

SUNY New Paltz and DEP sponsored NSF REU Summer 2011 Project Description

Hydrology (Dr. Shafiul Chowdhury):

Factors Controlling Water Quality: Surface water samples will be collected using auto sampler before and after major storm events (heavy precipitation) from selected locations from previously delineated sub-watersheds. These samples will be analyzed in the lab to determine water quality parameters (anions, cations, total organic carbon, total suspended solids etc.). Students will also measure pH, conductivity, temperature, turbidity and dissolved oxygen of the stream water in the field. The water quality parameters will be compared with land use, topography, soil type and geologic materials and processes (e.g. high surface runoff, only base flow, glaciated vs. non glaciated areas etc), to determine the controlling factors using GIS.

Surface Water/ Groundwater Interaction: During dry periods streams in the Stony Clove sub basin are mostly fed by groundwater (base flow). The above water quality evaluation approach will help us understand the movement of water between groundwater and surface water since this interaction provides a major pathway for chemical transfer between terrestrial and aquatic systems. This transfer of chemicals affects the supply of carbon, oxygen, nutrients such as nitrogen and phosphorus, and other chemical constituents which will be helpful to evaluate the effects of biological and chemical characteristics of aquatic systems.

Role of Groundwater on Stream Bank Erosion and Slope Failure: Evaluate the role of groundwater/surface water interaction in a set of rotational hill slope failures along Warner Creek's Reaches 11 and 12 by installing and monitoring piezometers and taking detailed measurements of geotechnical failure features (scarps, activity of slides, longitudinal and lateral migration of failures).

Piezometers will be installed on selected segments of the stream banks and hill slopes longitudinally and laterally to determine hydraulic heads which will give the information about the hydrostatic pressure conditions of the area. Vulnerable areas to potential slope failure will be delineated by combining the collected data of hydraulic head and above mentioned features of slope failure.

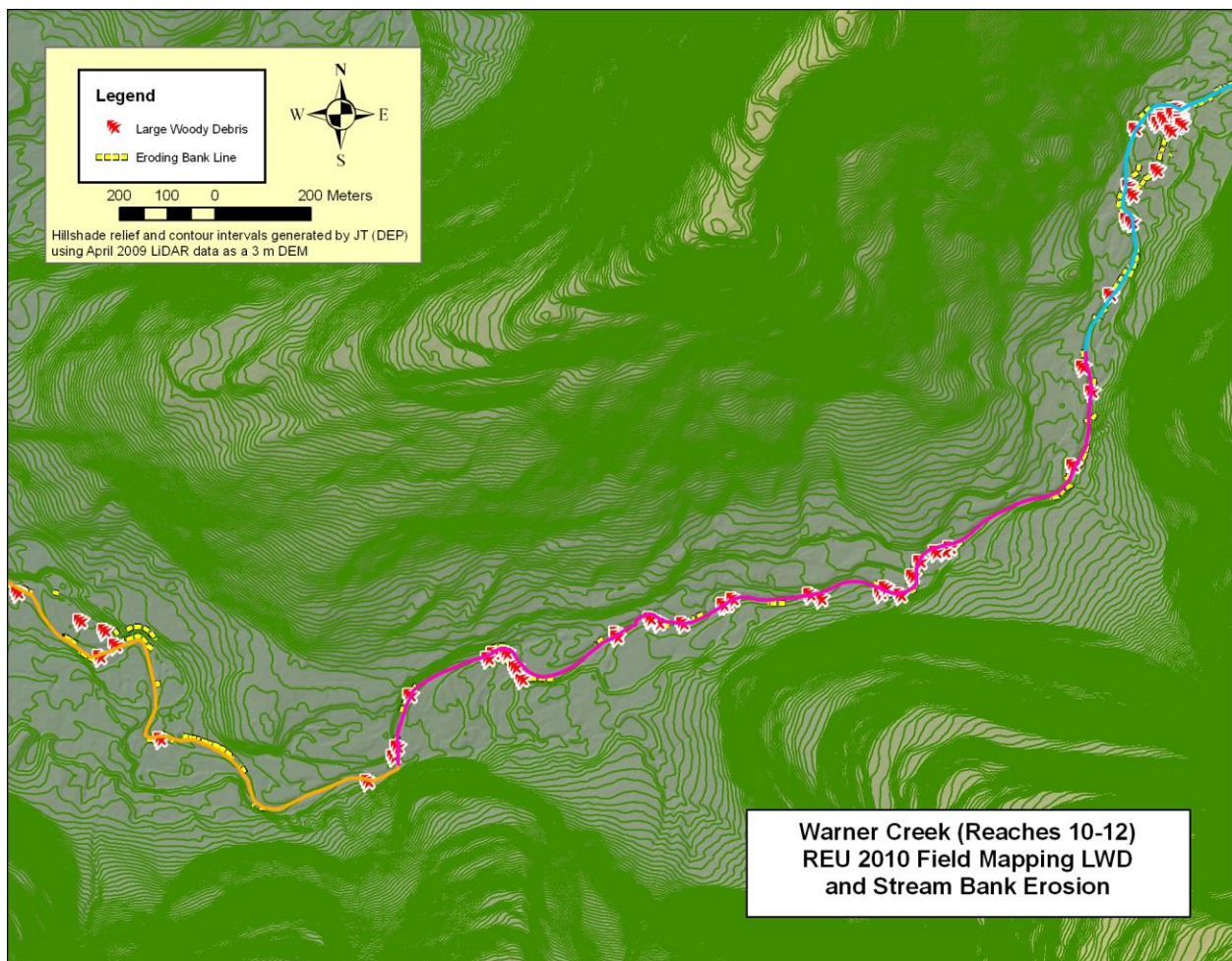
Fluvial Geomorphic Investigations (Mr. Dan Davis)

The SUNY New Paltz REU Program and the New York City Department of Environmental Protection (DEP) have initiated a comprehensive multi-phase investigation of fluvial geomorphic features and processes in the Silver Hollow watershed that hosts Warner Creek, a tributary to Stony Clove Creek located in the Catskill Mountains of Ulster County, NY. Four of the 2010 REU season undergraduate researchers worked with a DEP geologist to

(1) complete a GIS-based watershed-scale assessment using remotely-sensed data (orthorectified photos for 2001 and 2009, georeferenced historical aerial photos dating back to 1959, high resolution digital elevation models, land use/land cover maps) and

(2) a field-based stream feature inventory/assessment (see figure and REU 2010 project description) to record the occurrence of various features in the stream corridor (bed form, channel geology, stream bank and hill slope erosion, headcuts, large woody debris, depositional features, revetment, etc) to establish a baseline condition and to identify subsequent research topics. Students also worked on individual projects (hydrology, headcut mapping, LWD monitoring, and hill slope failure investigation).

The findings of the 2010 investigations are summarized in these power point presentations (provide a link). Following the 2010 field season, a high recurrence interval flood (>10 years) occurred in early April which produced numerous geomorphic adjustments and redistribution of some of the mapped features.



The 2011 REU students can pursue the following potential research topics (these can be combined into team efforts):

- Repeat stream feature inventory for select reaches (13 total) and compare the results to quantify the geomorphic response to the October 1, 2010 (and/or subsequent floods).
- Resurvey a statistically significant set of large woody debris (LWD) features and provide more comprehensive characterization, assessment of geomorphic and ecologic effects, tag for subsequent monitoring.
- The 2010 REU students attempted to qualitatively characterize the bank erosion hazard potential for individual eroding stream banks, evaluate the characterization based on the stream bank's response to post-assessment high runoff events and develop a photo-based field guide to qualitative and semi-quantitative assessment of bank erosion hazard potential for use in subsequent investigations.
- DEP and Ulster County Soil and Water Conservation District are working with a consultant (Clear Creeks Consulting) to complete a detailed stream corridor restoration assessment for 6,000 feet of stream (Warner Creek reaches 11 and 12) which will yield monumented cross sections installed in fall 2010, stream bed sediment characterization using Wolman Pebble counts, a detailed topographic map with 2 ft contour interval resolution, and mapped features such as headcuts, bank erosion, and sediment bars. Restoration projects are planned for late summer 2011 and in 2012, therefore students will have time to resurvey channel, cross-sections, longitudinal profiles, and other features to evaluate geomorphic response in these geomorphically active reaches of Warner Creek.
- Using the 3 meter DEM (very high resolution) attempt to predict the occurrence of stream bank erosion, suspended sediment entrainment sources, deposition, LWD entrainment/storage as a function of stream corridor morphology (slope, valley and channel cross-sectional geometry), geology, and land cover. Calibrate the model predictions with observed features in Warner Creek and test the model predictions by field checking predicted results in an unassessed tributary to Stony Clove Creek.
- Further project ideas can be discussed prior to start of the 2011 season.

Note: Project mentoring will be provided by SUNY New Paltz professors and a DEP geologist (1 – 2 days/wk). Assume a significant amount of field work in a beautiful mountain river. Please contact Danny Davis with DEP's Stream Management Program with questions about this set of suggested projects.

Water Chemistry (Dr. Megan Ferguson)

Impact of Stony Clove Creek Watershed on Disinfection Byproduct: Stony Clove Creek, a source of water to Ashokan Reservoir and ultimately New York City, is known to have high sediment loads, and substantial levels of dissolved organic matter may co- occur with that sediment. Since New York City does not filter its drinking water, this imparts a risk of generating disinfection byproducts – harmful halogenated compounds that form when source water that contains dissolved organic matter is treated with chlorine prior to distribution. To examine whether this is a potential problem in this watershed, students will collect water samples in various locations throughout the Stony Clove watershed and downstream toward Ashokan Reservoir. Basic water quality parameters will be collected onsite, and more in-depth information such as ion concentrations, total organic matter, and humic acid fraction will be determined in the lab. Water samples will subsequently be chlorinated in a fashion similar to New York City’s drinking water treatment, and students will identify and quantify disinfection byproducts using UV-visible spectroscopy, gas chromatography-mass spectrometry (GC-MS), and other analytical chemistry techniques.

Application of GIS (Dr. Lawrence McGlenn)

Modeling Stony Clove, Upper Esopus Basin, New York (GIS based): Several projects will utilize GIS to compile and analyze data for Stony Clove sub-basin in the Upper Esopus Creek watershed. Overlaying a range of existing and collected data in our GIS (aerial photography, LIDAR data, DEMs, soils data, hydrologic and geologic data), we will create a three-dimensional model of the Stony Clove basin. This model will aid in analyzing and interpreting the geomorphologic, water quality and slope failure data of Stony Clove. In subsequent years, we will build a robust environmental database on this foundation. Ultimately, our model will represent in detail the reality of Stony Clove as an outdoor laboratory.

Geologic Mapping (Dr. John Rayburn)

Surficial Geologic Mapping: Through both field investigation and analysis of LiDAR data we will investigate the surficial geology (primarily glacial and glacial lacustrine in origin) in the watershed. These are the primary sediment sources for sediment being eroded and transported into the Ashoken Reservoir.

Ecology (Dr. David Richardson)

Didymo geminata (rock snot) in Esopus Creek: Abundance of the nuisance stream alga, *Didymosphenia geminata*, has unexpectedly increased in streams and rivers worldwide in recent decades. *D. geminata* (*Didymo*) is informally called “rock snot” because during blooms

(i.e., periods of rapid growth), the diatoms produce long stalks which forms a mat on the stream bottom and resembles mucus. *Didymo* is capable of modifying the physical habitat and biology of the streams due to the large amount of growth on the stream bottom. In New Zealand, *Didymo* blooms, likely spread by recreational fishermen, have caused recreational and economic damages (>\$50 million). The Esopus Creek is one of five known bloom locations in New York State. The students working on this project will work closely with the local United States Geological Survey (USGS) group to investigate the ecology of *Didymo*, including the chemical and hydrological causes of *Didymo* blooms in the Esopus Creek using microscopy and water chemistry techniques. In addition to field measurements, the students could also plan and carry out experiments to look at chemical causes of *Didymo* growth and examine the spatial extent of *Didymo* blooms within Esopus Creek.