, except the pertinent USGS streamgage is station number 04233300, Sixmile Creek at Bethel Grove (German Cross Road).
 - Four reservoirs are found in the gorge between the streamgage and the City of Ithaca. These are essentially run-of-the-creek structures; flood flows that pass the gage will be detained (not retained) for a short period (Erik Whitney, Assistant Superintendent of Public Works / Water and Sewer, oral commun., 2013) before passing downstream, presumably at a magnitude similar to that which passed the gage. (This reach within the Sixmile Creek gorge, in which the four reservoirs are located, will not be simulated in the hydraulic model.)
3. Reach 3: Sixmile Creek from German Cross Road to just upstream from NY Route 79 in Slaterville Springs; about 7.2 mi)
- No FIS has been conducted for this reach. Therefore geometric data for ten bridges will have to be obtained from the County and State DOTs. Missing data and the elevations of at least four waterfalls will have to be obtained by field surveys.
 - A hydraulic model will be developed for the reach. Cross-section elevations, on average 500 ft apart, will be extracted from a DEM and input to the model. Below water-surface segments of each cross section will be estimated from within channel field surveys (conducted in the vicinity of road crossings) and inserted in the channel portion of each cross section.
 - Two streamgages (sta. nos. 04233286 and 04233300) are found in the reach and flows associated with 1-ft increments of stage will be picked from the current stage-discharge relations and input to the model. Inflows from a major tributary, Ellis Hollow Creek (between Brooktondale and Slaterville Springs),

will be estimated by the drainage-area-ratio method and also input to the model. The model will be calibrated to observed stages at the gages.

- Computed water-surface profiles will be imported to a GIS and flood-inundation polygons and depth grids will be created and post-processed as described in the flood map library guidelines (NWS and USGS, 2008).
- Flood polygons will be overlain on the most recent low-altitude orthophotographic imagery available and will be presented in PDF format on the USGS Publications Warehouse website. Flood polygons and depth grids will be presented on the interactive USGS Flood Mapper website, and with NWS approval, on the NWS AHPS webpage for the streamgage at German Cross Road, Sixmile Creek at Bethel Grove (04233300).
- A USGS scientific-investigations map report that documents the process used to generate the flood-inundation and flood-depth maps for Sixmile Creek will be written.

Personnel – A hydrologist, GS-12, and a hydrologic technician; both from the Ithaca, NY office. The technician would assist in surveying bridge geometries for those structures for which current data is unavailable, either from previously developed hydraulic models or from transportation departments’ design drawings. (The salary of the technician is included in the spreadsheet estimate for the hydrologist’s salary.)

Products – A draft USGS Scientific Investigations Report and associated flood-inundation polygon shapefiles and depth grids will be created and delivered 1 year from the start of the project for each stream that is mapped (if both reaches of Sixmile Creek are mapped, the output for each will be included in a single report).

Proposed titles:

“Flood-inundation maps for Fall Creek, City of Ithaca, N.Y., 20xx”

“Flood-inundation maps for Sixmile Creek, Tompkins County, N.Y., 20xx”

Time Frame and Costs– The USGS will share 30 percent of the cost of producing the maps and reports and integrating the final shapefiles into the USGS FloodMapper Website through the USGS Cooperative Water Program matching funds, dependent on the availability of federal funds.

Reach	Time	Cost	USGS share	Cooperator share
1	1.5 months	\$26,676	\$8,003	\$18,673
2	1.5 months	\$26,676	\$8,003	\$18,673
3	3.5 months	\$62,245	\$18,673	\$43,572

Reference

National Weather Service and U.S. Geological Survey, 2008, Flood inundation map library guidelines: accessed March 4, 2013, at

http://water.usgs.gov/osw/flood_inundation/toolbox/librarytools.html

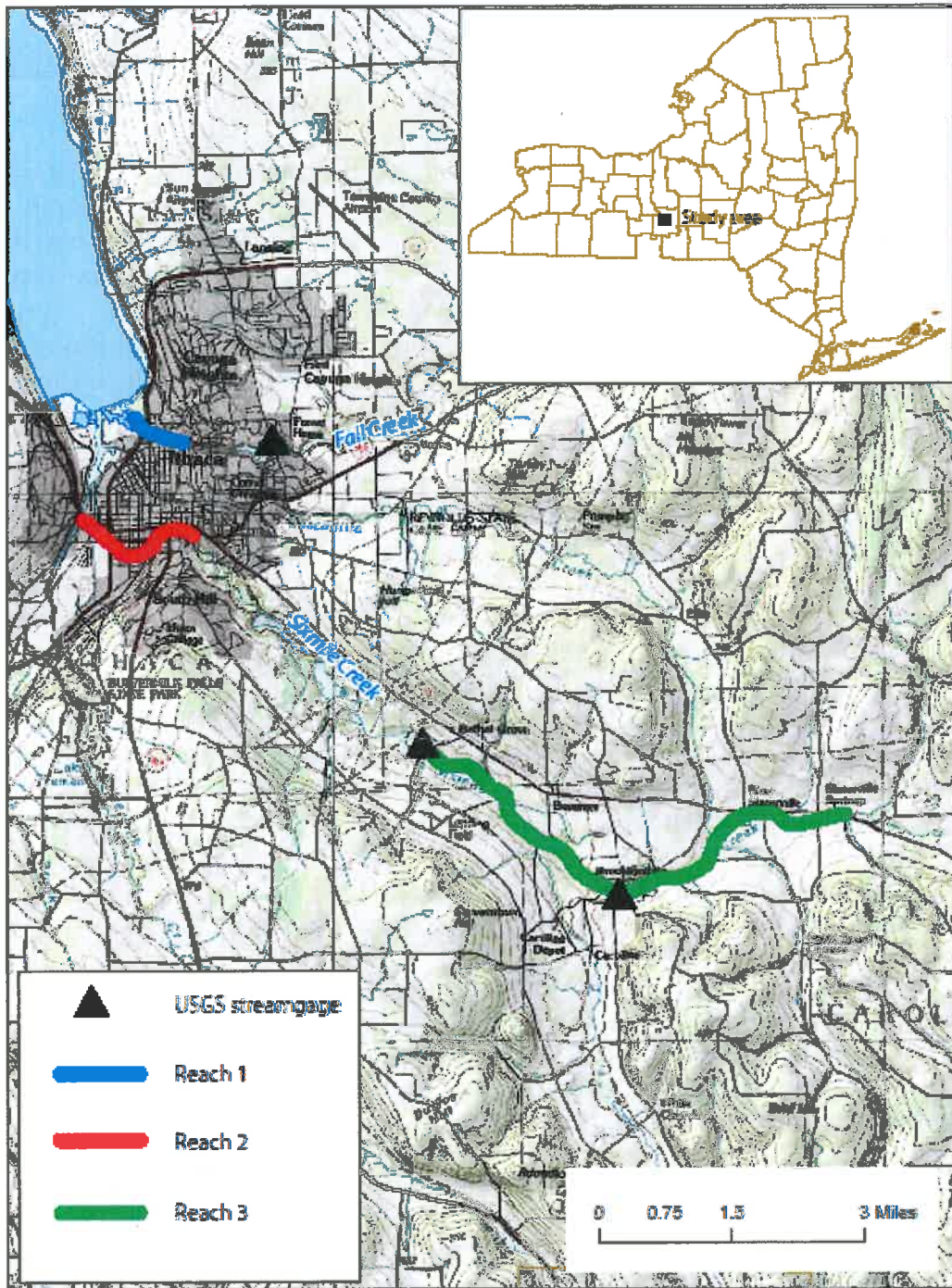


Figure 1. Proposed reaches for flood-inundation mapping, Fall Creek and Sixmile Creek, Tompkins County, New York