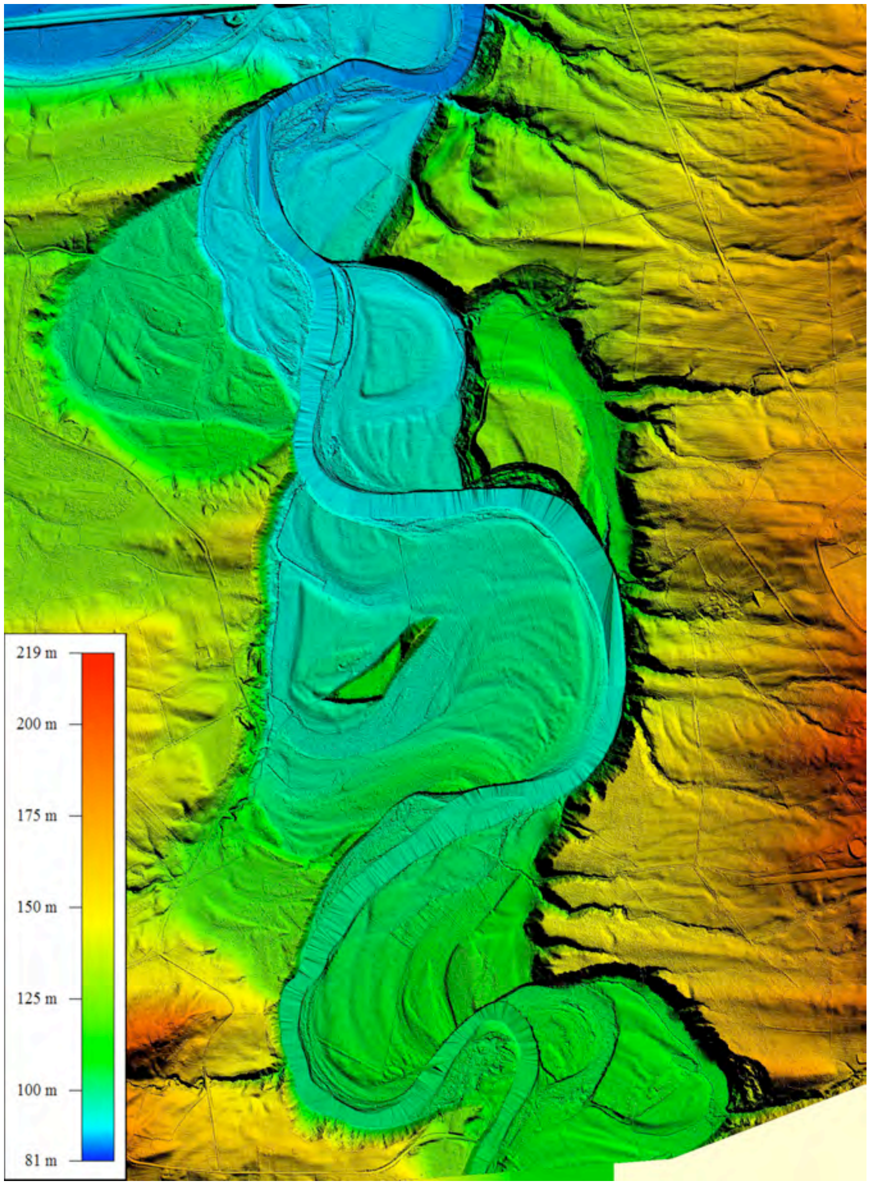
Mohawk Watershed Symposium

2010



Abstracts and Program

Olin Center, Union College
Schenectady NY
19 March 2010

Preface

We are making progress. The Mohawk River Basin Program Action Agenda has emerged from the DEC and primary stakeholders, and in that initial blueprint for action has emerged a mission that is at the heart of much of what we are all concerned with:

The mission of the Mohawk River Basin Program is to act as coordinator of basin-wide activities related to conserving, preserving, and restoring the environmental quality of the Mohawk River and its watershed, while managing the resource for a sustainable future. Vital to the success of the program is the involvement of stakeholders and partnerships with established programs and organizations throughout the basin.

An important emerging consensus is that integrated watershed management is the key to our future success. Ecosystem Based Management is a clear and explicit guiding principal that now appears to be integrated and fully woven into the fabric of our future direction. With the NYS Department of State's decision to support the Mohawk River Watershed Coalition of Conservation Districts' proposal to implement a Comprehensive Watershed Management Plan for the Mohawk Basin.

We can now look to the Mohawk Watershed Coalition of Conservation Districts, recently funded by NYS Department of State, to implement the different facets of the Comprehensive Watershed Management Plan for the Mohawk Basin.

This is the second annual symposium on the Mohawk Watershed and we are proud to present a full and interesting program with excellent papers and ideas that cover a wide range of topics in the Watershed.

We hope that the continued spirit of information exchange and interaction will foster a new and better understanding of the intersection between Science, Engineering, and Policy in the watershed.

John I. Garver   Jaclyn Cockburn

On the cover: Bare earth LiDAR image of the lower reaches of the Schoharie Creek in Montgomery County (see Marsellos et al., 28). The image shows the current river channel as well as a series of abandoned meander scrolls left from progressive and continuous downward incision since deglaciation. A small part of I-90 can be seen on the image on the top left. LiDAR provides us with an unprecedented view of topography and landforms. On this image the small elevation differences of roads and ditches can be seen. This is a "bare-earth" model, which means that vegetation and many anthropogenic features (such as houses) have been removed.

Mohawk Watershed Symposium - 2010
19 March 2010, Olin Center, Union College, Schenectady NY

- Final Program -

Friday 19 March 2010

Oral session (Olin Auditorium) - Registration and Badges required

8:30	*8:50*	***Registration, Coffee. Olin Foyer***
8:50	*9:00*	**Introductory remarks** *John I. Garver, Geology Department, Union College*
9:00	*9:25*	**Mohawk River: Erie Canal; Its one in the same (Invited)** *Howard Goebel, Canal Hydrologist, New York State Canal Corporation*
9:25	*9:42*	**EST: Linking watershed protection with youth development through community based volunteer stream monitoring programs in the Mohawk Watershed.** *John McKeeby, Executive Director, Schoharie River Center*
9:42	*9:59*	**Comparative analysis of volunteer and professionally collected monitoring data** *Kelly Nolan, Director of Environmental Services, Watershed Assessment Associates*
9:59	*10:16*	**Ice jam history, ice jam mitigation training and ice jam mitigation efforts in the Mohawk River Basin** *John Quinlan, Lead Forecaster, National Weather Service, Albany, NY*
10:16	*10:33*	**Learning through experiments and measurements: the Mohawk Watershed as an outdoor classroom** *Jaclyn Cockburn, Geology Department, Union College*
10:33	*11:03*	***COFFEE and POSTERS (see below for listing)***
11:03	*11:28*	**A new look at the formation of Cohoes Falls (Invited)** *Gary Wall, Hydrologist, United States Geological Survey*
11:28	*11:45*	**Weather and climate of the Mohawk River Watershed** *Steve DiRienzo, Senior Service Hydrologist, NOAA - National Weather Service*
11:45	*12:02*	**Landslides in Schenectady County** *John Garver, Geology Department, Unoion College*
12:02	*12:19*	**Use of high-resolution LiDAR images to identify slopes with questionable stability along the Mohawk River banks** *Ashraf Ghaly, Department of Engineering, Union College*
12:19	*12:36*	**Historic flooding at selected USGS streamgages in the Mohawk River Basin.** *Thomas Suro, Hydrologist and Engineer, United States Geological Survey*
12:36	*13:46*	**- LUNCH -**
13:46	*14:11*	**FEMA flood maps, flood risk and public perception (Invited)** *William Nechamen, DEC NYS*
14:11	*14:28*	**Peak shaving: An approach to mitigating flooding in the Schoharie and Mohawk Valleys** *Bob Price, Dam Concerned Citizens*
14:28	*14:45*	**US Army Corps of Engineers approach to watershed planning** *Jason Shea, Civil Engineer/Watershed Planner, US Army Corps of Engineers*
14:45	*15:02*	**The Hudson and the Mohawk: working together** *Frances Dunwell, Hudson River Estuary Coordinator, New York State Department of Environmental Conservation*
15:02	*15:32*	***COFFEE and POSTERS (see below for listing)***

15:32	*15:57*	**Mohawk River Watershed Coalition of Conservation Districts and its comprehensive Watershed Management Plan (Invited)** *Amanda Schaller, Resource Conservation Specialist, Montgomery County Soil & Water Conservation District*
15:57	*16:14*	**The case for conservation releases from the Gilboa Dam: impact on riparian habitat and water availability on the Schoharie Creek** *Howard Bartholomew, Dam Concerned Citizens*
16:14	*16:31*	**Protecting water quality through a watershed approach** *Kevin Millington, Coastal Resources Specialist, New York State Department of State*
16:31	*16:48*	**An overview of water rights in New York State** *Frank Montecalvo, Consultant, West Canada River Keepers*
16:48	*16:58*	**Discussion and Conclusions** *Jaclyn Cockburn, Geology Department, Union College*

Symposium Reception (Old Chapel) 5:30 PM to 6:30 PM, Dinner and Keynote to follow

Poster session (all day)

F1	**The Gilboa Dam and the role of Dam Concerned Citizens as a citizens' advocacy group** *Sherrie Bartholomew, Dam Concerned Citizens*
F2	**Methods and techniques of stabilization of soil slopes** *Ashraf Ghaly, Department of Engineering, Union College*
F3	**West Canada Creek Watershed Map** *Kathy Kellogg, West Canada Creek Riverkeepers*
F4	**Colloidal concentration estimation using ADCP echo intensity** *Bill Kirkey, Research Assistant, Clarkson University*
F5	**Thermal characteristics of Schohaire Creek and its consequences for Brown Trout *(Salmo trutta)*** *Ashley Kovack, Environmental Science Program, Union College*
F6	**A late Holocene record of Mohawk River flooding preserved in a sediment core from Collins Pond in Scotia,** *Mark Krisanda, Environmental Science Program, Union College*
F7	**Aqueous photolysis of organic ultraviolet filter chemicals** *Laura MacManus-Spencer, Chemistry Department, Union College*
F8	**Mapping and volumetric calculation of the January 2010 Ice Jam flood, lower Mohawk River, using LiDAR and GIS** *Antonios Marsellos, Research Associate, Geology Department, Union College*
F9	**Determination of historical channel changes and meander cut-off points using LiDAR and GIS in Schoharie Creek, NY** *Antonios Marsellos, Research Associate, Geology Department, Union College*
F10	**A tree-ring record of slope stability along Sandsea Kill, Schenectady County, NY** *Nicole Reeger, Environmental Science Program, Union College*
F11	**The effects of storm duration and intensity on the urban watershed** *William Schoendorf, Geology Department, Union College*
F12	**Schenectady County Environmental Advisory Council (SCEAC) and its activities related to water and climate** *Mary Werner, Chairperson, SCEAC*

Symposium Reception (Old Chapel) 5:30 PM to 6:30 PM, Dinner and Keynote to follow

Keynote Address:

Gail Shaffer - Watershed Wisdom: The Politics of Change

Ms Shaffer will share her reflections on drawing upon her experience in the public policy arena and in the non-profit sphere, to identify strategies of value to citizens in effecting change in our challenging political climate

Gail Shaffer is a native of the northern Catskill Mountains, having grown up on a farm in Blenheim, in Schoharie County. Her public service career spanned two decades. She served twelve years as New York Secretary of State. Prior to that she served in the New York State Assembly, representing Schoharie County and parts of Albany, Schenectady, Montgomery and Delaware Counties. She began her public career as a town supervisor and county legislature. She graduated summa cum laude from Elmira College, majoring in political science. A member of Phi Beta Kappa and valedictorian of the class of 1970, she also studied political science at the University of Paris during her junior year. Locally, she attended a one-room schoolhouse in Blenheim and graduated from Gilboa Conesville Central School.

Currently a writer, Shaffer is among the founding board members of Dam Concerned Citizens, Inc., a not-for-profit watchdog organization that advocates for dam safety at Gilboa Dam (Schoharie Reservoir) as well as statewide, nationally and globally.

For details and further background material refer to the Shaffer and Currie abstract (p 61) Citizen Participation: Grassroots organizing to impact policy - Dam Concerned Citizens as a case study

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THE CASE FOR CONSERVATION RELEASES FROM THE GILBOA DAM: IMPACT ON RIPARIAN HABITAT AND WATER AVAILABILITY ON THE SCHOHARIE CREEK

Howard R. Bartholomew

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Thirty-five miles north of its origin at Acra, Greene Co., NY at an elevation of 2,500' the Schoharie Creek ceases, for some considerable distance, being a perennial stream. Perennial, or "year round" steams occur where ground water and surface water systems are naturally and hydraulically connected. As a result of the 2000' long, 182' high Gilboa Dam, the Schoharie Creek below the dam is transformed into an intermittent stream. Even in times of drought, perennial streams keep flowing at a reduced rate. This is because ground water continues to supply water to these creeks, rivers, etc. in spite of a lack of surface water or run-off. Unlike perennial streams, intermittent streams stop running during dry weather. Intermittent streams are normally found in arid regions such as the American South West. They are sometimes referred to as dry gulches (1). Some ravines in the Catskills, which were once conduits for melt water from the glaciers at the end of the Pleistocene, are seasonal or intermittent in their flow. One does not normally expect to see a stream in a wet region like the Catskills become intermittent. So effective is the Gilboa Dam, its grout curtain and cutoff trench in halting down stream flow of the Schoharie Creek, below the dam that the creek literally "dries up" for a distance of .8 miles until the creek is revived by a minimal discharge from the Platter Kill USGS #01350120. As this tiny stream has a catchment of only 10.9 sq. miles, its contribution to the Schoharie Creek is negligible. A table showing Platter Kill flow for a 33-year period can be found www.dccinc.org. The annual phenomenon of the Schoharie Creek going dry below the Gilboa Dam generally occurs during the summer months of June-September. USGS surface water annual statistics for site #01350000, Prattsville, NY and site #01350101. Gilboa, NY can be found at the dcc web site and the figures speak for themselves. It can best be summed up by the USGS itself in describing the situation at Gilboa as "entire flow, run off from the 315 sq. mile, except for periods of spill, diverted from Schoharie Reservoir through Shandaken Tunnel into Esopus Creek upstream from Ashokan Reservoir for water supply of City of New York". An equally dramatic example of the impact of the diversion of Schoharie water to Ashokan Reservoir is in the chart "Burtonsville vs. Prattsville". Burtonsville is 41 miles, by creek, North of Prattsville. Burtonsville, USGS # 01351500 has a catchment area of 649 sq. miles below the Gilboa Dam, as compared to the 237 sq. mile drainage basin at Prattsville. It is were not for the substantial ground water resources of the Schoharie Valley, the Schoharie Creek at Middleburgh would be nearly as low as it is below the Gilboa Dam during the dry summer months (2). Tributary flow is not measured below the Mine Kill, USGS #01350140 which enters the Blenheim-Gilboa Power Project Reservoir and USGS maintains three more gauge stations below the PASNY Pumped Storage Reservoir, Blenheim, NY, USGS #01350180, Breakabeen, NY, USGS #01350355, and Burtonsville, NY. Several stream flow data sheets can be found at www.dccinc.org showing there to be more water at Prattsville than at Burtonsville! This is not an anomaly; it happens every year.

We will now briefly turn our attention to the tributaries below the Gilboa Dam that enter the Schoharie Creek. As the Schoharie Creek channel is of pre-glacial or perhaps inter-glacial origin, it has many "hanging valleys", where smaller alpine glaciers met the larger ice sheet that advanced and retreated only to re-advance several times during the Pleistocene Epoch (3). These hanging valleys are characterized with having one or more water falls. All these tributaries of the Schoharie Creek in Schoharie County contain Char, Brook Trout (*Salvalinus fontinalis*), Brown Trout (*Salmo trutta*), and Rainbow Trout (*Salmo gardneri*). The latter two species are introductions in the Schoharie. All three species move seasonally between the main stem river, or "Big Creek" as it is referred to locally, to the mouths of the "tribs" seeking thermal refuge in the warmer months. Deep, scoured "spring holes" abound in the Schoharie, proper, and are fed by ground water. Two major tributaries of the Schoharie flow over and originate in limestone. They are Foxes Creek, which enters north of the village of Schoharie from the east, and the Cobleskill Creek, which enters the main river from the west, and has a little known water falls formed over thick sandstone beds near the top of the Schenectady Formation. Near by is the outfall of spring water from Jack Patrick's Cave system. Foxes Creek has numerous springs and cave water sources. An excerpt from Jeptha Simms, "The History of Schoharie County and Border Wars", published in 1846 gives an account of the fish present in the region when it was first settled by Europeans in the early 18th century. On pages 86-87 Simms states, "Fish are said to have been very plentiful formerly in most of the streams in Schoharie County. For many years after the Revolution, trout were numerous in Foxes Creek, where now there are few, if any at all. From a combination of causes, fish are now becoming scarce throughout the county. In many small streams, they have been nearly or quite exterminated by throwing in lime. This cruel system of taking the larger fish destroys with more certainty all the smaller fish. Such a mode of fishing cannot be too severely censured. The accumulation of dams on the larger streams proves unfavorable to their multiplication. Fine pike are now occasionally caught in the Schoharie, as are also suckers and eels. Some eighty years ago, a mess of fish could have been taken, in any millstream in the county, in a few minutes." Conditions have improved considerably since this was written more than 150 years ago.

Another reference to the presence of Brook Trout in the main stream of the Schoharie can be found in "The Ultimate Fishing Book", edited by Lee Eisenberg and DeCourtney Taylor, Houghton Mifflin, Co., Boston 1981, p. 56. In a chapter entitled "Opening Days", by the late Ernest Schwiebert we read, "The Schoharie is still a native brook-trout fishery in its headwaters on the timbered summits of Indianhead. Its gathering currents riffle over ledges there, through vast thickets of rhododendron and the overgrown walls of abandoned colonial farms and it tumbles through huge boulders in other places. The swift runs and pools above Hunter are classic Catskill water, and in the valley at Lexington, it becomes a series of sweeping riffles and smooth flats. There are deep ledge rock pools downstream, and before the Gilboa Reservoir (sic) warmed its lower mileages, the old-timers told us, there had been excellent trout fishing as far downstream as the covered bridge at Blenheim". Two Brook Trout, caught simultaneously on a "3 fly" cast on May 28, 2008, bears out this statement by Schwiebert. These fish were caught 1 mile downstream of the Covered Bridge at North Blenheim at the mouth of a cold-water spring, in a 14' deep, scoured hole in the main stem of the Schoharie. It was not a "fluke" or a one-time occurrence. All three species previously mentioned are found below the Gilboa Dam in spring holes. Pictures of the aforementioned fish, a map showing the tributaries of the Schoharie Creek within Schoharie County, and a map of karst areas for a portion of the Schoharie Valley can be found at www.dccinc.org.

The impact of the Gilboa Dam on the fishery of the Schoharie Creek has been great over the last 82 years, but it has not been devastating. Walleyes or Pike Perch (*Sander vitreus*), referred to by Simms a "pike", can be found in the big pools or eddies of the Schoharie. However, the supply of invertebrates such as fly larvae, hellgrammites and crayfish, a considerable food source of Walleye, is negatively impacted by low surface flow through riffle areas that connect the big pools of the Schoharie Creek below Gilboa. The elevation of the Schoharie at the base of the Gilboa Dam is 939.56'; it is 507.98' at Burtonsville. As there are about 40 miles of stream between these two gauge stations, the average rate of fall is about 10.8' per mile. There are three greatly eroded ledge rock falls on the Schoharie between Gilboa and Burtonsville: one above the Covered Bridge, North Blenheim; a second at Frisbieville between Middleburgh and Schoharie; and one a short distance upstream from the gauge at Burtonsville. There is a smaller ledge of Onondaga Limestone just north of Middleburgh. As none of these falls are very high, the rate of drop per mile is relatively uniform. It is in the area of drop between pools that the riffles occur. It is these very riffle areas that suffer most when the Gilboa Dam stops spilling, as surface water diminishes so greatly in volume. The annual rainfall for Schoharie Co. is 38.1", according to the Progressive Farmer website of 2008, and the average rainfall for the Schoharie Watershed above the Gilboa Dam is 41" (www.gcswcd.com/stream/schoharie.eastkill/schohariecreeksmp), a difference of three inches.

With the Gilboa dam acting as a diversion for the upper reaches of the Schoharie Creek, the downstream sections of the river are in essence deprived of the at least three inches of rain per year. This difference, above and below the Gilboa Dam, is very detrimental to riffle flow between pools on the lower reaches of the Schoharie Creek. A fair question is: Where could the water "come from" to create a base level flow of 50-75 cfs at Gilboa, in times of non-spillage of the dam? The rainfall chart found at www.dccinc.org shows annual average precipitation, actual precipitation and a trend line (supported by local evidence) for the Schoharie Creek Region. Also, included are annual weather summaries for the years 2006-2008. More rainfall is falling in the watershed in 2009 than there was at the time the Gilboa Dam was built. Accompanying the over 14% increase in rainfall in the watershed, is the fact that NYCDEP, operators of the Gilboa Dam and Schoharie Reservoir, are limited to allowing no more than a combined flow of 300 million gallons per day (mgd) from the Esopus Creek (as measured at Allaben, NY, site #01362200) and the outfall of the Shandaken Tunnel during the months of June-October. This seriously impacts the output of the Shandakan Tunnel in the summer months when water is so desperately needed in the Schoharie Creek north of the Gilboa Dam. Using information provided by USGS on monthly water statistics for the Esopus Creek at Allaben, we find that the average discharge for the Esopus Creek upstream of the Shandaken Tunnel for the months of June-September for 1963-2007 was as follows: June-118 cfs, July-59 cfs, Aug.-39 cfs, and Sept.-60 cfs. Converting the cfs values to millions of gallons per day, we get the following: June-76.3 mgd, July-38.1 mgd, August-25.2 mgd, and Sept.-38.8 mgd. Subtracting these figures from the 300 mgd limit imposed by the "SPDES" Permit, we arrive at the following average limits for discharge from the Shandaken Tunnel: June-223.7 mgd, July-261.9 mgd, Aug-274.8 mgd, Sept.-261.2 mgd. Converting these mgd amounts to cfs we arrive at the following for cubic feet per second output for the Shandaken Tunnel: June-374.74 cfs, July-405.13 cfs, Aug.-425.13 cfs, and Sept.-404.13 cfs. As the carrying capacity of the Shandaken Tunnel is over 900 cfs at its present state (4), we see that large quantities of water are left in the Schoharie Reservoir during times of SPDES compliance by NYCDEP. The installation of an Obermeyer Gate system in the 220'x5.5' deep notch in the spillway portion of the Gilboa Dam will allow a full pool level of 1130' to be achieved as it was during the years from 1972-2005, prior to the emergency declaration at Gilboa. Obviously some of the "extra water" could and should be used for Conservation Releases from the Schoharie Reservoir. This is factually demonstrated from the following figures based on actual monthly discharges and their mean monthly quantities over a given number of years. Some of the measurements are based on records collected for over century, such as the records kept on Schoharie flow at Prattsville. Others are of a shorter duration, such as Toad Hollow. (All relevant tables are found at www.dccinc.org)

Water input Schoharie Reservoir from USGS Monitored Sources
based on mean of monthly discharges (cfs) for given years

	June	July	Aug.	Sept.	June-Sept. avg. of total input
Prattsville (1902-2008)	317.00	159.00	126.00	197.00	
Toad Hollow (1998-2008)	2.10	0.46	0.48	1.30	
Bear Kill (1998-2008)	47.00	15.00	14.00	27.00	
Manor Kill (1986-2008)	42.00	17.00	12.00	19.00	
Total input	408.00	191.46	152.48	244.30	249.06 cfs

Water diverted from Schoharie Reservoir (cfs) since SPDES Compliance (2005-2008) by NYCDEP

	June	July	Aug.	Sept.	June-Sept. avg.
Shand. Tunnel	209.6	227.3	189.8	199.6	206.57 cfs

Based on the latest discharge figures since the SPDES constraints have been in effect, we see that the month of June had a 198.40 cfs "surplus" over "output" from the Schoharie Reservoir; the month of July had an output of 35.70 greater than combined reservoir input; Aug. was a negative figure also at 37.74 cfs, Sept. was positive 44.7 cfs over output. Taken all together, we find that for the periods mentioned, which are four driest months, there were 42.42 cfs more water going into the Schoharie Reservoir than were being sent to the Ashokan Reservoir via the Shandaken Tunnel.

At present, full pool elevation in the Schoharie Reservoir is 1124.5' due to the 220'x5.5' ungated spillway notch, forming a capacity of about 18 billion gallons. Once the Obermeyer Gate system is installed, scheduled for fall of 2009, full pool level will be restored to 1130', with a capacity of 19.583 bil. gal.. This additional 1.5 bil. gal. ensures the ability of the Schoharie Reservoir to meet its water supply requirements to the Ashokan Reservoir, while providing conservation releases to the Schoharie Creek, north of the Gilboa Dam. Mark Twain is quoted as saying that there are 3 forms of falsehood...in order of magnitude: a lie, a damn lie, and a statistic. A lot of figures have been presented in this paper. They can all be found in the appendix at www.dccinc.org and those who read this paper are invited to draw their own independent conclusions on the veracity of DCC, Inc.'s position that sufficient water exists for conservation releases, without impairing in any way the quantity or quality of water discharged through the Shandaken Tunnel. DCC, Inc. is not asking for the coldest portion of the water column in the Schoharie Reservoir. The fishery of the Esopus Creek has come to depend upon that water. Rather, the Schoharie Creek needs flow to connect the spring fed eddies. Furthermore, reasonable people would consent to a temporary cessation of conservation releases, during times of drought or other emergency of any kind, if they were "ramped down" in an orderly manner over a period of 12-24 hours. Pictures at www.dccinc.org show results of the abrupt stopping of dam spillage that occurs when the Shandaken Tunnel discharge is suddenly increased to full capacity.

Thus far, we have dealt with matters pertaining to geology, the environment, hydrology and engineering. We will now turn our attention to a very troubling legal issue. This issue is the agreement reached in the settlement of a case brought by the City of New York against the NYS Department of Environmental Conservation, in the Supreme Court of the State of New York, County of Albany, Index #5840/80. It was resolved by a stipulation of discontinuance, which means that NYSDEC Commissioner Robert F. Flacke agreed to terms set out by the City of New York concerning conservation releases from New York City owned reservoirs. In a nutshell, the "City" would drop its case against NYSDEC if the commissioner consented to abide by certain stipulations. The full text of this stipulation of discontinuance can be found at www.dccinc.org. The second article of this agreement states that "New York State will not at anytime require releases from Schoharie, Ashokan or Kensico Reservoirs, except as provided herein…".

For several years people concerned with the Schoharie Creek and the Gilboa Dam have heard vague allusions to some law or agreement that exempted NYCDEP from making conservation releases from the Schoharie Reservoir. The aforementioned stipulation of discontinuance is the reason the NYCDEP has heretofore never participated in conservation releases from the Schoharie Reservoir. Stipulation rhymes with capitulation and that is what it amounts to in our eyes. For a Commissioner of the Department of Environmental Conservation to sign such an agreement is beyond belief. This case is to the environment what the Dred Scott decision is to civil rights. It is a wrong that must be righted, a legitimate grievance that must be redressed. The stipulation of discontinuance is 30 years old this October and "a lot of water has gone over the dam" in terms of environmental awareness since 1980. "Tunnel Vision" in reservoir operation is as bad as narrow mindedness in any other endeavor. A reasonable, intelligent exchange of ideas can lead to an equitable sharing of the water resources of the host or donor communities in the Catskills and the recipients of the vital water they require. With the impending reconstruction of the Gilboa Dam, the time is NOW!!!

Footnotes

1. Water Encyclopedia-Ground Water: Hydrologic Cycle, Patricia S. Irle, internet.
2. Ground Water Resources of Schoharie Co., NY, Jean M. Berdan, p. 28.
3. Ground Water Resources of Schoharie Co., NY, Jean M. Berdan, p. 27.
4. Susquicentennial Gilboa, NY, 1848-1998, Linda Trautman, Stratigos, ed., p 71.

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Dam Concerned Citizens, Inc. would like to express its gratitude to the United States Geological Survey and their website, "Real-time Data of New York Stream Flow" and their many useful links.

GILBOA DAM/SCHOHARIE RESERVOIR: CONCERNS, ISSUES AND PROPOSALS

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Dam Concerned Citizens, Inc., a citizen advocacy group, is currently focusing on issues directly related to the renovation of the Gilboa Dam, a project that will be ongoing until 2016. Since its creation in 2005, the paramount concern of DCC has been the rehabilitation of the Gilboa Dam and all appurtenant infrastructure to the highest possible factor of safety. DCC's board of directors, composed of Schoharie, Montgomery and Schenectady County residents living downstream of the Gilboa Dam, are advocates for the public before local, state and federal government.

Issues currently being pursued by DCC include (1) a continuous, sub-surface conservation release of reservoir water into the Schoharie Creek below the Gilboa Dam at a rate of 50-75 cfs. in times of non-spillage, (2) establishing a consortium composed of NYSDEC, NYCDEP, PASNY, Schoharie County Board of Supervisors, and Dam Concerned Citizens, Inc. which will develop a protocol for operating procedures for the Obermeyer Gates ("notch") and the required Low Level Outlet to mitigate flooding and to improve riparian habitat (3) the creation of a position of "public inspector" for the renovation work to be done on the Gilboa Dam commencing with phase 3, and (4) the support of the generation of hydroelectricity at the Schoharie Reservoir.

For a more in-depth description of each issue visit DCC, Inc.'s web site "www.dccinc.org".

LEARNING THROUGH EXPERIMENTS AND MEASUREMENTS: THE MOHAWK WATERSHED AS AN OUTDOOR CLASSROOM

Jaclyn Cockburn and John Garver
Geology Department, Union College

The ideal outdoor classroom engages students, provides simple effective discovery-based learning experiences in a setting that is familiar and accessible. Perhaps the most important aspect of watershed studies is that students see the science as relevant and important (Balmat and Leite, 2008). In our experience, we have found that field exercises in our courses make a powerful impact on students. In some cases these specific problem-based field studies have played a pivotal role in attracting students into science. An initial stumbling block for students studying a concept for the first time is making the connection between the textbook/lecture material and the real world. In addition, students although they attend school in Schenectady, may not be familiar with areas beyond the campus boundaries and the issue of Novelty Space (Elkins et al., 2008) may further impede the success of local studies. Through projects and field trips to areas close to campus, students are able to literally put their feet on the problem and see it for themselves. The benefit of the Mohawk Watershed is that there are a lot of processes and activities all within a short drive of campus, or at least manageable in a day trip (southern and western portions of the basin).

In several recent courses at Union College, students have been presented with problems or concepts in the classroom and then taken on varying field trips in order to develop a deeper understanding of the issue. In this paper, we discuss some of the positives and negatives in this venture and propose areas in which these experiences can be expanded.

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WEATHER AND CLIMATE OF THE MOHAWK WATERSHED

Stephen DiRienzo
NOAA/NWS Weather Forecast Office, Albany, New York

There is a relatively long record of weather observations for Albany, New York, with continuous monthly data extending back to 1820. The Albany weather observation is taken at the Albany Airport, which is in the Mohawk River Watershed. The Albany weather record is assumed to be a good proxy for examining long term trends or cycles in the watershed. Weather data from the official records, which are located on site at the National Weather Service Office in Albany, was entered into a spreadsheet for analysis. Charting Albany precipitation, temperature and snowfall data reveals cycles on the order of 100 years in precipitation and snowfall. These cycles appear to correlate well with past flood/drought cycles in the watershed. In presenting these data, we will learn about past climate cycles of the watershed and the clues they hold about possible future trends in the Mohawk River Watershed.

THE HUDSON AND THE MOHAWK: WORKING TOGETHER

Fran Dunwell
Hudson River Estuary Coordinator
NYS Department of Environmental Conservation

The Mohawk River is the major tributary of the Hudson. Historically and culturally, the Hudson and the Mohawk share common traditions influencing American life: together, the set the stage for American victory during the Revolutionary War; they launched the American transportation revolution and American engineering; their natural beauty became a focus of new movements in art and literature; and together, they forged New York state into an economic powerhouse that is now memorialized in the term Empire State. The unique natural resources, river ecosystem and geography of the Hudson-Mohawk river system underlie all these successes.

Today, the future of these river systems is at a crossroads. Major recovery efforts have focused on the environment of the Hudson main stem for the last 20 years. Environmental clean-up has been a major source of economic stimulus for the Hudson Valley region. There is an opportunity to do the same for the Mohawk, using the successful model of the Hudson River Estuary program to adopt and implement a Mohawk River Action Agenda. This presentation will review what we can learn from the Hudson estuary experience and will explore ways that the Mohawk and Hudson can mutually support each other, renew our bonds of connection and write a new chapter of history for this unique river system.

Hudson River Estuary Action Agenda, seeks to

Ensure clean water
Protect and restore fish and wildlife habitats
Provide recreation in and on the water
Adapt to climate change
Conserve the scenic landscape

Through this work, the Estuary Program is helping people enjoy, protect and revitalize the Hudson River and its Valley.

For more information on the Estuary Program see http://www.dec.ny.gov/lands/4920.html

HISTORICAL LANDSLIDES AND PRECIPITATION TRENDS IN SCHENECTADY COUNTY, MOHAWK RIVER WATERSHED, NY

John I. Garver, Amanda L. Bucci, Benjamin Carlson, Nicole Reeger, Jaclyn Cockburn
Geology Department, Union College,
Schenectady NY June, 2009

A landslide is the downslope movement of a mass of rock, soil, or colluvium that occur on a variety of spatial and temporal scales. Failure occurs when the force of gravity exceeds the strength of the surface material on a slope and this condition is commonly facilitated by high pore pressures resulting from saturated conditions (Spiker and Gori, 2000). The US Disaster Mitigation Act of 2000 resulted from the recognition that pre-disaster planning is necessary to reduce losses, and because of the funding available at the state and local level, this act has fostered an increased attention on landslides, and other natural hazards that affect local municipalities. While most areas of the Mohawk watershed are not prone to landslides, they do occur and it would appear that we are in a period of enhanced hillslope instability. This observation has implications for sediment mobility and sediment availability in the watershed. In light of this, we have undertaken a multiyear effort to inventory landslides and evaluate the slip history of those amenable to study.

The New York State hazard mitigation plan reviews a number of different hazards that the State faces annually, all with different probabilities and risk factors. In the NYS Multi-Hazard Mitigation Plan, the Sate Emergency Management Office (SEMO), defines landslides as the downward movement of a slope and materials under the force of gravity. This definition includes a wide range of ground movement, such as rock falls, deep slope failure, shallow debris flows natural rock, soil, or artificial fill.

In the SEMO analysis of landslides, a key issue is the triggers that induce movement on marginally stable slopes. These triggers, which are naturally occurring or human-induced, include: 1) water saturation of the ground, and 2) mass redistribution (increased mass at the top of a slope or removal support from the bottom). Here we are primarily concerned with understanding water saturation and the affect increase in pore pressure has on slope stability because this pre-condition has a regional effect.

Our work includes a historical survey and scientific findings from dendro-geomorphology conducted on several key unstable slopes in Schenectady County, NY. Tree-rings of tilted conifers are used here to determine the slip history of several unstable slopes in the watershed. Schenectady County had been involved with ongoing landslide mitigation efforts that started in a small but fatal slip that occurred in downtown Schenectady in January 1996. Since that time, the county and the city of Schenectady have been directed mitigation efforts that were largely driven by several new landslides that caused dramatic damage to residential areas.

Federal mandates in the last decade have resulted in attention being focused on disaster mitigation. The US Disaster Mitigation Act of 2000 includes funding for mitigation activities, developing hazard maps, and creating a Hazard Mitigation Grant Program (HMGP). The HMGP is a national program in the US where counties can apply for grant money to use towards natural hazard mitigation and relief, provided the county has created an All Hazard Mitigation Plan (AHMP).

New York has a relatively low landslide potential with the exception of failure-prone glacial lake clays that occur widely in the Hudson lowlands, and locally elsewhere, especially in the Finger Lakes area. Schenectady County, in east central New York State, has many slopes underlain by unconsolidated material susceptible to mass movement.

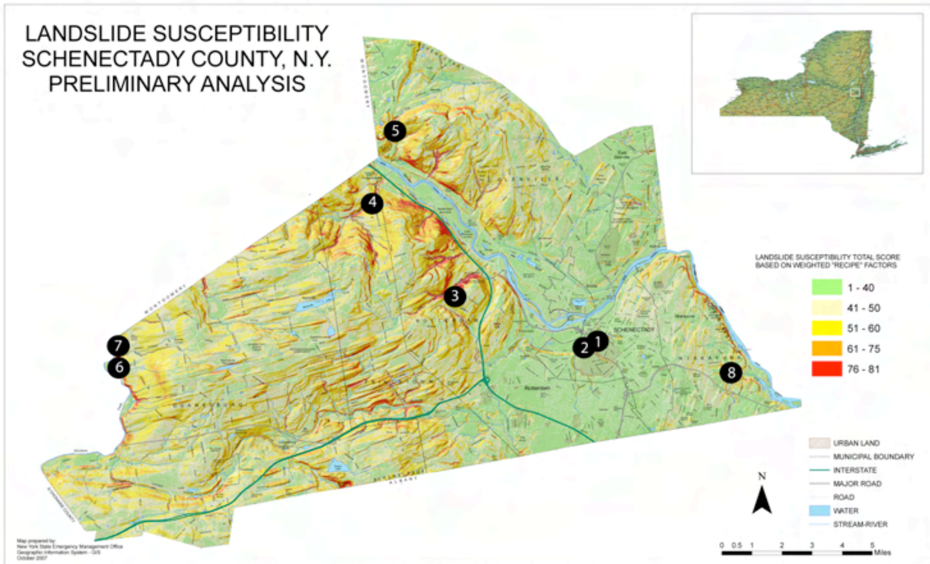

Figure 1: Preliminary Landslide Susceptibility map for Schenectady County, NY prepared by the USGS, NY State, and Schenectady County (map is unpublished but available from NY State Disaster Preparedness Commission, 2008 and Keppel and others, unpublished). Locations of significant landslide activity in Schenectady County that we have investigated: 1. Broadway, Tel Oil; 2. Broadway, SI plant; 3) Plotterkill Preserve; 4) Sandsea Kill; 5) Wolf Hollow; 6) Bowman Creek; 7) Burtonsville; 8) Lisa Kill.

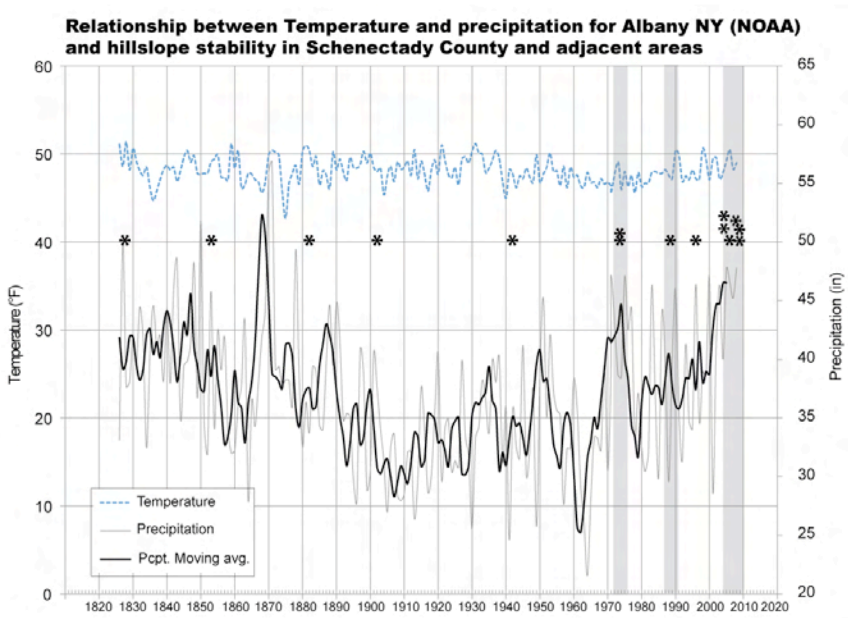

Figure 1: Plot showing precipitation and temperature for Albany (the longest record in the Capital District). Precipitation is shown as the total annual (light continuous line) and a 3 yr moving average (dark line). Shown on the graph are known periods on ground instability (starting year show). Solid gray fields at 1972-75, 1988-89, and 2005-2009 are periods of widespread instability (recognized at more than one location). Includes analysis or historical reports from Plotterkill, Bowman, Burtonsville, Cranes Hollow, Broadway. This trend of wetter conditions is recognized elsewhere in the region (Burns et al., 2007).

The city of Schenectady sits along the Mohawk River valley, which is underlain by glacial till, glacial lake clays, and fluvial deposits that are then cut and incised by post-glacial erosion. Landslides, debris flows, mudslides, and slumps on these hillsides have occurred for some time, but the best historical record is of those hillslopes in and around the city of Schenectady, Troy, and other communities.

The oldest records of landslides in Schenectady have been partly gleaned from historical archives and this survey work uncovered a partial history that included specific events that occurred in September 1853, October 1903, January 1996, March 2004, and February 2007.

The January 1996 slide was small, but it was one of the most significant in recent history because it resulted in a fatality (#1, Fig. 1). With heavy precipitation on top of snowmelt during this mid-winter thaw, a landslide was triggered on the Broadway slope by I-890 at the Tel Oil Co. On March 2004, there was a landslide by the SI Group (Schenectady International) building located slightly to the south, also on Broadway, just south of the Tel Oil Co. incident (#2, Fig. 1). The SI Slip is related to a month-long period of higher than normal precipitation and available surface water.

In January 2008, the City was awarded FEMA grant of $1.13 m for this project after slides along this hill caused a number of homes at the top (near the crown) were seriously affected. Nearby on a slope continuous with the SI site, in February of 2007, state contractors were clearing debris from a culvert on a slope near the Michigan Avenue exit (Exit 6) off I-890, a slide occurred that buried equipment. Thus this area is slide prone and a historical perspective of these events is of interest to county planners (Kalohn and others, 2007).

In the wake of all this activity, Schenectady County participated in a unique Landslide Susceptibility Pilot Study in 2007 in which a landslide susceptibility map was produced for the county (Kappel and others, unpublished; see Fig. 1). This map has been a key factor in focusing attention on the geology and mechanisms of landslides in the country. On this map, the a number of areas were mapped as having the highest hazard, based on a combination of five relevant factors including soil composition, relief, and slope aspect. This mapping project was an outgrowth of efforts related to the development of the Schenectady County AHMP (Kalohn and others, 2006) and was done as a collaborative effort between N.Y. State Emergency Management Office, N.Y.S Geological Survey, U.S. Geological Survey, and Schenectady County.

Our work has focused on trying to quantify both the spatial and temporal scale of landsliding and hillslope instability in Schenectady County. To accomplish this inventory, we have primarily used dendrogeomorphology to determine the slip history of unstable slopes including active slow-moving earth flows in these areas identified as having high landslide susceptibility (sites 3,4,6,7 and 8 on Fig. 1).

We have focused on unstable slopes with living (or recently killed) *Tsuga canadensis* (Eastern Hemlock), as the ring record of this species is very distinct relatively unambiguous. *Tsuga canadensis* shows a clear and distinctive response to stem tilting, which is ring asymmetry and the production of lignin-rich reaction wood (see Fig. 3). In most of our analysis of tilted trees we have a 100-150 yr history of ground movement. We emphasize that our work continues and we are working on a number of active slopes.

In the last century, there is a clear pattern that is common to a number of slopes. There are periods of inactivity and periods of activity. Because several key active periods are common from slope to slope, it is likely that this ground motion was driven by rainfall-induced reduction in pore pressure.

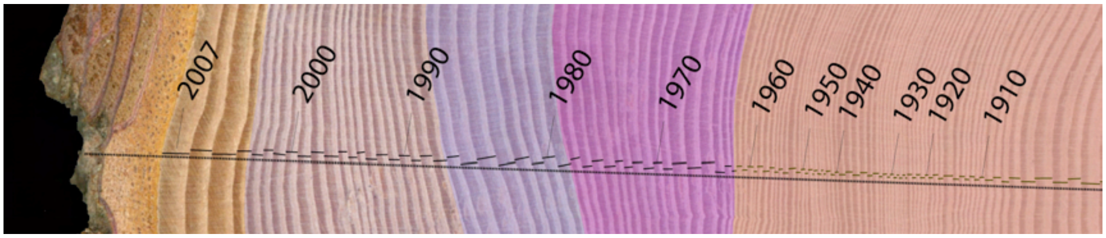

Figure 2: Slice of Tsuga canadensis (Eastern Hemlock) that was growing on the Bowman slide, but was then knocked over and killed in the 2008 slip event. Note that the downslope side of the conifers grow reaction wood (dark park in the annual light-dark bands) in response to tree tilting. This tree tilted and grew in response in 2005, and ground failure occurred in 2008 (from Bucci and Garver, 2009).

In the last century, there is a clear pattern that is common to a number of slopes. There are periods of inactivity and periods of activity. Because several key active periods are common from slope to slope, it is likely that this ground motion was driven by rainfall-induced reduction in pore pressure.

The last decade has been the wettest ten-year interval in Albany NY since 1878 as revealed by NOAA records. In addition, the Northeast has seen an increase in the number of extreme precipitation events – defined as total precipitation per event > 2 in (Frumhoff and others, 2007). We have seen from the data that there is currently enhanced movement on hillslopes since 2005. Together, these findings would imply that we are entering a period of enhanced hillslope instability, similar to the 1970's, if not more dramatic. Our data seem to suggest that in part some of this hillslope instability is a result of reactivating material previously mobilized in the early 1970's. Simply put, this conclusion would suggest that hillslopes with a history of instability should be monitored closely for renewed activity.

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USE OF HIGH-RESOLUTION LIDAR IMAGES TO IDENTIFY SLOPES WITH QUESTIONABLE STABILITY ALONG THE MOHAWK RIVER BANKS

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(Oral Presentation)

High-resolution LiDAR images for the Mohawk River watershed were made available by the New York State Department of Environmental Conservation. With the aid of Geographic Information Systems (GIS), the slopes and aspects of the terrain within the Mohawk River's watershed and along its banks were derived from the LiDAR images. This process helps identify the slopes with critical or questionable stability that are in need for stabilization to avoid the hazard of landslide. The level of detail that LiDAR images exhibit can make the task of identifying the slopes with urgent need for attention reasonably accurate. It is a process that can be highly productive relative to field inspection and instrumentation, which requires the installation of devices and making measurements at locations of questionable stability. The benefits of such an analysis are the ability to analyze large volume of data that covers wide-spreading area with significantly less effort and time. Furthermore, early identification of potentially hazardous locations can help alleviate possible problems and damages in a timely fashion. This can potentially reduce the threats of sudden failure of embankments, structures, or roads.

METHODS AND TECHNIQUES OF STABILIZATION OF SOIL SLOPES

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(Poster Presentation)

There exist numerous techniques that can be utilized to stabilize a soil slope. Techniques vary considerably and the costs associated with them also vary significantly. Some of these techniques are as simple as planting a layer of deep-rooted vegetation on a potentially hazardous slopes, or as sophisticated as using tie-backs in conjunction with reinforced soil techniques. The use of geosynthetics for slope stabilization has also been implemented successfully in a variety of situations where drainage, filtration, and/or reinforcement were required. The need to ensure slope stability is coupled with the continuous exposure of scour and erosion that could endanger infrastructure facilities constructed along or across a river, such as the Mohawk. Facilities such as dams, bridges, piers, abutments, and roads could be impacted and even damaged if soil slopes were inadequately stabilized. This presentation will offer insight into various stabilization techniques, together with effective ways of implementation in a variety of situations and applications. In addition to the technical aspect of this subject, economic considerations and feasibility issues will be also factored.

COLLOIDAL CONCENTRATION ESTIMATION USING ADCP ECHO INTENSITY

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Suspended sediment concentration (SSC) plays a major role in determining the physical and biological characteristics of river systems. For example, sediment settling often necessitates dredging to maintain adequate depth in ports and channels. Also, many pollutants, such as polychlorinated biphenyls (PCBs), have a high affinity for sediment particles, making the transport of suspended sediment the primary means of dispersing such chemicals throughout the watershed (Orton, 2001). Recently, there has been interest in using acoustic doppler current profilers (ADCPs) to monitor suspended sediment concentrations (SSC) (Wall, 2006). The use of ADCPs for this type of measurement permits simultaneous multipoint measurements with high spatial and temporal resolution, as opposed to conventional single-point SSC measurements. Additionally, the combination of SSC measurements with identically resolved ADCP water current measurements enable the computation of suspended sediment discharge. However, because ADCP SSC measurements are based only on the intensity of reflected acoustic waves, they cannot elucidate any information on particle size distribution. Further, this echo intensity is a function of both SSC and size distribution. As such, using an ADCP to measure SSC requires either measurement or accurate assumption of particle size distribution.

Laser In-Situ Scattering and Transmissometry (LISST) is a technique, which uses laser diffraction to determine particle size distribution as well as overall SSC at a single point. In order to correlate ADCP echo intensity with LISST measurements, both types of instruments must be deployed within the same water column. Autonomous moored profiling sensor platforms, in which a suite of sensors is robotically maneuvered in order to monitor water quality at a range of depths, are ideal for such a deployment. Two such monitoring stations were developed and deployed during 2009 as part of the Rivers and Estuary Observatory Network (REON) operated by the Beacon Institute for Rivers and Esturaries in partnership with Clarkson University. With these platforms, the spatial and temporal measurement frequency can be specified as needed, provided that ample solar power is available to sustain the desired measurement rate. The data is automatically collected and archived, and visual data is available on the World Wide Web at www.bire.org. One platform, shown in Figure 1, was deployed in the Hudson River near Beacon, NY, and the other in the Grasse River (a tributary to the St. Lawrence River) in Massena, NY. Each profiling system is presently equipped with a particle analyzer (LISST-100x, Sequoia), a fluorometer (FL3, Wetlabs), a conductivity/temperature/depth (CTD) analyzer (SBE37, Seabird), and a dissolved oxygen probe (Optode, Aandera). In addition, each platform includes a meteorological monitoring unit (RM Young or Maretron) and a downward-looking ADCP (Workhorse, RDI Instruments). The presence of the LISST provides both particle distribution information needed to extract SSC from the ADCP echo intensity data and a direct measurement of SSC with which to compare the calculated results. At the same time, the ADCP augments the LISST by recording SSC simultaneously throughout the water column, rather than point-by-point.

The echo intensity measured by an ADCP is a function of both the particle size and concentration and thus provides the theoretical basis for measuring SSC. This study shows depth specific echo intensity from a 2400 kHz ADCP to be linear on a semi-log scale to colloidal clay suspension mass concentration standards dispersed in an outdoor test tank. Both the linear slopes and correlation coefficients increased with proximity to the ADCP as a result of signal attenuation from beam spreading and water absorption. The empirical relationship between the measured echo intensity and total volume concentration is evaluated with respect to the theoretical echo intensity derived from the Rayleigh scattering equation and the empirical particle size distribution determined with a LISST instrument, as shown in Figure 2. This analysis provides a framework for computation of SSC from in-situ ADCP data guided by corresponding LISST data.

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Figure 1: REON platform deployed in the Hudson River near Beacon, NY (Spring 2009).

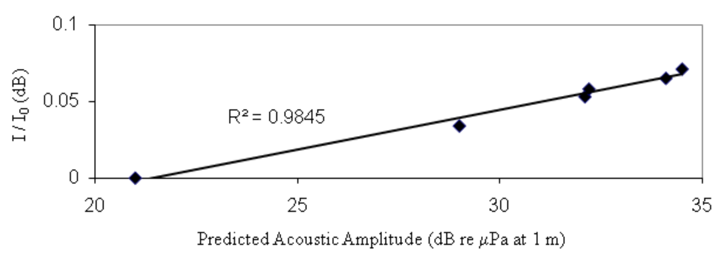

Figure 2. Measured ADCP echo intensity versus predicted Rayleigh-scattered acoustic amplitude for various SSC standards as recorded by a specific ADCP bin.

THERMAL CHARACTERISTICS OF THE SCHOHARIE CREEK AND ITS ROLE IN THE REINTRODUCTION OF BROWN TROUT (*SALMO TRUTTA)*

V. Ashley Kovack, Jaclyn Cockburn and John Garver
Union College, Schenectady, NY

The Schoharie Creek drains the north-facing portion of the Catskills Mountains and is a tributary to the Mohawk River. Currently a small portion of the river is suitable habitat for Brown trout (*Salmo trutta*). Water temperature is the major limiting factor in trout habitat, as it requires cool well-oxygenated water. The upper limiting lethal water temperature for adult Brown trout is 27.2˚C, with optimal water temperature ranging from 7 to 19˚C for all life stages. In this study, continuous water temperature, air temperature, and discharge for four locations in Schoharie Creek were collected during summer of 2009. Findings indicate large discharge events greater than 5 million m^3 (average discharge ~20 m^3/s) moderate the thermal regime of the stream resulting in cooler water temperatures. In parts of the river where there is little to no runoff, the water temperature follows the air temperature, frequently exceeding 27˚C, and is therefore uninhabitable. The lower reaches of the river had the warmest water levels, although the very uppermost part of the stream was warm due to low or no flow through the middle of July and end of August 2009 (Figure 1). Trout habitat could be expanded if higher flows during the warmest months of the year were ensured to provide sufficient flow and temperature conditions. Higher water volumes are possible with a guaranteed cold-water release from the Schoharie Reservoir, but require negotiation with New York City Department of Environmental Protection.

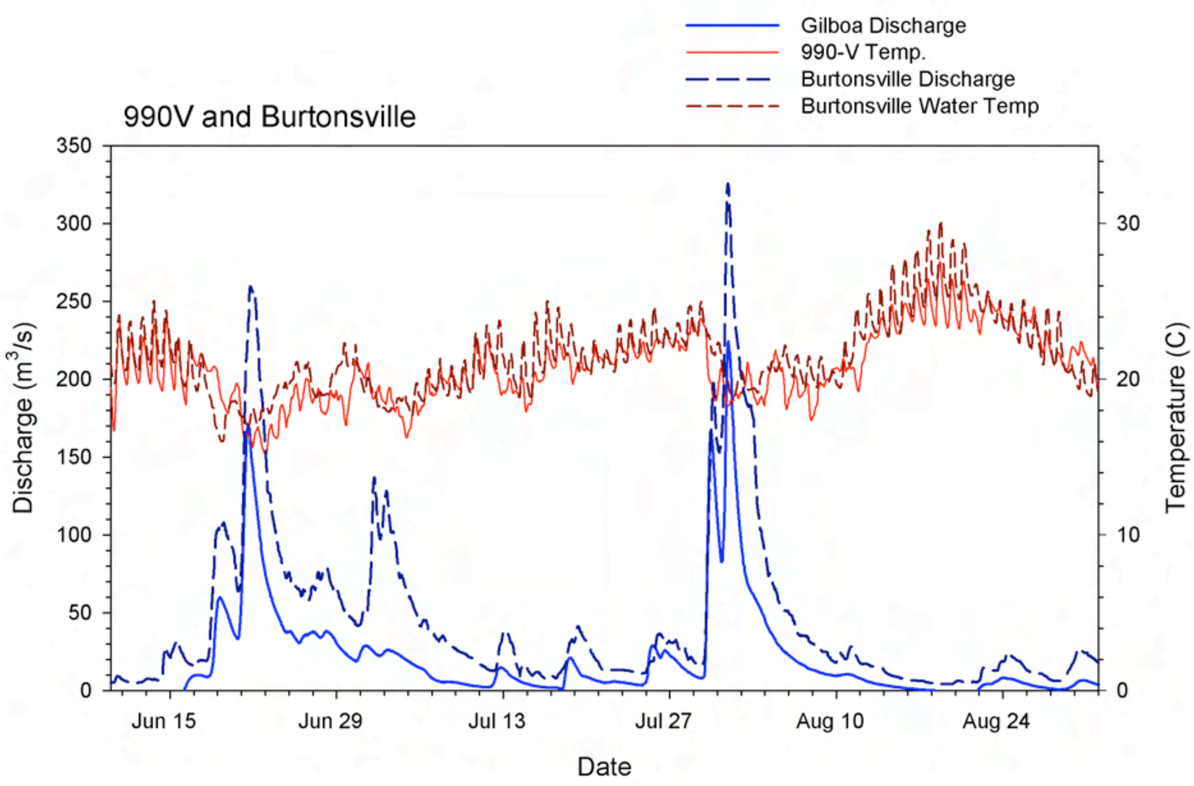

Figure 1: Discharge and water temperature at 990V Bridge (upper watershed) and at Burtonsville (Currie Farm) June – August 2009. The ideal range of temperature for trout is between 7^{o}C and 19^{o}C and for most of July and August water temperature is well above the upper limit.

A LATE HOLOCENE RECORD OF MOHAWK RIVER FLOODING PRESERVED IN A SEDIMENT CORE FROM COLLIN'S POND IN SCOTIA, NEW YORK

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Collin's Pond is a small, dimictic pond on the floodplain of the Mohawk River in Scotia, NY (Figure 1). The sedimentary record indicates sedimentation rates increased drastically from ~138cm/1000yr to ~789cm/1000yr at approximately 1200AD (Figure 2). This large increase in rate may be indicative of increased ice jams or summer floods in the Mohawk River. The sediment record has discrete, normally graded medium sand to silt laminae that are intercalated with massive, organic-rich sediment. Many of these laminae possess erosional basal contacts, and some contain rip-up clasts of fine-grained organic sediment. These characteristics suggest that density-driven undercurrents caused by Mohawk River flooding may have deposited the clastic layers. The bottom of the core contains wood fragments overlain by a layer of coarse sand, which likely marks the formation of Collin's Pond (~4128yr BC). The frequency of flood lamiae decreases at ~1500AD, which may reflect decreased flood frequency of the Mohawk River. At ~1850AD, the core records a pronounced increase in organic carbon content, which likely reflects cultural eutrophication of Collin's Pond, and construction of a levee between the Mohawk River and the Pond that reduced clastic sediment input from the Mohawk River.

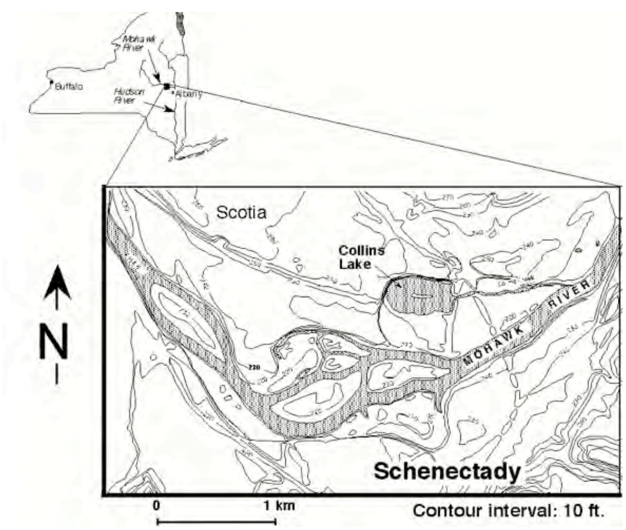

Figure 1: Collins Pond relative to the Mohawk River and Village of Scotia (Ruggiero et al., 2000).

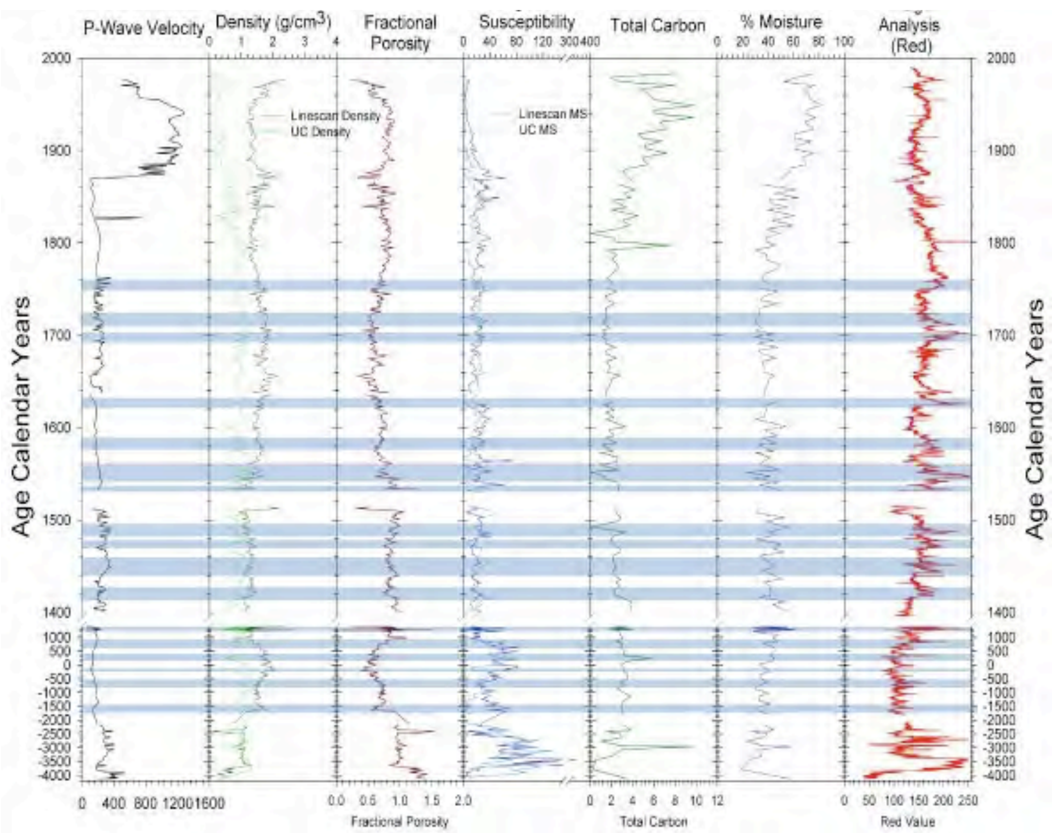

Figure 2: Downcore data analyzed in the 2009 Collin's Pond sediment core. The age-depth model is based on a variety of radiocarbon dates collected from this sediment core and previous studies (see poster for details). The sediments have coarse reddish layers that were interpreted as material flushed into the ponds during high-water events on the Mohawk River and are characterized by high bulk density and magnetic susceptibility. The horizontal bands in the figure represent the location of these deposits in the sedimentary record. Increased sedimentation rate between 1242 AD to 1800 AD is attributed to increased storminess in the northeast related to the Little Ice Age. Higher sedimentation rates in the last two centuries is likely due to anthropogenic activities - canalization of the Mohawk River and eutrophication of the water column.

MOHAWK RIVER: ERIE CANAL; ITS ONE IN THE SAME

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[1]Director of the New York State Canal Corporation
[2]Canal Hydrologist

The Mohawk River and the Erie Canal have shared an interwoven connection since the Erie Canal was constructed in 1825 as "Clinton's Ditch". Eastern portions of the original Erie Canal and the 1862 and 1895 enlargements represented a static canal constructed essentially parallel to the Mohawk River. The Mohawk River flowed freely with overflows from the adjacent canal discharging to the river.

The existing Erie Canal, originally referred to as the Barge Canal, was constructed between 1905 and 1918. Construction of the Erie Canal took a much different approach than the prior "canals", utilizing rivers to develop a dynamic canal and create a new canal for a new age. The Erie Canal, from its beginning in Waterford, NY, to the summit level in Rome, utilized major portions of the Mohawk River to create the navigable waterway. The challenge of this approach was how to functionally utilize a free flowing river as a navigable canal over the full range of hydrologic extremes observed in the Mohawk Watershed.

A system of Mohawk movable dams borrowed from the Czech Republic made taming the mighty Mohawk River possible, while allowing for the free flow of water and ice during the winter.

The Erie Canal's lifeline is water, and it cannot be operated without it. The Barge Canal Act of 1903 began the appropriation of lands and waters necessary to operate the canal and in the Mohawk River Basin, Hinckley and Delta Reservoirs were constructed as the primary source of water.

These reservoirs are managed to maintain water levels on the downstream canal to provide necessary water depths and overhead clearances required to uphold the State's Constitutional obligation to maintain a navigable channel.

The Canal Corporation provides an extensive water management program aimed at providing navigable pools at each lock conducive to navigation throughout the navigation season. Water levels and gate openings throughout the Erie Canal are routinely input into the Canal Infrastructure Management System. These data, coupled with short- and long-range weather forecasts, are utilized for proactive and reactive management of the system.

The Erie Canal also serves as a catalyst for economic development throughout the Mohawk Valley region. In the past decade, the Canal Corporation has undertaken capital projects that enhance and promote tourism, recreation, historic interpretation, and community revitalization. The Canal Corporation has partnered with other state agencies to focus on canal-related programs and projects to benefit the community and raise awareness of the benefits of being a canal community.

Further community development and intergovernmental partnerships are being initiated in the Mohawk Valley through the Corporation's Community Development Team. This Team provides enhanced technical assistance for communities to promote public access and link the communities to the canal. One major initiative in the Mohawk Valley includes the Erie Canal Greenway Grant program. This program is providing grant funding in Schenectady for public access facilities with docks and waterfront park improvements, a Canal Community Infrastructure Project in Rome, and expansion of harbor services at the Rome Bellamy Harbor, St. Johnsville public docking facilities, and construction of the Fort Plain Welcome Center at the Fort Plain Public Library. In addition, Fonda Waterfront Park, Schenectady Mohawk-Hudson Bike Hike Trail/Erie Canalway Trail and the Canastota to Rome Canalway Trail projects are being realized through these efforts.

The Canal Corporation is also a major sponsor of the World Canals Conference 2010 (WCC), scheduled to take place in Rochester during the week of September 19, 2010. During the nearly week long conference, the Erie Canal will take center stage as hundreds of canal enthusiasts from around the world will convene in Rochester to experience all that New York's Canal System has to offer and to showcase the investments New York State has made in the Canal System during the past decade.

MAPPING AND VOLUMETRIC CALCULATION OF THE JANUARY 2010 ICE JAM FLOOD, LOWER MOHAWK RIVER, USING LIDAR AND GIS

Marsellos, A.E.[1,2] , Garver, J.I.[2], Cockburn, J.M.H.[2]

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Ice jams are an annual occurrence on the Mohawk River (Johnston and Garver, 2001; Lederer and Garver, 2001; Scheller and others, 2002; Garver and Cockburn, 2009). As a northern temperate river, ice jams are expected and the lower Mohawk is particularly vulnerable to jams and the hazards associated with them. Breakup involves ice floes that commonly form ice jams (or dams) that occur when the frozen river breaks up and the moving ice gets stuck due to restriction of flow at channel constrictions and areas of reduced flood plain. Historically we know that the time of ice out and ice jam formation occurs on the rising limb of the hydrograph, when the floodwaters are building. When flow starts to rise it is not uncommon for unimpeded ice runs to develop, but invariably the ice gets blocked or impeded along the way by constrictions in the river, especially where the flood plain is reduced in size.

An important issue in understanding ice jams and where they form is how much water can get backed up behind ice dams that block the flow of the water (see Robichaud and Hicks, 2001; White and others, 2007). It is typical for these features to form, but then break up as water levels increase (Jasek, 1999). In a sense they are self regulating because rising water causes the ice jam to float, which ultimately results in self destruction. When this does occur, there is an ice jam release wave that propagates downstream (Watson et al., 2009). This release of water can itself cause flooding, and it is clearly recorded as an increase in instantaneous discharge downstream. In fact, in many break up floods, the highest instantaneous discharge is in fact a surge that has resulted from the release of an ice jam. The highest instantaneous discharge recorded on the Mohawk River (143k cfs), resulted from just such an event in March 1964.

The mid-winter break up event of 25-26 January 2010 caused significant ice jams to form in the lower part of the Mohawk River. Moderately warm temperatures and heavy rain from a south-to north-tracking Atlantic storm caused considerable melting and rapid increase in discharge on the Mohawk River and its main tributaries, especially Schoharie Creek, which drains the northern Catskills. The highest rainfall amounts were in the headwaters of the Schoharie Creek and were ~5 inches, but elsewhere in the lower basin totals were only about 1 inch. Although rain and melting occurred in the upper parts of the drainage basin, the effects were limited.

January 2010 Ice Jam

Ice accumulation and maximum water levels suggest that the main jam occurred at the Boston and Maine (B&M) rail bridge, which crosses the Mohawk River from Glenville to Rotterdam Junction. The western part of this bridge is essentially on the edge of the SI plant, which had constant monitoring of water levels and video surveillance of the ice. From the video record it is clear that after several minutes of re-adjustment, and a rapid water rise of about 1 foot, the jam released at 09:44 AM on 26 January. Following this release, there was rapid and continuous movement of the ice floe down the Mohawk, and a sharp reduction in water levels. The highest level recorded at the SI plant was 244' at their independent observation station.

Because it appears that the front of the release wave made it from Rotterdam Junction downstream to Cohoes (39 km) by 11:00 AM (26 Jan), this would suggest that the front of the release wave travelled at an average rate of 31.2 km/hr (19.4 mph) over that entire distance. We estimate that the jam first formed at the B&M rail bridge at or before 11:45 PM on 25 January. At this point we consider the volume of water that was backed up in the ice jam, and to do this we calculate the volume of the ice jam release (from the hydrograph downstream) and we use a LiDAR topographic model in the flooded area to estimate the volume of backed up water (Figure 1).

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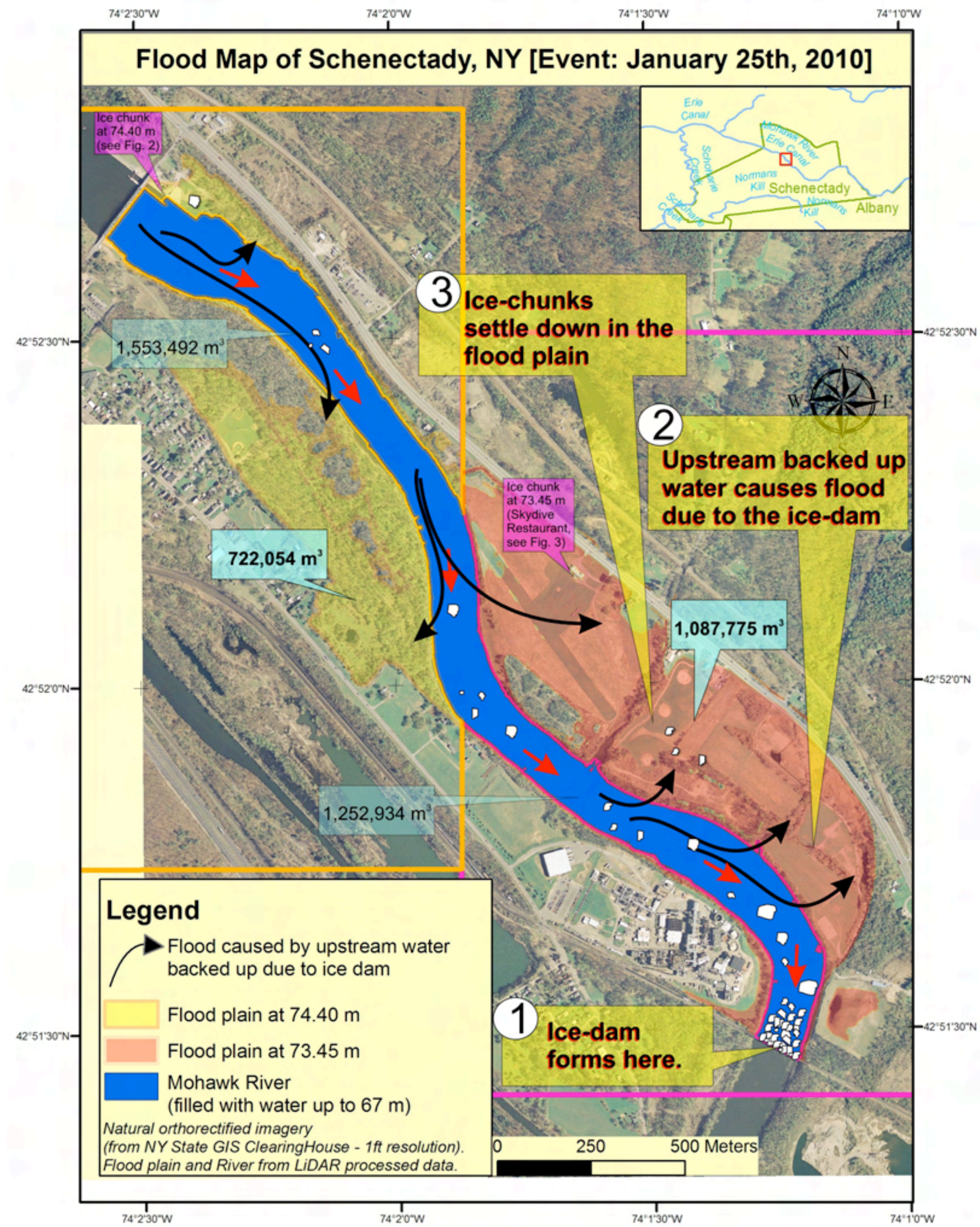

Figure 1: Flood Map where it shows the flood affected area. The flood took place on the 25-26th January (2010) due to the ice-dam that formed in this constricted part of the floodplain. Volumetric calculation results are shown for each sector on the map.

LiDAR volumetric calculation model

Here we test whether flood model applications using LiDAR are successful where topographic relief is low and changes occur gradually. Such digital elevation models (DEM) are particular useful for flood simulation in rural or urban areas. Although important topographic features and properties are not simulated explicitly by Air-LiDAR (such as trees) ground points provide a very realistic digital elevation model of decimeter accuracy. In urban areas, features like roads or buildings have an important effect on flooding and as such must be accounted for in the model set-up.

An accurate calculation of the flood volume requires a digital elevation model of less than 1-meter accuracy. In this study we calculated the volume between the flood plain and the maximum elevation of the ice jam induced flood on January flood from field observations and a LiDAR developed DEM of 0.11 m accuracy. Buildings, affected trees and other existing infrastructure were used to determine the maximum flood elevation.

The flooded study area is located between the New York State Canal System Lock 9 (E9 Lock) and the B&M Rail Bridge at the Schenectady International (SI) Plant (Figure 1). A DEM with grid size of 0.11 m grid was generated from LiDAR data and served as a base line case for various flood simulations. Ideally data processing is supported by a field survey to obtain specific observations and elevation measurements of highest observed water levels (Figure 2). Due to the low gradient of the flood plain, the elevations of the high water mark was estimated in two different target areas. The river area has been delineated using the lowest elevation values, which are essentially bank full conditions (67 m). The lack of information about river levels prior to jamming makes it difficult to fully assess the volumetric calculation, but bank full conditions are a reasonable starting estimate. For this reason, the two target polygon areas were subtracted by the river's polygon (clipped). However, in this study we present the volumetric calculation for both target areas of the river area as separate numbers (Figure 1). The volumetric calculation that took place on the Mohawk River had a 67 m water elevation base line of the river and the flood at 73.45 m and at 74.40 m water elevation, respectively for the two target areas. The main methods that were used to specify the flooded areas were raster to feature process with a prior reclassification of the water values.

The volumetric calculation of the flood has shown that the northwestern portion of the area (near the E9 Lock) was flooded by 722,054 m^3 of water (Figure 1) covering an area of 301,233 m^2. The southeastern portion of the area flooded (from the Skydive restaurant to the Chemical Plant) was flooded by 1,087,775 m^3 covering an area of 525,601 m^2. Assuming that the water level at the river before the ice-dam formation was 67 m then the river was flooded by 2,806,426 m^3. The maximum volume of water that flooded the land derived from the flood of the 24-25th of January caused by the ice-dam between the E9 lock station and the Chemical Plant was 1,809,829 m^3, and it covered an area of 826,834 m^2. Therefore the estimate of the total volume delayed by the ice jam was approximately 4.6 million m^3 using volumetric calculations based on LiDAR-derived topography.

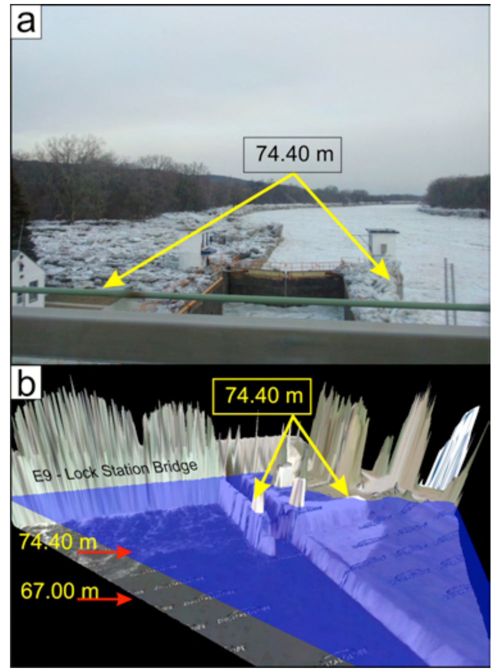

Figure 2: (a) Field observations from the E9 Lock station; (b) water flood model derived from the LiDAR DEM (0.11 m resolution) to determine the accurate flood elevation level.

Hydrograph Separation

A volumetric comparison of the LIDAR based flood volume calculation was conducted using USGS stage and discharge data from the Cohoes Falls station on the Mohawk River (USGS 01357500). Hydrograph separation is a common method used to determine the runoff volume for a given hydrograph component. Graphical separation is the simplest technique and is used extensively in simple runoff events (Singh, 1992). To determine the volume of water released after the jam broke on Jan 26, a straight line was drawn from the time the hydrograph rose rapidly (~11:00am) to intersect with the falling limb of the hydrograph (Figure 3). The slope of this line approximated the slope of the rising limb, prior to jam formation and intersects the falling limb at 3:45pm on Jan 26. It was estimated that 0.0047 km^3 of water (4.7 million m^3) was delayed by the ice jam, by calculating the area between the hydrograph and the straight line. Graphical separation is admittedly simple and has the potential to over or under estimate volumes of flow, but given the data available this method was the most appropriate for the January 26, 2010 ice jam.

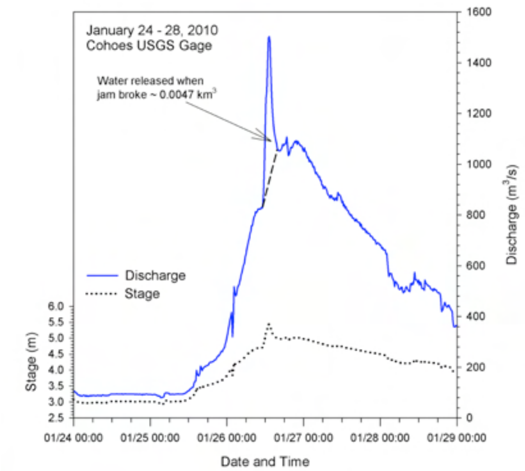

Figure 3. Hydrograph and water level (stage) in the 2010 event (from Cohoes Falls, NY). Estimation of the volume of water that surged through the system is c. 4.7 million m^3.

Conclusions

As ice jams form and break-up there are clearly critical thresholds that are reached that ultimately cause the self-destruction of the ice front. Our calculations of the volume of the flooded area (4.6 million m^3), and the volume of water recorded downstream using hydrographic separation (4.7 million m^3), are, remarkably, in agreement. We suspect continued studies of volume of water behind ice jams in different reaches of the lower Mohawk River will shed light on the critical thresholds for ice build-up and the effects of the release of water downstream (i.e. Brufau, P. and Garcia-Navarro, P., 2000; Nzokou et al., 2009).

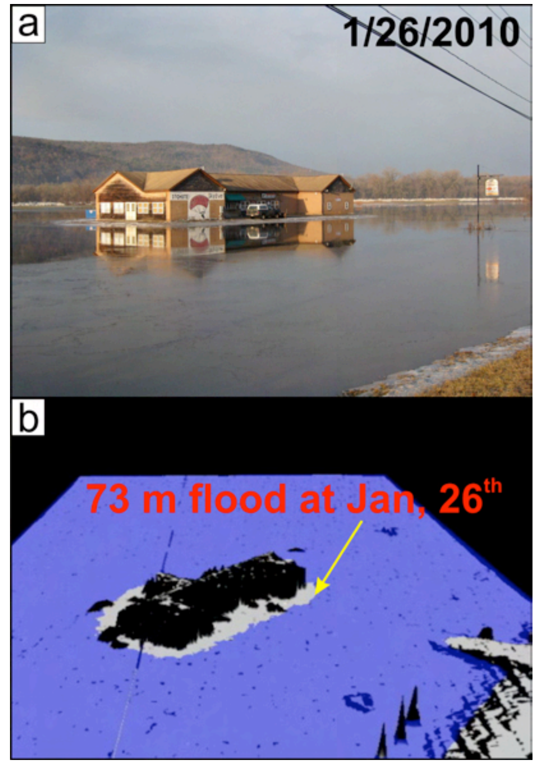

Figure 4: (a) The flooded area as it appears around the Skydive Restaurant in the morning of the 26th of January; (b) LiDAR 3D representation of the flooded area shown by the blue color.

A key piece of data that is required in the future is a real-time monitoring network using pressure transducers that can provide fast reliable data on the condition of the ice movement along several key parts of the river that are prone to ice jamming (Robichaud and Hicks, 2001; White et al., 2007).

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DETERMINATION OF HISTORICAL CHANNEL CHANGES AND MEANDER CUT-OFF POINTS USING LIDAR AND GIS IN SCHOHARIE CREEK, NY

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Introduction

The lower reach of the Schoharie Creek (Fig. 1) takes an unusual route through a glaciated bedrock high (now Lost Valley) and then a significant reach underlain largely by glacial till before the confluence with the Mohawk River. During the Recent evolution, this section of the river has incised downward, likely to keep pace with downward incision of the Mohawk River. The objective and the scope of this work is to utilize LiDAR data to construct a bare-earth model that allows identification of subtle terrain features such as abandoned channels and landslides. These geomorphological features reveal a complex history of incision and avulsion in the lower reaches of Schoharie Creek.

Bare-earth model

Light detection and Radar (LiDAR) is used to generate high-quality digital elevation data. These highly accurate topographic data can be used to analyze flood hazards, and to delineate floodplain boundaries because the topography is revealed in incredible detail. LiDAR sensors utilize a laser pulse (typically between 0.5 and 1 meter in diameter) and a pulse length (a short time of the laser pulse). LiDAR sensors are capable of receiving multiple returns, commonly up to five returns per pulse. Thousands of returns per second can be recorded classifying targets according to the number of returns. When a laser pulse hits a soft target (e.g., a forest canopy), the first return represents the top of that feature representing the top of this feature. However, a portion of the laser light beam likely continues downwards below the soft target and hit a tree branch or the ground below a tree. This would provide a second return. Theoretically, the last return represents the bare earth terrain. A classification of the points with the highest number of returns could reconstruct the ground surface (e.g. a TIN surface), while the rest of the points with lower number of returns could represent anthropogenic structures or forest canopy. Surface water (lakes or rivers) does not return laser light and therefore a void is created that shows the outline of a current river channel or lakes.

Methods

The collected LiDAR data have a resolution of greater than 12 pts per m^2 providing a resolution in the gridded data at 0.25 m or less (commonly 0.09 m). The point cloud data has had minimal processing to eliminate outliers, from reflections etc. Larger areas with outliers or reflection have been manually subtracted and interpolated with the surrounding data points (this process mainly affects the river channel).

The high-resolution topographic images that show bare-earth LiDAR-derived topography are made by subtracting the canopy and defining a "bare-earth" elevation model using only the classified ground-points (Fig. 2) to identify evidence of the evolution of incision revealed by abandoned channels. Avulsion and subsequent abandonment of fluvial channels is analyzed by geomorphic mapping of these high-resolution topographic data (Fig. 3).

To facilitate viewing, interpretation and post-processing of the point cloud data 3D elevation models were constructed with examination of water levels in the TIN model (e.g. Fig 2). The flood plain area has been evaluated by the mapping highest elevated abandoned channels. A water level plain surface at 120 m in the TIN has specified as the TIN flooded area. The TIN flooded area has been converted to polygon features clipping the flood plain coverage. The path of the Schoharie Creek has been extracted by delineating the gap area from the LiDAR points. The abandon channel features have been extracted from the TIN model derived by the ground points. Those successive abandon channels have been classified according to the distance from the current creek location, and then connected to reconstruct historical pathways of the Schoharie Creek. All the extracted linear features from those historical

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pathways have had same beginning and ending points, and their distance was measured.

Results

In Schoharie Creek, delineation of a series of successive abandon channels shows a clear evolutionary trend in this part of the river of successive channel formation and abandonment (Fig. 3, 4). There are at least three different channel deviation and incision times (Fig. 5). The succession of these channels helps to identify the principal trends (see Fig. 3) of the migration of meander bends that areas are currently used for agriculture. An important question that emerges from this analysis is the primary driving mechanism caused channel avulsion.

In the study area, the present current creek length is 9.0 km. The length measurements of the three successive channel deviations are 10.1, 11.2, and 12.2 km. In the same floodplain area the three reconstructed paleomeanders show a ~30% decrease of their length. The successive meander changes of their length (Fig. 5) show a linear association that may allow a broad prediction for the future meander length. This study is a first step in using high-resolution LiDAR data to Quantify Landscape evolution in the Mohawk watershed. Future analyses may include dating techniques to understand the temporal pace of these changes so that they may be linked to basin-wide processed.

Table 1: Meander length measurements (km) of different generations with the relative change (%). Prediction of the future has derived from a linear equation (y= -1.06x + 13.31).

Meander Generation	Length (km)	% change
C (older)	12.22	
B	11.2	8.35
A (younger)	10.17	9.20
Today	9.01	11.41
Future	7.99	11.38

Fig. 1: Aerial view from the study area of the Schoharie Creek (from Google Earth).

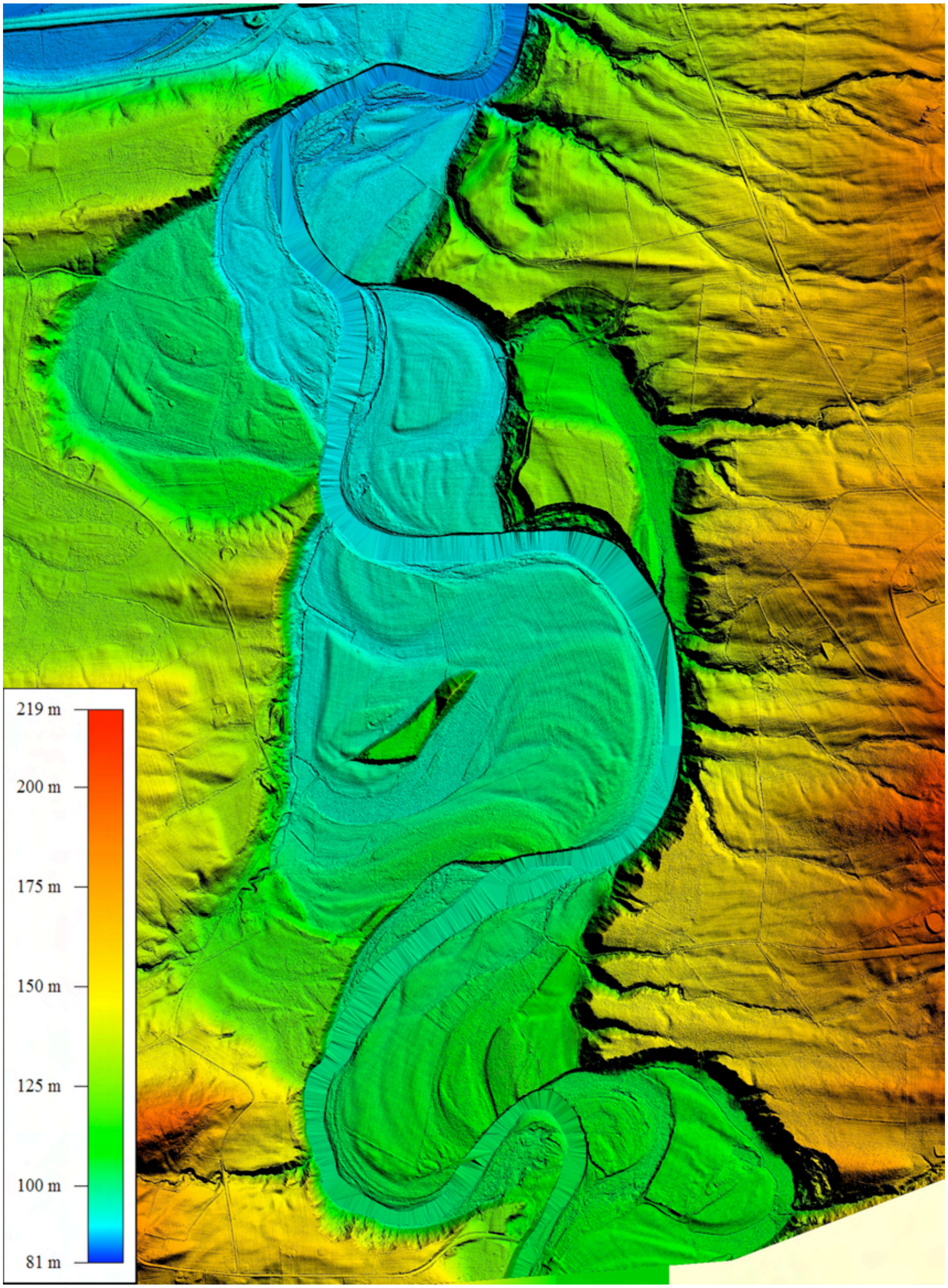

Fig. 2: TIN model derived from LiDAR ground points (bare-earth model)

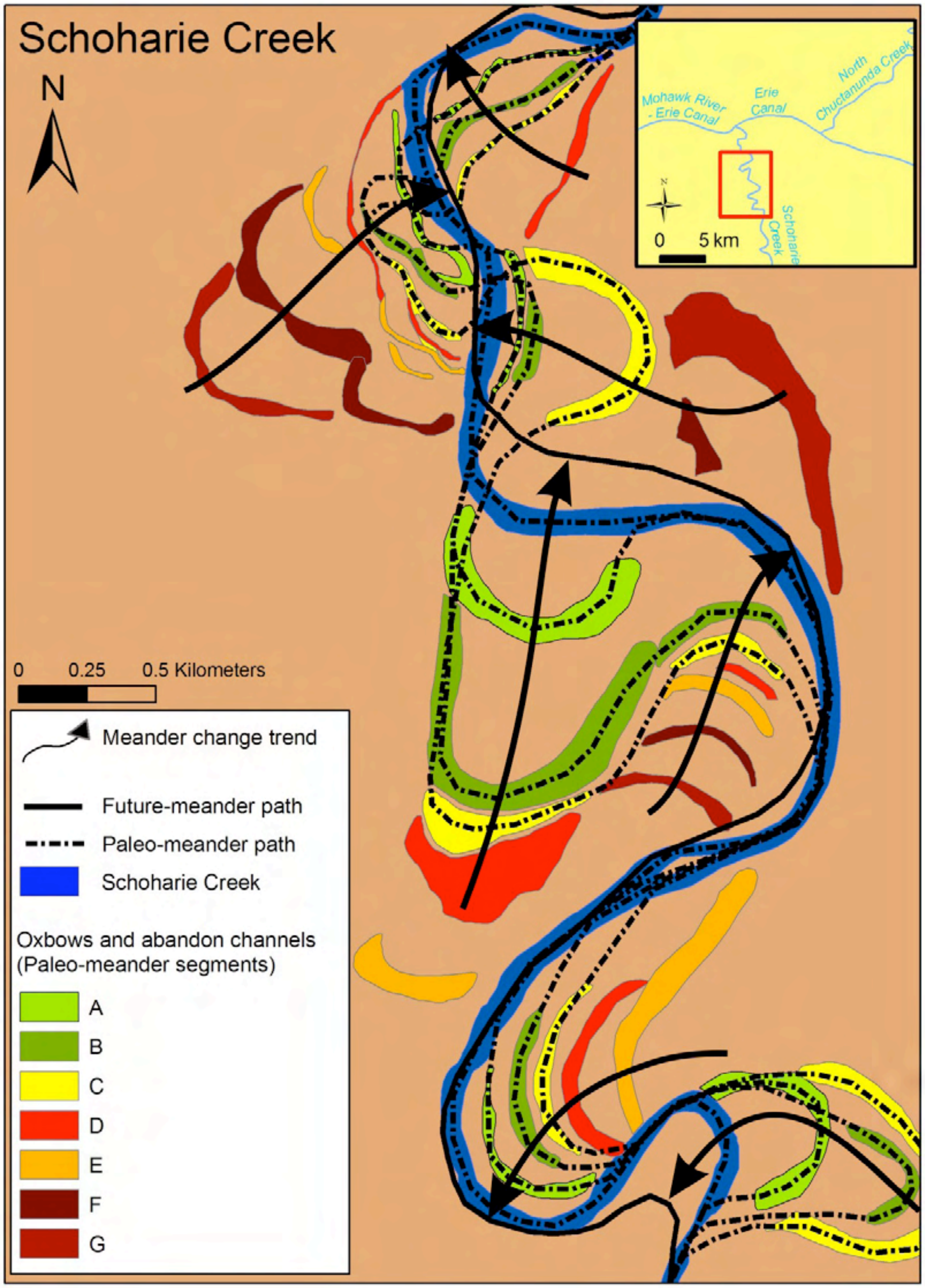

Fig. 3: Classification of oxbows and abandon channels as segments of older meanders.

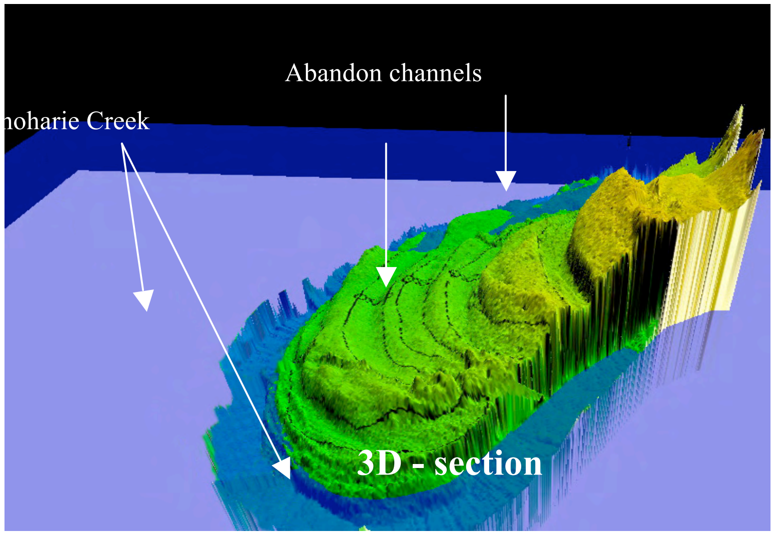

Fig. 4: A portion of the LiDAR bare-earth model that shows the successive abandon channels in 3D.

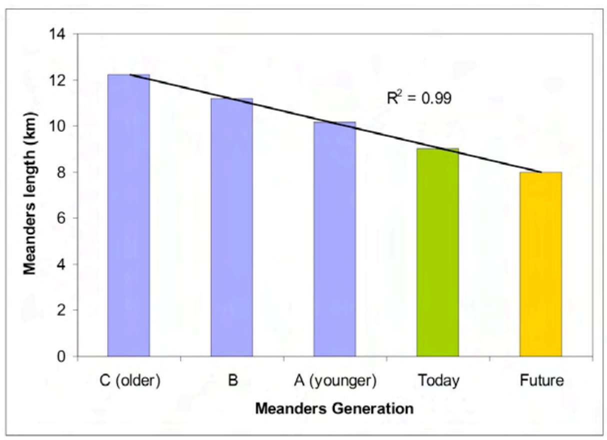

Fig. 5: The length of the present river path that appears to decrease by about ~10%.

The Environmental Study Team Program: Engaging Youth and their Communities in Water Quality Monitoring of their local Freshwater Streams, Lakes and Rivers

John McKeeby[1], Caitlin McKinley[2] and Zachary McKeeby[2],
[1]Executive Director, Schoharie River Center
[2]EST members and students at Duanesburg School District

As new "regional" approaches in the management of the Mohawk River Basin Watershed grow and take shape through recent state and regional initiatives. A key component for the successful implementation of regional watershed management planning is developing strong local community based support and involvement in coordinated watershed management efforts. However, obtaining local community buy- in and local stakeholder cooperation to promote watershed management initiatives that may have benefits primarily outside of their local area, can sometimes be difficult. Especially now, as communities and local governments face a myriad of economic challenges as they struggle to maintain basic and mandated services to local residents, (the downturn in the economy and resulting decreases in tax revenues, the loss of state aid while the costs of necessary services continue to increase), the costs of voluntary compliance with regional watershed management requirements can seem to outweigh the benefits for some local communities. Often the educational, social welfare and local quality of life benefits possible through coordinated activities, that promote both effective watershed management planning, and community development and citizen engagement, goes unrecognized and underutilized at local levels. Engaging a broad range of community organizations and non-profits, schools, youth service agencies, and the youth and families they serve in a local community can be an effective and efficient strategy in creating local support for watershed planning and management at the local level.

The Schoharie River Center's Environmental Study Team Program (EST) is an effective, cost efficient and easily replicable program model for engaging and building community interest and support in local water quality issues and promoting local stakeholder interest in regional watershed management planning and education. The SRC - EST program works closely with local youth (ages 13 – 18) their parents, and the community organizations that serve them (grass roots organizations, schools, afterschool programs, county youth bureaus, social service agencies, etc.), as well as watershed management professionals, County SWCD, and local colleges and universities, to integrate youth development skills programming, field biology, and general science education into an experientially based year-round program that promotes that values of community based environmental conservation and stewardship, and support academics, drop-out prevention and youth development skills and career exploration. Utilizing a broad based approach encompassing training and ongoing programming in local water quality monitoring, sustainable forestry agriculture – maple syrup making, community based archeology, academic enrichment, out-door recreation - cross country skiing, hiking, swimming, SCUBA, sailing, etc. The EST program model is successful in engaging a wide variety of youth and communities, developing locally based out-door education programming which encourages local youth and adults to become knowledgeable about and involved in the protection and stewardship of their local environment and freshwater resources. Successfully leveraging program funding from a diverse group of stakeholders (environmental & conservation organizations, education, social services, and private non-profit foundations) the program has broad appeal due to its holistic, and long term approach; engaging, training and utilizing the energy, natural curiosity and passion for learning of youth (a renewable natural resource) to study, monitor, protect, enjoy and improve their local environment and freshwater resources. The program provides a link between professional freshwater water resource managers, college and university researchers and local youth and community members residing in the watersheds under study.

The EST program is flexible and easily adapted to local community interests, organizational missions, and the cultural schema of each community. The Schoharie River Center operates three EST programs in different areas, all within the Mohawk River and/or Schoharie Creek watershed. In Schenectady, the EST program operates as an afterschool youth development program targeting at-risk and inner city youth, engaging them in water quality monitoring of local streams and the Mohawk River. Youth also participate in a variety of environmentally based community service activities and public education programs designed to support them academically and promote the values of stewardship and a greater understanding of their (and their communities) relationship to the natural world and the larger environment. The Schoharie EST program, in operation in Duanesburg since 2001, works with youth from three counties (Schenectady, Schoharie, and Montgomery) primarily studying the lower Schoharie Creek and its tributaries as well as the Normanskill. The first EST program established by the SRC (a non-profit organization) with the help of Mr. Kelly Nolan, (Watershed Assessment Associates, LLC.), the Schoharie EST program meets bi-weekly on weekends year round, and involves youth ages 13 – 18 and their parents in a wide range of freshwater monitoring and bio-assessment study , outdoor recreation activities, community archeology projects, and maple syrup making. Youth in EST document their research both in writing and through video and photography, and present their research findings at local science conferences such as the Clean Water Congress (Hudson Basin River Watch) and at local community festivals and school science fairs. The program has also partnered with local schools to develop field trip opportunities and special programs for area youth to participate in school and community based research opportunities. The Manor kill EST program in the Conesville –Gilboa area (in Schoharie County and within the NYC Watershed) was established by the Schoharie River Center in 2009, with grant funding from the Schoharie County Youth Bureau, the United Way, and NYC DEP Watershed Protection Fund. This EST program is working closely with the local school (Gilboa-Conesville School district), the Town of Conesville, and the Schoharie County SWCD office to implement specific aspects of the county's approved Manor kill Watershed Management Plan. The focus of the program is youth skills development and stewardship education, integrating stream water quality monitoring activities with riparian zone surveys, invasive species removal (Knotweed) and native species replanting projects with academic support. Members from the three EST programs do participate together periodically in specific training and recreation activities that allow them to meet together and learn about one another their home waters. All three programs are geographically within the same watershed, the Mohawk River Basin (about 100 river miles apart). However, the Manor kill is part of the NYC Watershed due to the Gilboa Dam and reservoir, which impounds the upper half of the Schoharie Creek to provide drinking water to New York City. Each EST program, (and the youth who participate in them) although living in separate communities, are linked together through the experience of being in the same watershed and the same watershed-monitoring program.

Based on the success and continued growth of the Schoharie/Mohawk EST programs we believe that the EST model offers a blueprint for other communities and organizations that may want to initiate greater community outreach and involvement their regional efforts and stream management.

For more information about the Environmental Study Team programs at the Schoharie River Center, or to inquire about starting a new EST program in your area. Contact John McKeeby, Executive Director, Schoharie River Center, Inc. 2047 Burtonsville Road, Esperance, NY 12066, or email at schoharierivercenter@juno.com.

PROTECTING WATER QUALITY THROUGH A WATERSHED APPROACH

Kevin Millington
New York State Department of State

The Department of State encourages the preparation of inter-municipal watershed protection plans as a means to effectively identify priorities, establish a consensus on future actions, and guide the resources needed for implementation. The Department has extensive experience in this topic, and provides grants from the Environrnental Protection Fund - Local Waterfront Revitalization Program for the preparation and implementation of such plans.

Addressing the complex issues affecting a specific water body is most effectively accomplished through inter-municipal efforts based on a watershed eco-system approach.

Through both financial and technical resources, the Department has fostered the preparation and implementation of numerous watershed protection plans across the State. Most recently, a $370,270 grant from the Environmental Protection Fund - Local Waterfront Revitalization Program was awarded for the preparation of a watershed plan for the Mohawk River.

To further assist communities, the Department recently completed a guidebook which describes in detail the components and benefits of a inter-municipal, watershed plan.

The Department of State's Inter-municipal Watershed Management Program provides municipalities with professional expertise and funding to develop and implement watershed management plans to protect and restore water quality and related resources. The Inter-municipal Watershed Management Program focuses on identifying connections between land use and water quality to reach consensus on actions to protect water resources while facilitating economic development and guiding growth to the most appropriate locations. Department staff with backgrounds in the natural sciences and local and regional planning work closely with interested communities across the State.

The Inter-municipal Watershed Management Program enables communities to:

- **Establish a mechanism** for long-term watershed management, often through the creation of an inter-municipal watershed organization;
- **Describe and understand existing water quality and watershed conditions**, current impairments and anticipated threats to water quality, and recognize the key problems and opportunities in the watershed;
- **Identify and describe priority actions** needed to address water quality impairments or threats;
- **Create an implementation strategy** identifying stakeholder roles and the financial and institutional resources needed to undertake these priorities;
- **Develop a means to measure success,** track implementation, and monitor performance; and
- **Network** with other communities, agencies and organizations with experience in the successful preparation and implementation of watershed management plans.

To this mix, Department of State, as New York's coastal management and community planning agency, brings its extensive experience in creating practical responses to land and resource management challenges - experience that has shown the importance of inter-municipal and inter-agency collaboration.

Benefits of Watershed Management - Clean and plentiful waters are needed to support local economies, provide recreational opportunities, sustain fish and wildlife habitats, and enrich our everyday experiences. New York State's water resources - rivers and streams; lakes and reservoirs; estuaries; Great Lakes; and the Atlantic Ocean and Long Island Sound - all contribute to our quality of life. Planning on a watershed scale allows communities to effectively and comprehensively address water quality issues throughout their watershed, while balancing the need for economic growth and development.

Watershed Definition - A watershed is a geographic feature. It is the total area of land draining to a body of water such as a stream,

A watershed is defined as the total area of land draining to a body of water.

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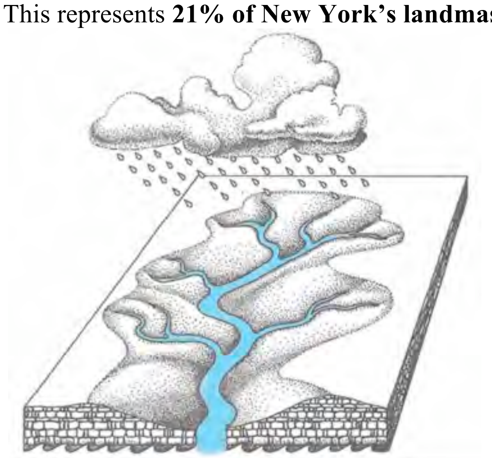
river, wetland, estuary, or aquifer. Watersheds can range in size from a few acres that drain into a small creek to a large basin that drains an entire region into a major waterbody, such as Lake Ontario. A watershed is not confined by jurisdictional boundaries. Its boundaries are determined by topography and on the nature of how water moves. More often than not, a watershed spans multiple jurisdictions. It is, therefore, important that counties, towns, villages and cities work together to address shared water quality problems and to seek available opportunities. By using the appropriate geographic scale, a watershed management plan can be developed that best meets the needs of any community.

Department of State Intermunicipal Watershed Management Plans The Department's approach to watershed planning has proven highly successful throughout New York, from Long Island to the Adirondacks, and from the Hudson River Valley to the Great Lakes. Watershed management plans guide communities to identify critical actions needed to protect and restore water quality, set watershed priorities, and develop a strong and clear implementation strategy for the future. Together with municipal, State, and federal partners, the Department has assisted in the development and implementation of **37 watershed management plans covering 458 municipalities and over 11,500 square miles (over 7 million acres).** This represents **21% of New York's landmass.**



The Inter-municipal Watershed Management Program focuses on watersheds within New York State's coastal area and inland waterbodies. To address the specific concerns pertaining to the New York City water supply, the Watershed Protection and Partnership Program assists watershed communities in preparing or updating comprehensive plans, establishing or revising community development tools and local laws, and creating strategic plans for the protection of water quality.

Following preparation of plans, the Department continues is partnership to focus on implementation of priority actions and projects. Of the 37 management plans developed with funding and assistance from the Department of State, **all** 37 are being implemented in partnership with the Department. Projects include installation of best management practices, assessment of and improvements to local land use controls, invasive species control, habitat restoration, streambank stabilization, education and outreach programs, onsite wastewater treatment system inspection programs, and monitoring water quality for pollutants. All of these projects are critical to the protection and improvement of water quality.

***Financial Assistance* -** the Department and its partners have invested over **$38 million** through the Environmental Protection Fund - Local Waterfront Revitalization Program (EPF LWRP), Clean Water/Clean Air Bond Act, and Great Lakes Coastal Watershed Restoration Program to prepare and implement watershed management plans. As a direct result of the Department's involvement, as well as local expertise and matching funds, water quality is improving in New York's waterbodies. Municipalities are working together to share resources to save money as they address common issues. Organized by region, the following tables summarize the Department's assistance to protect and restore New York watersheds.

Department of State Supported Watershed Planning Efforts		
Region	Number of Communities	Square Miles
Statewide	53 Counties 458 Municipalities	11,729
Adirondack and Tug Hill	10 Counties 93 Municipalities	3,568
Great Lakes and Finger Lakes	19 Counties 157 Municipalities	3,103
Mohawk River Basin	14 Counties 127 Municipalities	3,510
Long Island and NYC	4 Counties 36 Municipalities	284
Hudson River	6 Counties 45 Municipalities	1,264

Technical Resources - In addition to funding, the Department supports the Program and ensures local successes through a practical how-to information package, analytical tools, and hands-on assistance as communities develop and implement Inter-municipal Watershed Management Plans.

Guidance - To promote watershed planning, the Department of State, in partnership with the Department of Environmental Conservation, prepared a multi-media package entitled *Watershed Plans: Protecting and Restoring Water Quality*, which summarizes the integrated approach to planning and implementation. The informational package, available at www.nyswaterfronts.com/watershed_home.asp, includes a step-by-step guidebook, an explanatory video, and reference web-pages containing additional resources and case studies.

This guidebook helps communities:

- **Understand their watershed and the importance of water quality;**
- **Recognize the relationships among economic, social, and natural processes;**
- **Define a vision for the future;**
- **Set realistic goals; and**
- **Develop a detailed strategy for implementation, including local laws.**

Technical Assistance - The Department of State works closely with communities to provide them with the professional expertise needed to develop their watershed management plans. The Department:

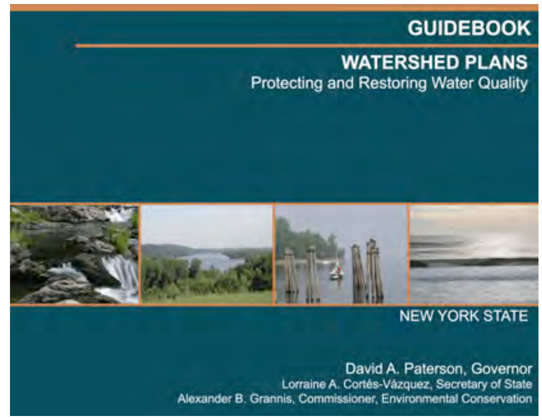
- **Assists in the initial organization** of communities and watershed stakeholders and the formation of inter-municipal organizations;
- **Provides hands on assistance** related to watershed characterization, review of local land use controls, and prioritizing recommendations for capital improvement projects and actions;
- **Reviews materials** (including project designs) and provides critical feedback;
- **Facilitates partnerships** between state, federal, and nonprofit organizations;
- **Assists in the prioritization** of watersheds and management recommendations
- **Helps conduct** public meetings and outreach sessions;
- **Aids in the preparation and refinement** of implementation strategies.

Assessing Local Controls and Practices - To address water quality problems and threats, the Department of State, in 2001, developed a tool to assess local nonpoint pollution controls and practices, as part of the *Long Island South Shore Estuary Comprehensive Management Plan.* This assessment was critical in identifying gaps in local land use controls and implementation of local laws, practices, and programs. In 2001, the Department partnered with and funded **($267,000 grant through the Great Lakes Coastal Watershed Restoration Program)** the Genesee/Finger Lakes Regional Planning Council to adapt the assessment tool to be used statewide. The tool and manual entitled, *Protecting Water Resources through Local Controls and Practices: An Assessment Manual for New York Municipalities* is available at: http://www.gflrpc.org/.

Communities can use this manual to perform a self-assessment in order to gain a greater understanding of how their local land use authority can impact water quality.

The manual represents real life examples because it was developed as part of the Genesee/Finger Lakes Regional Planning Council's assessment of programs, practices and local development controls of 56 municipalities in the watersheds of Conesus, Cayuga and Canandaigua lakes, with more detailed analysis of over a dozen key municipalities. Gaps and specific solutions to better protect water quality were identified, including an environmental protection overlay district, subdivision regulations, wetlands protection, watercourse protection, and onsite wastewater treatment system regulation. These specific examples of local controls can be readily adapted to communities across the State.

As a result, local governments will be better able to avoid unwanted impacts of development and related activities on natural resources and water quality. The Department of State will continue to work with municipalities to use this assessment tool as part of the watershed management planning process.



Mohawk Watershed

The Department recently awarded a $370,270 grant from the Environmental Protection Fund for preparation of a watershed plan for the Mohawk River. The grant was awarded to Montgomery County on behalf communities throughout the watershed, which spans fourteen counties. Preparation of the plan will be managed by the Mohawk River Basin Coalition of Conservation Districts, and overseen by an organization comprised of local governments, State agencies, and non-governmental organizations involved in protection of the river.

AN OVERVIEW OF WATER RIGHTS IN NEW YORK STATE

Frank Montecalvo, JD

New York State is blessed with an abundance of water resources; however, they are unevenly distributed – a critical factor in determining where human activities may be conducted. Different uses of water may compete for the same supply. Municipal water supply systems may compete with agricultural, transportation, power generation, recreation, ecosystem management, and other uses. People in different regions may compete for the same supply. Over the course of many years these competing interests have been balanced by our laws, which determine water rights. The intent of this article is to provide a primer on water rights in New York State, with a focus on surface water and public water supply systems, and those provisions that may have application within portions of the Mohawk River drainage basin.

Origin of Laws

With the exception of issues that can be related to interstate commerce, Indian tribes and international treaties, the federal government's role in water rights is limited, and such rights are primarily a matter of state law. In the United States there are two different systems of water rights, which reflect differences in climate: (1) *riparian* or land-based rights found in the east, where the climate is generally humid and (2) *prior appropriation* or use-based rights found in the west, where the climate is dry. *Prior appropriation* (essentially, the first use in time is the first in right) is mentioned to alert you to the fact that, when reading about water rights, things are done differently in Colorado and California than in New York, owing to the scarcity of water in those places.

In New York, the laws are found in the State Constitution, common law, statutes, administrative regulations, interstate compacts, and judicial decisions. Water rights in New York are private property as recognized by common law. Part of this common law is of Dutch origin, due to New York having first been settled by the Dutch in the 1600s. Land grants with appurtenant water rights made during that era were governed by the Dutch civil law. English common law was superimposed on the existing law when New York became an English colony. When New York became a State, the State Constitution preserved the non-conflicting existing common law.

Riparian Rights, Nature and Extent

In the riparian system, rights in water arise from, and only from, ownership of land which adjoins or underlies a stream or other body of water – a "riparian" tract of land. Riparian rights include, for example, a right to access the water in the stream for such things as swimming, boating, or fishing, and the right to reasonable use of the water for such things as domestic purposes, watering crops, or livestock. The rights are not of ownership of the water itself but are rights of *use* of the water – "usufructuary" rights.

The water may be used only on the riparian tract of land. Each riparian owner is entitled to make reasonable use of the water flowing by his property taking into account the needs and uses of other riparian owners downstream. *United Paper Board Co. v Iroquois Pulp & Paper Co*., 226 NY 38 (1919). A riparian owner has a property right in the full flow of all the water of the stream, of which he cannot be deprived by diversion without his consent, except by condemnation proceedings and payment of compensation, even though after such a diversion he still has enough water to satisfy his needs. *Gray v Ft. Plain*, 105 App Div 215 (1905). If a riparian owner does not use his rights, he does not lose them. Riparian rights are an incident of ownership, which cannot be lost my mere disuse. *Townsend v McDonald*, 12 NY 381 (1855).

Riparian rights are premised upon notions of reasonableness and respect for downstream owners and their uses. When considering whether the use of the water in a stream is an exercise of a riparian right, it is important to predict how downstream users could be affected. Using water to turn a mill wheel or a power turbine might not change the flow in a stream and, thus, not interfere with other uses. However, if water is retained and released in spurts when power demand is high, there could be an interference with some downstream uses and a violation of downstream riparian rights

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because flows will fluctuate. Using water for domestic purposes on a farmstead or for watering crops or livestock on the riparian tract of land would normally be considered riparian uses. However, it would be unreasonable and not a riparian use if, for example, it caused pollution in the stream. What may be considered a reasonable use during a wet season, when there is an excess of water for most purposes, may cause an interference with other uses during a dry season. Of course, different people have different notions of what is reasonable, and not everyone has respect for their neighbor. The state ultimately is the arbiter of what is reasonable.

Diversions for Public Water Supplies

Diverting water from a stream for a municipal water supply is NOT a riparian right because it (1) involves a use that is not associated with the riparian tract of land and (2) reduces the flow in the stream and conveys it away from the riparian tract of land. The same could be said if the diversion was to fill a navigation canal. A permanent and uncompensated diversion of water is a continuing wrong to the owners affected for which damages are recoverable or an injunction may be had, *Gallagher v Kingston Water Co*, 25 App Div 82 (1898). This suggests that, *e.g.*, if a company or municipality wanted to develop a public water supply from the water in a particular stream, it would not only have to buy a piece of property along the stream to place its intake, but it would also have to buy the riparian rights of all those owners downstream who might be affected and/or to compensate them for the diversion in some fashion. Compensation does not have to be in the form of money, however. It could take the form of adding water to the stream from a reservoir further upstream to make up for the amount of water removed. This *compensating reservoir* is filled with water that is considered excess and which, if left to flow naturally, potentially could cause harm. Downstream owners would not object to the removal of excess water, if their property interests are protected in the process. Compensating reservoirs, thus, reduce the need to purchase riparian rights from landowners further down stream.

State Allocation of Water Supplies

The state possesses a duty and power to conserve and control water resources for the benefit of its inhabitants – an incident of its sovereignty. *Syracuse v Gibbs*, 283 NY 275 (1940). In New York, the responsibility has remained at the state level. A city has no right to authorize the diversion of a water course, *Covert v Valentine*, 66 Hun. 632 (Sup. Ct. 1894) *rev'd* on other grounds, 141 NY 521. The question of water supply is a matter of state-wide concern over which the legislature has full control, *In re Suffolk County v Water Power and Control Commission*, 269 NY 158 (1935). It has been held that it was beyond the state's power to authorize a water company to sink as many wells as the company found necessary because the state has a duty to preserve an equitable distribution of potable water among its various divisions. *In Re New York Water Services Corp. v Water Power and Control Commission*, 256 App. Div. 80, aff'd. 281 NY 656 (1939). The state must ensure that water supplies, which are more available for use by one community, are not absorbed by another. *Syracuse v Gibbs*, 258 App. Div. 405, 408 (3rd Dept, 1940), rev'd other grounds, *supra*.

In New York, with an exception for New York City-owned water supplies, control over the state's water resources has been delegated by the legislature to the Department of Environmental Conservation (DEC, which assumed the functions and powers of the Water Resources Commission and the Water Power and Control Commission). Environmental Conservation Law (ECL) Article 15. The legislature declared as policy that the state's waters be conserved and developed for all public beneficial uses, that comprehensive planning be undertaken, that consideration be given to the relative importance of different uses, and that domestic and municipal purposes have priority over all other purposes ECL§15-0105. DEC's powers over water are found in ECL Article 15, with authority to regulate water supplies found within under Title 15.

All proposals for new or additional sources of public water supply and various actions regarding public water supplies require a permit from the DEC. Permit requirements are generally found in ECL §§15-1501 and 15-1503; and DEC's regulations at 6 NYCRR Part 601. Among the requirements for a permit, anyone who proposes taking water from a particular source must state the need for and the reasons why the particular source or sources of supply were selected among the alternative sources which are or may become available, and must show the adequacy of the selected source. When making a decision on the permit application, the Department must determine whether the project is required by the public necessity, whether the source is adequate, whether it takes proper consideration of other sources of supply that are or may become available, and whether the project is just and equitable to all affected municipalities and their inhabitants with particular regard to their present and future needs for sources of water supply. In this regard, the DEC *allocates* particular water sources to serve particular areas. The courts have held that the problem of allocation of authority to serve a given territory involved specialized administrative judgment. *Swan Lake Water Corp. v Suffolk County Water Authority*, 20 NY2d 81 (1967). The ECL authorizes DEC to place conditions in its permits to ensure the permittee's compliance with the matters subject to the Department's determinations. This includes designating service areas, prohibiting the provision of service beyond the designated areas, and also mandating service to other areas that may need to have water allocated from a particular source. In regard to mandated service from one water supplier to another, if the suppliers cannot agree on rates to be charged, the DEC has the authority to set the rates.

Reservoirs On Forest Preserve Lands

Special procedures are provided under ECL Title 15 regarding the construction of reservoirs on state forest preserve land. §§15-1511 – 15-1519.. These lands are protected by the "forever wild" provision of the state constitution. NY Constitution Art. XIV §1. However, the constitution permits the legislature to allow up to three percent of forest preserve lands to be used for construction and maintenance of reservoirs for municipal water supply and for the state's canals, as long as the reservoirs are constructed, owned, and controlled by the state. NY Con. Art XIV §2.

Limitation on Use of Wild Rivers

The legislature found that many rivers and their immediate environs possess outstanding natural, scenic, historic, ecological, and recreational value. It determined that such rivers should be preserved in a free-flowing condition and that they be protected for the benefit and enjoyment of future generations. ECL Art. 15 Title 27 designates the state's system of wild, scenic and recreational rivers and describes how it may be expanded. Powers under this title are vested in the Adirondack Park Agency for private properties within the Adirondack Park and in DEC for all other locations. After any river is included in the system, no dam or other structure impeding the natural flow is permitted.

New York City Water Supplies

The effect of the ECL is limited with respect to certain rights granted by the legislature under the Administrative Code of the City of New York, in particular Title K of Chapter 51, otherwise known as the Water Supply Act, and Title D of Chapter 15. ECL §15-0111. It has been held that the Water Supply Act did not accord the City the right to preempt upstate sources to the exclusion of the people who live in these areas (certain counties are named) and depend on these sources for water. If a municipality in this upstate area wishes to take water out of the New York City system, all it must do is apply to the City's water commissioner who *will* grant a permit under reasonable rules and regulations. State consent is not needed. *Cornwall v Environmental Protection Administration*, 45 AD2d 297 (1974). Rates and amounts are to be agreed upon between the City and the upstate municipality, with DEC acting as arbiter if no agreement is reached. The Act, however, specifically limits the quantity of water to be taken to be equal to the population of the municipality to be served times the per capita consumption within the City of New York. Admin. Code. §K51-42.0.

Water-Works Corporations

New York State Transportation Corporations Law (TCL) Article 4 plays a role among those holding water rights. TCL§45 authorizes water-works corporations to intercept and divert the flow of waters from the lands of riparian owners, and from persons owning or interested in any waters by purchasing the rights, either by agreement or by condemnation. Significantly, the section also states that no such corporation shall have power to take or use water from any of the canals of the state, or any canal reservoirs as feeders, or any streams which have been taken by the state for the purpose of supplying the canals with water. TCL §42 imposes a duty on water-works corporations to supply water at reasonable rates to each city, town, or village through which its conduits or mains may pass. This has been interpreted to mean that, if a water company has a contract with a municipality to supply it with water, the municipality has the implied power to compel the company to supply water to any part of the municipality at reasonable rates. *In re Massena v St. Lawrence Water Co*., 126 Misc. 524 (Sup. Ct. 1926).

Conclusion

Although individuals have rights in water resources under the common law riparian system, these may be acquired or regulated pursuant to state law for public purposes. The state has an obligation to ensure that multiple uses are protected, giving priority to public water supply systems. The state also has an obligation to fairly allocate the state's water resources among its various subdivisions. What may be done with a particular water resource can be a complicated mix of common, statutory, and administrative law and court decisions based on variations of history, geography, and who is involved. This paper is intended to provide a starting point to understanding particular water rights issues. Always consult an attorney for an assessment of your particular situation.

FEMA Flood Maps, Flood Risk and Public Perception

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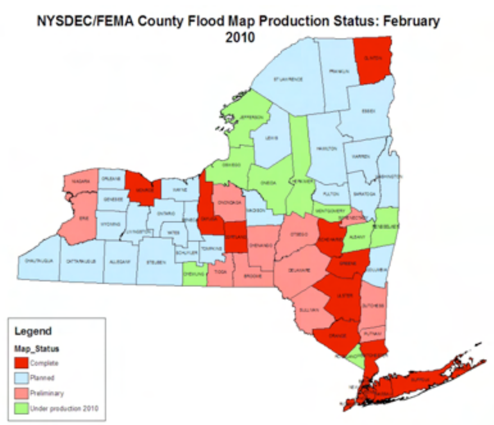
The National Flood Insurance Program was passed by the United States Congress in 1968 to provide federally backed insurance for flood damages to homes and businesses in return for local communities agreeing to pass and enforce flood resistant development requirements. The program has evolved through the years, with more detailed and sophisticated floodplain mapping products, extension of federal floodplain development standards extending into state building codes, and including the development of mandatory flood insurance purchase requirements as a condition of any federally regulated mortgage for a structure in a mapped flood hazard area.

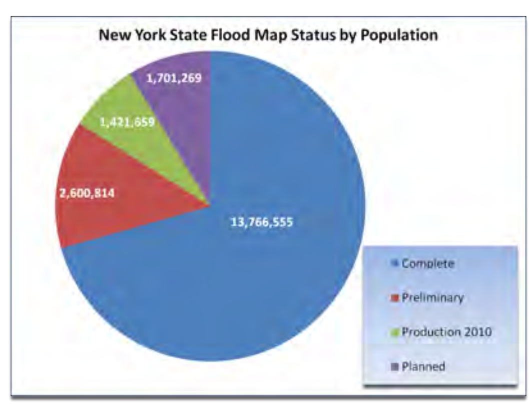
In the late 1990s and early 2000s, a consortium of interests, including environmental groups, real estate associations, insurance organizations, and lenders agreed that the existing flood maps were out of date and not aligned with modern mapping technology. Congress was convinced that updated, more accurate flood maps would reduce future flood losses in an amount far in excess of the cost of the new mapping. In 2003, Congress passed a five year $1 billion Map Modernization program to update the nation's flood maps. In New York State, the Department of Environmental Conservation signed a Cooperating Technical Partnership agreement with the Federal Emergency Management Agency (FEMA) to cooperatively update flood maps in New York State into Digital Flood Elevation Rate Maps (DFIRMs).

Unfortunately, even the increase in funding is insufficient to meet the state's and the nation's needs for updated flood mapping data. The state and FEMA moved forward to update areas of greatest at risk population, while in some places due to funding constraints, older data is not updated but is "redelinated" onto a new topographic data layer without changing flood elevations. New maps have been predominantly county wide, using digital ortho-photo base maps and utilizing LiDAR (Light Detection and Range) aerial techniques to develop more detailed area wide topographical models for a much lower price than was previously available. The result has been development of digital DFIRMs in a primarily county-wide format which is compatible with other state produced GIS data layers.

The program has also resulted in a large number of preliminary map releases in a short period of time, each of which requires extensive outreach meetings with local communities and the general public. Map releases have occurred throughout the state, but have been concentrated in the population centers, as well as in the areas that were hard hit by the June 2006 flood event. The following figure shows, which counties have been mapped or are in some stage of, map production.



While many parts of the state are not yet in map production, the counties in production represent a significant portion of the state's population.



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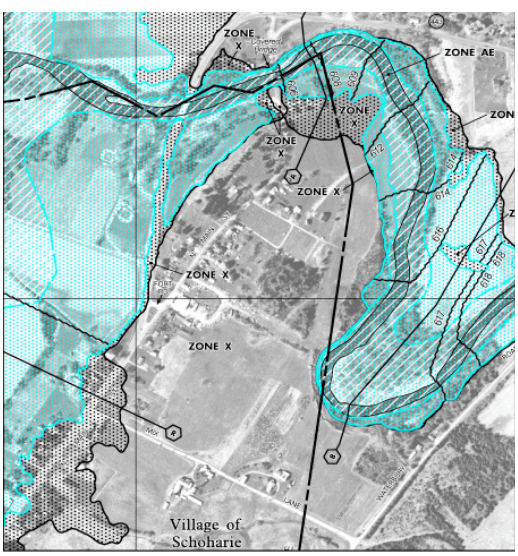
Along with the map release and the associated meetings comes press coverage and concerns about how many people will be "hurt" by the new maps. The purpose of the maps is to show which areas are in various flood risk zones so that people can purchase the required flood insurance and so new and improved development will be reasonably safe from flooding. However the focus is always on the cost.

Flood insurance is mandatory as a condition of any federally regulated mortgage for any structure which is within the mapped high risk flood zone. This is the area that is commonly thought of as the 100 year flood zone, but is more accurately described as the area that has a one percent or greater chance of flooding in any given year. Even that concept, though, does not adequately portray risk.

Flood mapping is derived from a number of steps, each of which adds uncertainty to the process. This statement obviously leads many people to conclude that the risk is not real. Indeed, the actual one-percent flood elevation may be lower than portrayed on the maps in some locations. It is also as likely to be higher. In fact in many locations, the limitations of the flood mapping processes themselves result an understating the risk.



In the most obvious example, a flood map is essentially divided into a "high," "medium," and "low" risk zone. The high risk zone is defined on the DFIRM panels as "Special Flood Hazard Areas subject to inundation by the 1% annual chance flood." This is further defined as a flood that has a 1% chance of being equaled or exceeded in any given year. In some areas, the "shaded zone X" zone, often called "B" or "C" zones on older flood maps, is also shown. This is the area subject to the 2% annual chance flood, better but inaccurately known as the 500 year flood.

These determinations are based on probability. For example, the probability that the one percent annual chance flood occurs in any 30-year period at a given location is 26 percent. Even within a 100-year period, however, the probability is 63%. This leads people who have been fortunately enough to have not seen such an event in their lifetimes to assume that they cannot occur and that the maps are in error since "it hasn't flooded here." The so-called 500-year flood seems like an event that is so rare that it shouldn't even be discussed. However the probability that a 500-year flood will be equaled or exceeded in a given location over a thirty year period is about six percent; not an unthinkable probability.

Another problem with flood risk perception is that the flood maps show areas as appearing to have the same flood risk within the same flood zones. In fact, the areas that are lower in elevation will obviously be at higher risk than those areas that are just below the Base Flood Elevation (elevation of the one-percent annual chance flood).

Increasing uncertainty about flood risk is a number of additional factors. The development of a flood map is based on three key factors: hydrology, topography and hydraulics. Stream hydrology in this case is the determination of how much water will be flowing past a particular location along a stream during a flood of a given frequency.

Where there is long term stream gage data for a watershed, the hydrologic determination will be most accurate. For gaged streams, guidelines for determining flood flow frequencies utilizing a Log Pearson Type,are available from the United States Geological Survey. However, when using gaged sites, even the longest period of record rarely exceeds 60 years, and gages are frequently victims of budget cuts. For the period of record, hydrologists determine the greatest single day flow for each year of record. Those are then used to determine the probability that a particular flow will be exceeded in a given year. The flow that has a one percent probability of being exceeded in a given year becomes the one-percent chance flow. However, given the limited period of record, that flow could have a margin of error of plus or minus thirty percent. The model calculates the actual confidence interval.

If there is no gage data available, hydrologists often use USGS regression equations, which compare watershed characteristics to data from similar watersheds with gage data. In some cases, a rainfall-runoff model is developed, particularly if flows are affected by upstream impoundments. Use of different models could produce different results.

There is always uncertainty in determining a "reasonable discharge." When comparing discharge estimates computed using different models, hydrologists consider the assessment or "reasonableness." There is considerable uncertainty when using rainfall-runoff models. As a result, FEMA requires the mapping partners to calibrate the parameters of rainfall-runoff models against major known storms. The results are deemed to be acceptable if they fall within one standard error of the USGS regression equation or gaging station data.

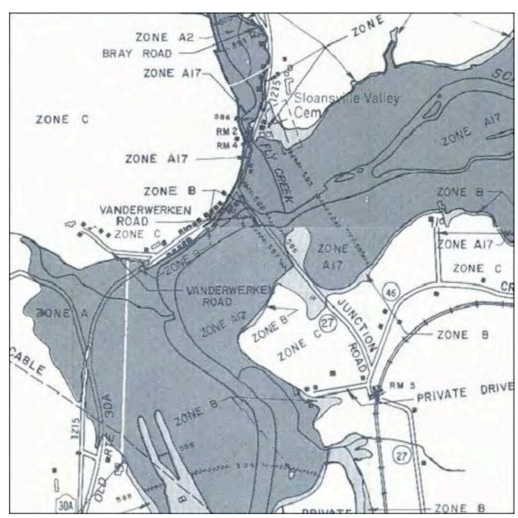
The next step is the development of a topographical model in order to determine how the water will flow through the stream and over the floodplain during a flood of a certain magnitude. Surveyors run cross sections at varying intervals to precisely measure the bathymetry and the shoreline shape, and to measure bridges, culverts and dams. The ground survey work is labor intensive. Cross sections are generally gathered about every 1,000 feet, plus at hard structures, stream junctions, and at sudden changes to the stream profile.

Hydraulic engineers then use the flow data and the cross sections to calculate flood elevations at the cross sections. This is a precise exercise given the data used. In other words, if the input flow and survey data is correct, the flood elevation can be calculated for that flow with a high degree of precision.

In between cross sections, however, topographical models are used to plot the flood hazard area onto a map. Sometimes the only model available is from USGS topographic models. Any topographic map is considered to be accurate to one half of a contour interval. Therefore, a map utilizing ten foot contour intervals will have a ground elevation that is accurate to plus or minus five feet at any given location.

Use of LiDAR data reduces the uncertainty. FEMA standards for LiDAR use in flood maps are that it must be accurate to within two feet. Thus, contour maps based on LiDAR are shown with two foot contour intervals at which any point will be accurate to plus or minus one foot. LiDAR points themselves must also meet an accuracy test. In general, the LiDAR points are accurate to about 8 cm. The FEMA standard for relatively flat terrain is that 95% of elevations in the dataset must have an error of under 1.2 feet. For rolling or hilly terrain, a four foot equivalent contour interval is considered acceptable, with datasets having 95% of the elevations with an error of fewer than 2.4 feet.

FEMA has faced criticism that the LiDAR is not accurate enough to determine whether a structure is really "in the floodplain." This criticism is based on instances in which new maps have shown houses to be in the Special Flood Hazard Areas when ground surveys show that they are out by a matter of up to one foot. The perceived problem is exacerbated by the fact that the new maps utilize a digital ortho-image, allowing users to actually see the house on the map. The older maps only used a grey shade on a blank map with roadways. This made it very difficult to do a determination on a particular structure along the edge of the flood zone without ground survey.



FEMA has estimated that by replacing LiDAR, which can be collected and processed for about

$350 per square mile, with ground survey of structures, would cost about $900 million just in New York. This would be a prohibitive expense. State-wide LiDAR, on the other hand, would cost under $20 million.

In fact, the FEMA flood mapping techniques, and their use in the National Flood Insurance Program, are full of compromises. Mandatory flood insurance purchase requirements only apply to the "high risk" flood zone, yet risk certainly exists outside of that zone. The mapping techniques themselves do not consider certain risks. They do not consider how bridges or culverts blocked with debris increase flood elevations. They do not include the possibility of a dam break. They are beginning to consider the risks inherent in levees but the techniques used to not accurately portray the risk of a levee failure or overtop. The maps also do not consider trend lines in flooding. They do not consider natural changes to stream morphology. Streams migrate. They also do not consider ice jam flooding.

John Garver has demonstrated that historic ice jam flooding in Schenectady is considerably in excess of the newly derived Base Flood Elevation for Schenectady. However the recently released Schenectady County preliminary DFIRMs do not show the risk of ice jam flooding.

The National Flood Insurance Program is based on the one-percent flood as measured by state of the art engineering methods limited by the inherent errors in statistical measurements and topography that can never be accurate to an inch over a wide area. The program is also limited by a "binary" approach to mandatory insurance. You are "in" or you are "out." Real flood risk does not behave that way.

Given the rapid increase in flood mapping technology, the techniques exist to have a more realistic approach to flood insurance. Rating should be based not on a strict "in or out" determination, but on a comparison of ground elevation to the flood elevations. This should extend beyond the limits of the one percent chance flood zone as the risk does not suddenly disappear, or even rapidly decrease, when you take a step across that line. Finally, steps must be taken to allow more affordable flood insurance for older structures that were built prior to flood maps and related design standards, accompanied with a more active mitigation program to buy out or elevate such structures that are at high risk. That would decrease the public opposition to new flood maps.

Property owners, the press, and politicians see the new flood maps as delivering a risk of flood insurance requirements. They must be more properly viewed as flood risk maps. Reform of flood insurance requirements to expand the risk pool and eliminate the "in or out" determination will lead to a more rational program. It is absurd that people will spend hundreds of dollars to get a survey to prove that they are one inch above the Base Flood Elevation in order to eliminate the flood insurance purchase requirement.

Reform of the flood insurance purchase requirements will also allow for development of more realistic flood risk maps, without the current focus on who is "hurt" by the maps. This would result in the proper use of the maps to mitigate the risk, while reducing the public and political push back against the maps.

Comparative analysis of student, volunteer and professionally collected monitoring data

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Schenectady, NY

Recent recognition of the great social and ecological value and resources of the Mohawk River Basin has stimulated local and state agencies, academic institutions, and non-profit organizations to fund or initiate projects within the Basin aimed at socio-economic development, watershed management and conservation, data collection, and community outreach and education.

Several studies document the benefits of volunteer collected data as a screening method (Fore et al. 2001, Engel and Voshell 2002). Properly organized and trained volunteer monitoring groups contribute greatly to the understanding of watersheds and are excellent long-term stewards; participants experience a sense of pride and stewardship that extends beyond the streamside event into the community. The United States Environmental Protection Agency (USEPA) encourages states to incorporate volunteer data when reporting on the condition of waterbodies (305(b) list) and when reporting impaired water bodies to the 303(d) list (Engel and Voshell 2002). However, without proper training and professional oversight volunteer data may not be recognized or accepted by regulatory agencies that enacts change (e.g., restoration, conservation, protection). Many local, state, and federal agencies that advocate for volunteer data have also developed systematic training and certification programs to ensure data quality and accuracy (EPA 1999, Fore et al. 2001, Engel and Voshell 2002, McNeil et al. 2006).

Monitoring programs that incorporate both volunteer and professionally collected data will improve the planning watershed objectives, provide more detailed data analysis and interpretation, and gain recognition by state and federal agencies. The objective of this paper is to illustrate the differences between volunteer and professionally collected data and express the need to establish monitoring programs that integrate both sources of data. The Mohawk River Basin community is posed to develop effective and robust biological monitoring programs while engaging community participation and education.

Methods

Biological monitoring data from New York State Department of Environmental Conservation (NYS DEC) was examined in relation to basin size, number of volunteer monitoring groups/organizations (estimated), and additional data resources (public data collected by or funded by local and federal agencies).

Metric results and conclusions were examined from three studies where student and professional (trained biologist/certified taxonomist) data were collected simultaneously to test the efficacy of the collection, processing and reporting. In 2006 and 2007 side-by-side Battenkill Watershed benthic macroinvertebrate samples were collected, processed and analyzed as part of the ongoing Battenkill Conservancy biological monitoring program. A similar study was conducted in Rockland County in 2007 as part of the Rockland County Soil and Water Conservation District's routine biological monitoring program. The intent of these studies was to educate and assist students to apply the proper field and laboratory methods and appropriate analytical tools. The expectation was not for the students' results to meet the caliber of the professional's results or to supply data to the funding organization, but to provide an educational opportunity and research experience. However, these studies provide excellent examples of the differences and inconsistencies in data quality, interpretation, and level of detail between volunteer (nonprofessionally) and professionally collected data.

Volunteer monitoring group reports were evaluated to qualitatively assess the interpretation of the results. The collection methods, identification and metric calculation accuracy were not evaluated; the volunteers received similar training as the LSI students, therefore we assume that the data collection, processing and calculations were properly performed. The intent of these reports was to

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provide an educational outreach experience and publically present their findings.

Results

The Mohawk River Basin is part of the Hudson River Watershed, comprising approximately 26% of the Hudson River Watershed's drainage area. The sites monitored by the New York State Department of Environmental Conservation Stream Biomonitoring Unit (NYS DEC SBU) in the Mohawk River Basin are approximately 31% of the total sites monitored within the Hudson River Watershed and are relatively evenly distributed, however many areas of the basin (and the Hudson Basin) are sparsely visited. The data resulting from NYS DEC SBU monitoring efforts provide information on the water quality, historical perspective (if applicable), screening for impairment status, supportive data for priority water listing, identification of non-point source discharges, and data to evaluate SPDES permits, compliance and enforcement, contaminants, and data to list impaired water bodies (Bode et al. 2002).

The Hudson River Watershed, particularly within the tidal section (from The Battery in New York City to the Federal Dam in Troy), has many non-governmental organizations advocating, educating, and monitoring to restore and conserve the Hudson River and its tributaries; several of these organizations have increased the number of monitoring sites by 38% (Table 1). The Mohawk River Basin has fewer non-governmental organizations contributing to the understanding and stewardship of a major sub-watershed of the Hudson.

The non-governmental groups within the Hudson Basin conduct numerous activities to meet their objectives and produce data and information of varying quality. Over time, some of these organizations have re-evaluated their objectives and abilities. For example, Hudson Basin River Watch (HBRW) initially sought to educate the public about the Hudson Basin. Their major funding source, Hudson River Estuary Program, shifted focus to the collection of more accurate biological assessments (higher degree of analysis) to help report on the condition within the Hudson River and its tributaries, in conjunction with educational outreach. HBRW, recognizing the significance of the Hudson River Estuary Program's priorities, adjusted its programming to offer more scientifically rigorous biological monitoring methods and increased the number and depth of educational workshops, while maintaining strong educational opportunities for all ages throughout the Hudson Basin.

Table 1. Number of NYS DEC and non-governmental monitoring sites in the Mohawk and Hudson River Basins.

	Mohawk River Basin	Hudson River Basin*
Area (mi^2)	3,476	13,470 (including Mohawk River Watershed; without 9,931)
Number of non-governmental organizations	13	65
Number of NYS DEC biological monitoring stations	230	505
Number of non-governmental monitoring sites	16	318
Total monitoring sites	*246*	*823*

**Excludes Mohawk River Watershed data, unless otherwise noted*

Partnerships with volunteers and professionals to collect data accomplish both educational goals and data quality goals. Several non-governmental organizations have demonstrated this through implementing a unique program developed by Watershed Assessment Associates called Lotic Scene Investigation™ (LSI). The LSI program provides hands on learning with an experienced biologist/certified taxonomist to assess stream water quality condition. Both student and professional mentor collect, process and analyze (side-by-side) benthic macroinvertebrate data from several streams.

The results from three LSI studies demonstrate the advantages and necessity of collaboration with research professionals (Table 2). As expected, the taxa and EPT richness differences were high between the professionally and student collected data. Students identified taxa to family and the certified taxonomist identified taxa to genus/species level. The benthic community metrics calculated by the student and taxonomist were specifically designed for the taxonomic effort employed and should supply similar results. Differences in impact category determination, based on the multi-metric BAP score, ranged from 0-100% (Table 2). These discrepancies lead to inaccurate interpretation of the results and inappropriate comparative analysis with historical data.

Table 2. The absolute differences between benthic macroinvertebrate metrics calculated by students and professionals; numbers represent average differences among 4 sites. Students and professionals collected benthic samples side-by-side (i.e., same location, date, time, and method). ** Metric results were not supplied.

	Battenkill 2006	Rockland County 2007	Battenkill 2007
Taxa Richness	15.5	8	**
Biotic Index	0.79	0.78	**
EPT Richness	5	1.8	**
Model Affinity	14	20.3	**
BAP	2.1	1.3	0.4
Water quality category determination†	100%	50%	0%

†Water quality category determination is based on the BAP score, the site is designated as either non-impacted, slightly impacted, moderately impacted or severely impacted. The values in the table represent the percent of discrepancy between the student and professional water quality category placement.

Five volunteer reports were evaluated based on following criteria: (1) methods (appropriate for study objective), (2) accurate interpretation of results, and (3) inclusion of incorrect information (i.e., references to erroneous water quality standards, or improper use of terminology) (Table 3). Volunteer groups solely completed the reports. Appropriate methods were employed and accurate interpretation of the results were achieved by 40% of the volunteer groups; 100% of the groups included incorrect information when describing the results (Table 3).

Table 3. Qualitative assessment of the volunteer monitoring reports evaluated.

Volunteer Report	Appropriate method for stated objective	Accurate result interpretation	Inclusion of incorrect information
1	No (impairment analysis requires 3 replicate samples from 3 similar sample locations; requires genus/species taxonomic effort)	No (no replicate data, inaccurate to determine community differences related to impact; did not account for habitat variability)	Yes (references to erroneous water quality standards)
2	No (sample design did not accomplish objective)	Yes	Yes (references to erroneous water quality standards)
3	Yes	No (supposing impact without adequate references)	Yes (references to erroneous water quality standards)
4	Yes	Yes	Yes (references to erroneous water quality standards)
5	No (impairment analysis requires 3 replicate samples from similar sample locations; inappropriate reference site selection; requires genus/species taxonomic effort)	No (no replicate data, inaccurate to determine community differences related to impact; did not account for habitat variability or weather prior to sampling, concluded all sites to chemically and biologically NOT impacted but stated they were impacted without adequate justification)	Yes (references to erroneous water quality standards)

Discussion

The failure of the LSI students to accurately categorize water quality is likely due to the students' limited taxonomic experience and varying levels of ability and effort during the study. The training the LSI students received was accomplished during a 3 month period; this may not be adequate for all participants. Also, inclusion of a student taxonomic accuracy evaluation would help address taxonomic differences.

The indices utilized by the students (family-level) are scaled to parallel results for higher resolution (genus/species-level) index results. However, the genus and species within benthic macroinvertebrate families are very diverse and represent a range of pollution tolerances and feeding habits that provide more detailed information regarding the community structure and condition. Genus/species taxonomic effort allows the calculation of other metrics that indicate possible sources of impairment (Impact Source Determination), nutrients (Nutrient Biotic Index (NBI)) (Smith et al. 2007, Riva-Murray et al. 2002, Smith and Bode 2004), and impairment criteria analysis (Bode et al. 1990). Also, volunteer data using order or family level metrics are generally only able to differentiate between the least and most disturbed sites, and are less able to differentiate among sites with subtle disturbance levels (Fore et al. 2001).

Further, without professional guidance and review, volunteer monitoring data may lead to over or under estimation of biological condition, inappropriate analysis, and inclusion of misinformation. For example, a volunteer report concluded a site to be impacted although the biotic metric results indicated no impact; the authors also inaccurately referenced water quality standards (Table 3). If submitted to a regulatory agency, this type of information may lead to unnecessary and more expensive assessment by an agency or result in no action when action is needed (Engel and Voshell 2002).

LSI is an effective program, but other programs may better fit an organization. For example, trained volunteers could collect benthic samples and certified taxonomists could identify and interpret results; trained volunteer data and sample processing could be checked (QA/QC) by certified taxonomists, and organizations could sponsor workshops to train and certify volunteers. In addition, it would be tremendously beneficial for state and volunteer organizations to work together to develop protocols that fit the expertise of the volunteers and the expectations of the state. The Virginia Save-Our-Streams volunteer monitoring program redefined its protocols, resulting in the production of higher quality data submitted to professional scientists, and increasing the effectiveness of the program to achieve its mission objectives.

A robust volunteer monitoring plan would include proper training (macroinvertebrate identification, sample collection and sample processing) and require oversight by professional scientists to improve the sampling strategy plan, define monitoring objectives, and oversee final review and interpretation of the data (Fore et al. 2001, Engel and Voshell 2002).

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PEAK SHAVING: AN APPROACH TO MITIGATING FLOODING IN THE SCHOHARIE AND MOHAWK VALLEYS

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The Schoharie Reservoir is the second west of Hudson water source built to supply New York City. It was authorized in 1916, with construction on its outlet tunnel begun in 1918 and in 1919 on the dam at Gilboa, Schoharie County. Water first flowed through the Shandaken tunnel in 1924, and flowed over the dam spillway in 1926.

The Gilboa Dam comprises two elements, a concrete spillway section 1326 feet (404.16 m) long and an earthen section 674 feet (205.4) long. The top of the spillway is at 1130 feet (344.6 m) above mean sea level. The reservoir covers 1142 acres (462.15 hectares) draining a total area of approximately 314 square miles (81325.62 hectares.) The reservoir design capacity is approximately 22 billion gallons (67515 acre-feet), and it contributes upwards of 15 percent of the drinking water for New York City and other on-line communities.

In 1996 it was discovered that scouring of sections of the foundation of the dam had occurred, possibly allowing slippage of the structure, thus compromising its integrity. The New York City Department of Environmental Protection (NYC DEP), the agency responsible for the city's water supply, undertook repairs to stabilize the concrete dam structure and planned installation of a series of post-tensioned anchor cables anchored into bedrock. First, NYC DEP installed four siphons, each capable of draining 225 cubic feet per second (cfs), at roughly the midpoint of the spillway. Subsequently, to relieve pressure on the dam, a "notch" 220 feet (67 m)long was carved into the spillway to reduce the elevation in that short section to 1124.5 feet (342.7 m). The notch thus limits the occasions on which the reservoir level reaches maximum height and places pressure on the weakest section of the dam structure. These measures were taken as an emergency expedient, as NYC DEP has undertaken a major reconstruction of the Gilboa Dam, scheduled to be largely completed in 2014.

Dam Concerned Citizens, Inc.
Recognizing the potential for a catastrophic failure at Gilboa, DCC was organized in 2005. DCC is an advocacy and watchdog group, and it has been actively monitoring these efforts. In fact DCC has been in the vanguard, proposing various approaches to assure the safety of downstream communities along Schoharie Creek and the Mohawk River. It is our belief that carefully considered design and implementation will best serve the cities, villages and towns along these watercourses.

DCC is convinced that an effective Operating Plan, developed and implemented by the New York City Department of Environmental Protection, the Schoharie County Department of Emergency Management, other relevant agencies and citizen input can mitigate flooding in all but the most severe weather events, We believe among the elements of the Operating Plan, Peak Shaving has the greatest potential.

Peak Shaving
Peak Shaving suggests that pre-emptive reduction in the level of the reservoir can dramatically reduce the likelihood of flooding during periods of high precipitation and snowmelt. The notch, with its capacity of roughly 8350 cfs has amply demonstrated that downstream flow can be partially controlled by allowing a limited amount of water to be released, heavy flows resulting from water rising to spillway crest level and above can be reduced. With the construction of a low-level outlet and installation of controlled gates in the notch, further control is available. The reconstruction project includes placing Obermeyer gates in the spillway notch, and installing a low-level outlet of 2500 cfs capacity upstream of the dam. These works will allow NYCDEP great flexibility in meeting its water supply responsibilities and assuring downstream residents that their safety is of utmost importance.

Peter Ontkush has developed, independent of DCC, a behavior model that graphically demonstrates the value of Peak Shaving in

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controlling downstream flow. The accompanying charts, using the example of the January 25, 2010 high water event, illustrate the opportunity that pre-emptive level reduction, or void creating, can have in minimizing downstream disruption.

Flow control

As illustrated, in Chart 1, the flow into the Schoharie reservoir at Prattsville gauging station (USGS 01350000), measured approximately 29000 cfs at 5:00 PM, January 25, the result of approximately 2.9 inches of rain, average, over the drainage area. Flow peaked at approximately 19,000 cfs at the Gilboa gauging station USGS 01350101) at 9:00 PM January 25. The downstream flow caused minor local flooding and one road closure.

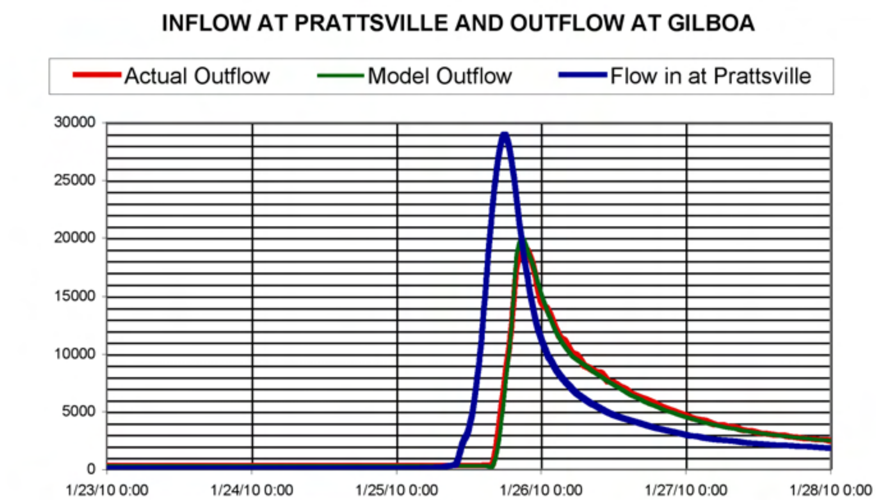

CHART 1

Using the model, we can see the dramatic effect that peak shaving can have on downstream flow. With the siphons removed, and the low level outlet installed and in operation starting at the time the flow at Prattsville doubled (125 cfs to 243, 8:00 AM January 25) the maximum flow would have been reduced to approximately 11,000 cfs. Given the weather forecast for the area, opening the low level outlet at midnight, January 24, would have reduced the maximum flow to approximately 8200 cfs, as shown in chart 2.

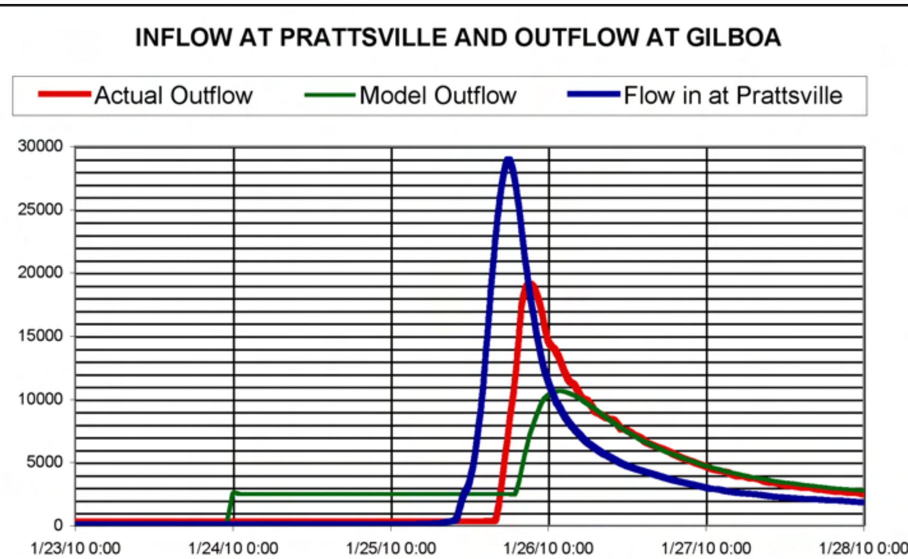

CHART 2

Dam Safety

By limiting the flow of water over the spillway of the Giboa Dam during heavy rainfall events, downstream safety in enhanced. The spillway of the dam shows the effects of heavy flows during the many extreme weather events over the past 80 years. Keeping flows confined to the notch to the as much as possible, limits further erosion on the spillway surface, thereby enhancing its integrity.

Continuing to use the January storm as an example, Chart 3 shows the change in water level over the course of the event, and the level predicted by the model. The water level at Gilboa reached approximately 1131.5 feet above mean sea level at 10:00 PM on January 25. Had the low level outlet been in operation and opened at midnight, January 24, the model predicts a maximum level of approximately 1129.5 feet, a foot below flood stage.

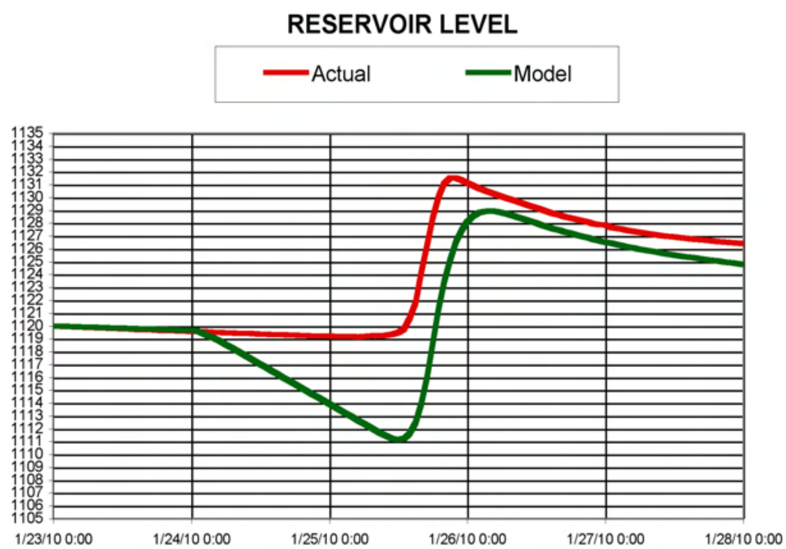

CHART 3

The case for Joint Control of Operations

Clearly, dam safety and limiting downstream flow to below-flood-level rates is advantageous for all parties. While the supply of water in the Catskill drainage area to the City of New York is of paramount importance, the safety of the citizens of Schoharie, Montgomery, and Schenectady Counties and beyond is of no lesser importance. By developing a comprehensive Operating Plan for the Gilboa dam, including the use of the Obermeyer gates to be installed in the notch later this year and the low level outlet planned for operation in 2014, all constituencies can be well served. DCC recommends that planning begin now for developing such an operating plan. We also recommend that the NYC DEP, Schoharie County Emergency Management Office, Schoharie County Flood Committee, concerned citizens groups (farmers, business groups, recreation groups, landowners, etc.) and similar organizations in the other affected areas along the Schoharie and Mohawk Rivers be included in developing this plan. Further, those entities should be directly involved establishing the operating parameters (predictions of precipitation, measures of snow pack, ice formation, etc.), along with developing schedules of preemptive void creation based on anticipated weather. With such cooperation, the goals of ample water supply to the city and the health and safety of downstream communities can be achieved.

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ICE JAM HISTORY, ICE JAM MITIGATION TRAINING AND ICE MITIGATION EFFORTS IN THE MOHAWK RIVER BASIN

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Ice jams are a frequent occurrence in the northeast United States and most often occur during the second half of the winter season. New York State ranks second in the nation in the total number of ice jams, with only the state of Montana recording more since 1780. While freeze-up jams normally cause nuisance flooding early in the winter season, it is the break-up jams which usually occur in January, February and March that result in most of the ice jam flood events.

The National Weather Service in Albany, New York has maintained an ice jam reference for many years listing the major trouble spots on streams and rivers in eastern New York and western New England. During the last 10 years a concerted effort has been made to train emergency managers, highway departments, and first responders on the favorable locations for ice jams occurrence, when ice jams are expected to occur, and mitigation techniques that diminish the impact of the ice jams.

This presentation will include a history of ice jams in the Mohawk River Basin, and a discussion of the Ice Jam Training and Mitigation Workshops that have been conducted in recent years. It will also highlight successful ice jam mitigation techniques that have been used in Herkimer County.

A TREE-RING RECORD OF SLOPE STABILITY IN SANDSEA KILL, SCHENECTADY COUNTY, NY

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Slope stability is a major issue that affects property owners, infrastructure and the natural environment. Stability can be measured directly, but changes often happen very slowly and it is more useful to have a long integrated record of slope changes. Trees can adapt to slope changes by growing asymmetrically to compensate for the moving slope. This study evaluates trees sampled from a slope along Sandsea Kill, Schenectady County to assess long-term slope stability. Immediately upstream of the sample site is the where the major slope failure in 2006 occurred, that caused part of Rynex Corners Road to be closed.

Hemlock trees were cored from the upslope and downslope side of each tree (Figure 1) and placed in a clear plastic tube in ensure a safe transfer to the lab. At the lab, the cores were placed in grooved plywood pieces, glued, and left to dry. The samples were then sanded down. Next, the tree cores were scanned and Adobe Illustrator was used to measure tree ring widths in millimeters. The measurements were transferred to and Excel spreadsheet where analyses were carried out. The data on the tree widths from the upslope and downslope were used to compare the growth patterns of the sampled trees in this area.

Figure 1: An example of the coring process from the downslope of the tree.

Tree-rings often indicate what environmental conditions were like during the tree's lifetime. Two important things to observe in the tree core is whether the tree appears to have symmetric or asymmetric growth, and whether reaction wood is present.

Symmetric patterns of the tree rings may indicate that the tree is growing consistently, and is not affected by any specific conditions in the area. Situations of asymmetrical growth in which there are very short rings accompanied by thicker widths could be a possible indication that the tree is not stable and is attempting to compensate by growing larger rings downslope of the tree. Reaction wood could be another indicator that change is occurring. It is easily distinguishable because of the darkness of color that takes up more of the ring width (Figure 2). Reaction wood forms when the tree is subject to mechanical stress and its purpose is to help bring the tree to an optimal (straighter) position. Reaction wood is often found in disturbed trees that are experiencing instability and its presence and structure are often analyzed (Stoffel and Bollschweiler 2009). The tree core analyses in this study revealed that the presence of reaction wood or asymmetrical growth patterns are indicators that the tree is responding to changes in stability at the Sandsea Kill site.

In most cases, the sampled trees appear to be impacted from slope instability on the downslope of the tree since its growth is more asymmetric and there is a larger presence of reaction wood. The downslope of tree 1 had reaction wood from 1996-2004, 1982-1990, 1967-1969, and 1952-1955 (Figure 2). Asymmetric growth is also seen throughout the sample. Both asymmetrical growth pattern and reaction wood indicate that the bottom of the slope has seen the most changes in stability but has recently stabilized. In the last four years, the upslope and downslope began to converge (Figure 3). This could indicate that the tree was attempting to recover from the environmental conditions. In some instances reaction wood is the only evidence that the trees were under

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stress. Trees that were sampled lower at the site also show to have been impacted more from slope instability. Trees located higher on the slope have symmetric growth especially in the recent years.

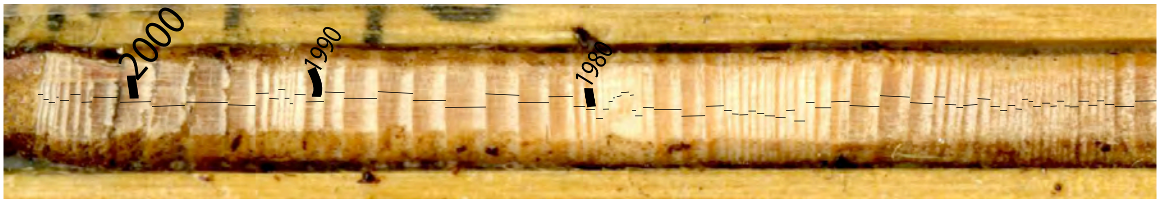

Figure 2: A section of the downslope of the tree core from sample 1. This tree core has visible periods of reaction wood as well as asymmetrical growth.

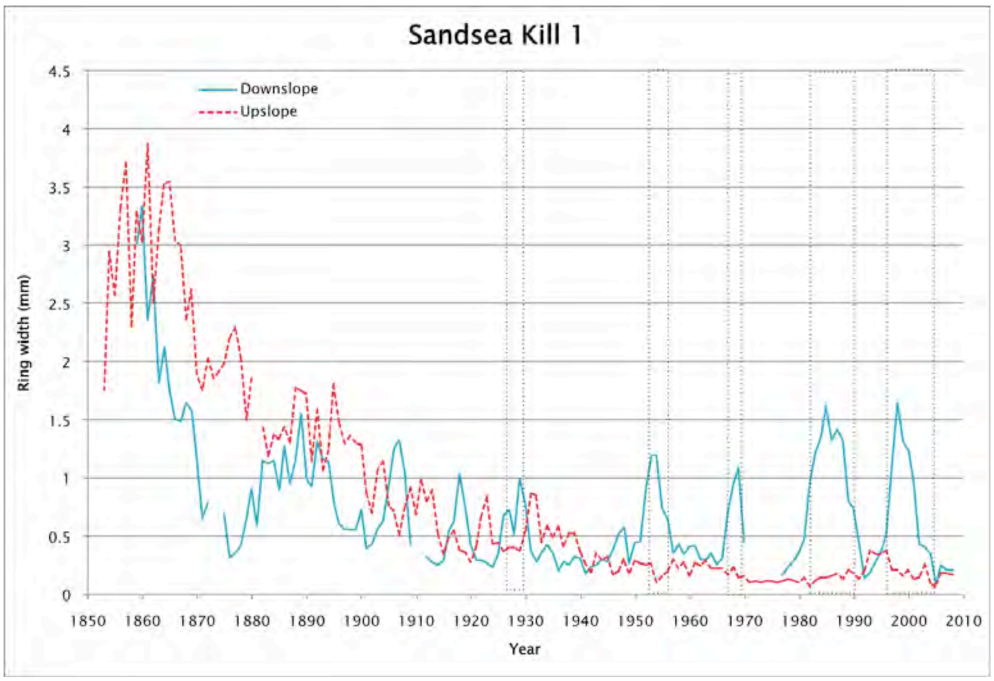

Figure 3: Tree ring widths from the downslope and upslope of sample 1. The downslope ring widths show variability, while the upslope of the tree maintains consistent growth. The rectangles indicate specific instances of reaction wood.

At the Sandsea Kill site, the presence of reaction wood and asymmetrical growth of the tree samples provides evidence that the ground is moving. Episodes of slope instability coincide with periods of frost heaves. The ground on this site is mostly bedrock, during periods of rainfall the water becomes saturated in this soil. In the colder months, the freezing of this water-saturated soil caused the deformation of movement of the ground surface (McKnight and Hess 2001). Tree 1 is the clearest example of this taking place since it is located at on a flat surface toward the bottom of the slope. Years with temperatures closer to zero in their monthly averages coincide with years that have a larger presence of reaction wood for Tree 1. Intense frost heaving is occurring from late 1990s until about 2004 (Figure 4). The bedrock is moving throughout the whole slope and causes the tree to move in the spring.

The study at this site shows the ability of a tree to respond to tree and reinforces the idea that tree cores could be accurate tools in mapping out this change. The trees are responding to changes in temperature and the action of the frost heaves causes the ground to move which leads to the movement and instability of these trees. Additional studies in the area are necessary in order to understand causes of instability and prevent movement of trees.

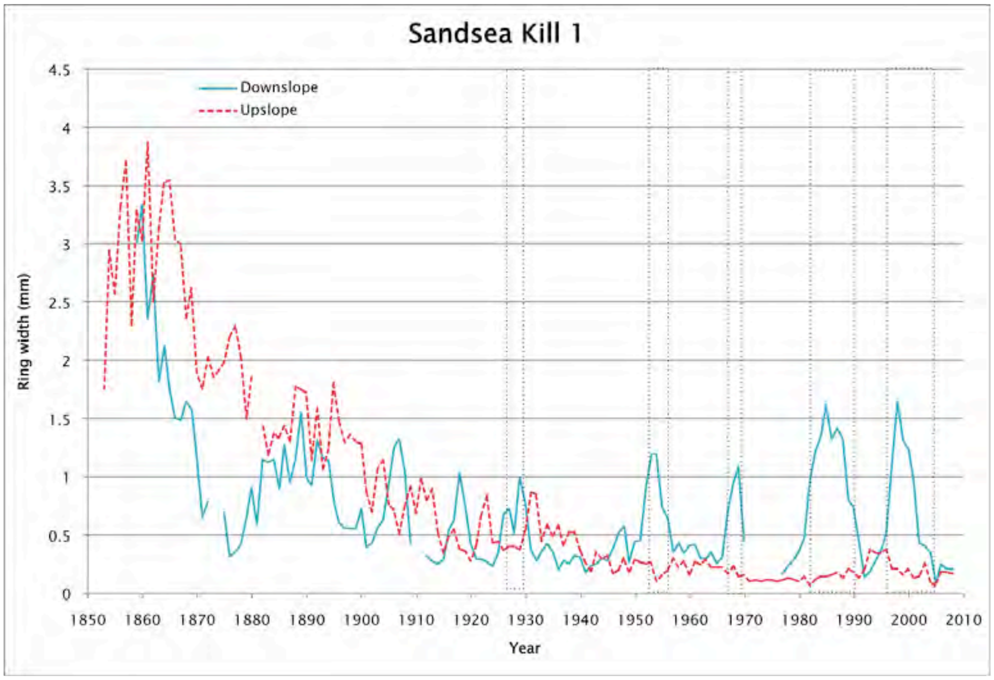

Figure 3: Tree ring widths from the downslope and upslope of sample 1. The downslope ring widths show variability, while the upslope of the tree maintains consistent growth. The rectangles indicate specific instances of reaction wood.

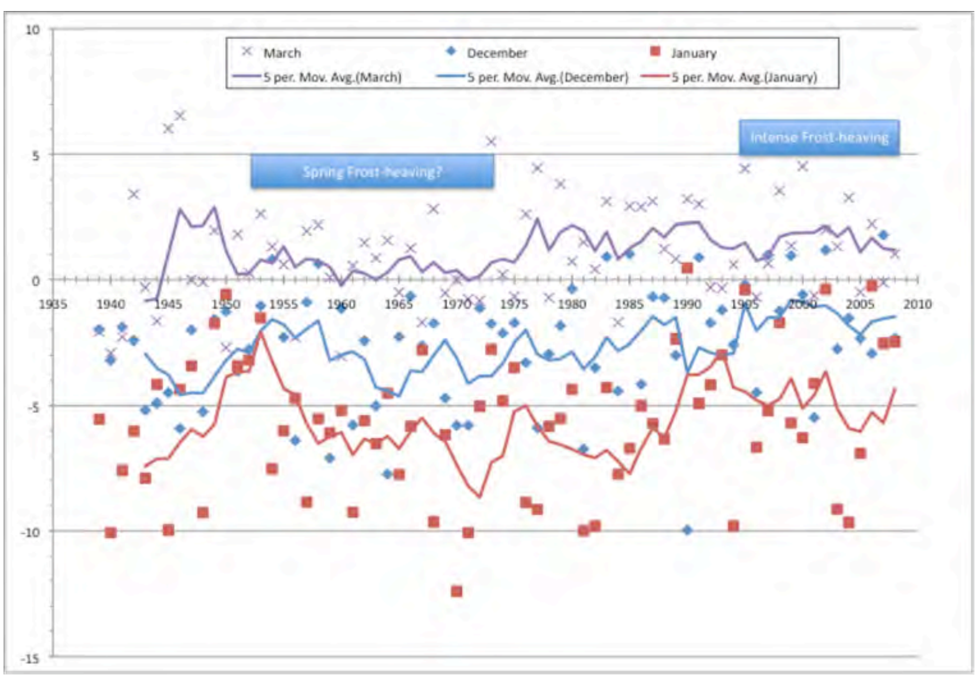

Figure 4: The difference in the average temperatures from zero, for December, January, and March. The closer the monthly averages are to zero, the closer they are to the freeze- thaw optimum.

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MOHAWK RIVER WATERSHED COALITION OF CONSERVATION DISTRICTS AND ITS COMPREHENSIVE WATERSHED MANAGEMENT PLAN FOR THE MOHAWK BASIN

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Mohawk River Watershed Coalition of Conservation Districts

Formed by memorandum of understanding in April 2009, the Mohawk River Watershed Coalition of Conservation Districts (MRWCCD) consists of the fourteen soil and water conservation districts (SWCDs) whose jurisdictions lie wholly or partially within the Mohawk River Basin: Albany, Delaware, Fulton, Greene, Hamilton, Herkimer, Lewis, Madison, Montgomery, Oneida, Otsego, Saratoga, Schoharie, and Schenectady. Because of the work traditionally completed by SWCDs and in the spirit of collaboration, the Coalition quickly adopted the mission, "to implement conservation initiatives that protect, promote, and enhance the natural resources of the Mohawk River Watershed in partnership with local, state and federal stakeholders."

While still in its nascent stages, the Coalition has had much new policy to which to respond when developing a strategy for action, as well as many existing programs by which to be inspired. US Congress had distinguished the Mohawk Valley by enacting the Erie Canalway National Heritage Corridor Act in 2000, initiating new work through several agencies within the region, including the NY Canal Corporation, the Hudson Mohawk Land Conservancy, and the Mohawk Valley Heritage Corridor Commission. The region's need for conservation programming and economic development became readily apparent when Article 14 of the NYSECL was passed in 2006, or "The New York Ocean & Great Lake Ecosystem Conservation Act," which mandated agencies within the State to adopt ecosystem-based management, or a watershed approach to conservation efforts. Not long after, the NYSDEC developed and released its draft Mohawk River Action Agenda 2009-2014, outlining several ambitious goals for the Valley.

In an effort to find its own direction, the Coalition endeavored to develop a comprehensive Watershed Management Plan, joining forces with the USACE, the USGS, NY Canal Corporation, NYSDAM, NYSDEC, NYSDOS, NYSDOT, NY Power Authority, NYSSWCC, the Capital District Regional Planning Commission, the Southern Tier East Regional Planning & Development Board, the Herkimer-Oneida Counties Comprehensive Planning Project, the Central NY RC&D Project, the Hudson Mohawk RC&D Council, the Greater Adirondack RC&D Council, the Albany Pine Bush Preserve Commission, the Greene Land Trust, the Mohawk Hudson Land Conservancy, the Mohawk Valley Heritage Corridor Commission, the Nature Conservancy, the New York Natural Heritage Program, the Schoharie River Center, Union College, and the Water Quality Committees of all fourteen counties involved. Subsequently, a grant application outlining the project at an estimated cost of approximately $787,000 was submitted by Montgomery County on behalf of the Coalition to the NYSDOS Local Waterfront Revitalization Program. In December 2009, the Coalition was awarded all requested assistance to complete the proposed watershed management plan.

Although still awaiting contract, the Coalition has begun preliminary work on the plan; forming a technical advisory committee, hiring consultants, and reviewing a plan of action. In order to accomplish an effective plan, the Coalition intends to inventory the natural features, land uses, and pollution sources of the Basin, assess the ecological integrity of existing Basin resources and identify areas for improvement, create a usable GIS mapping database for the Basin, evaluate and analyze governmental roles within the Basin, and finally, identify and phase management strategies for watershed protection and watershed restoration. It is hoped to involve as many public and private stakeholders as possible in the many stages of the project. Members of the Coalition and its partners have thus far encountered only enthusiastic, positive responses to their goals.

The objective of writing a watershed management plan is to creative an effective groundwork for future environmental work within the Mohawk Valley. Members of the Coalition will use management strategies determined by the plan in development of conservation initiatives in the region. The plan will be a spring-board for implementation and program growth in the Basin, appealing to local, state and federal interests. For more information about the MRWCCD or its LWRP award, please contact the Coalition Chairman, David Mosher at SSWCD@nycap.rr.com.

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THE EFFECTS OF STORM DURATION AND INTENSITY ON A SMALL URBAN WATERSHED

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Understanding storm response of streams within urban settings is important due to the potential for infrastructure damage and property loss. This study investigated storm event responses in a small urban stream, Schenectady, NY. Hans-Groot Kill flows through the neighborhoods east of Union College and onto college property before its diverted below street level to the Mohawk River. Factors influencing runoff include how precipitation is introduced and the path it takes to the channel. Rainfall in an urban setting does not quickly infiltrate into substrates, as a result urban settings have complex systems to reroute the rapid runoff. The timing between precipitation and runoff is the focus of this study and characteristics of the urban system handling the runoff was investigated in order to fully understand the system response. The average stormflow for each event was used to determine peak discharge, watershed response time, and effective water input. Sharp, concurrent peaks suggested significant contribution of event-flow to the natural channel by stormwater systems draining impervious surfaces (Figure 1). The conclusions are that runoff in the Hans Groot Kill is greater than the natural runoff of the watershed and has components of stormwater overflow systems, which poses threats to the stream's natural ecosystem.

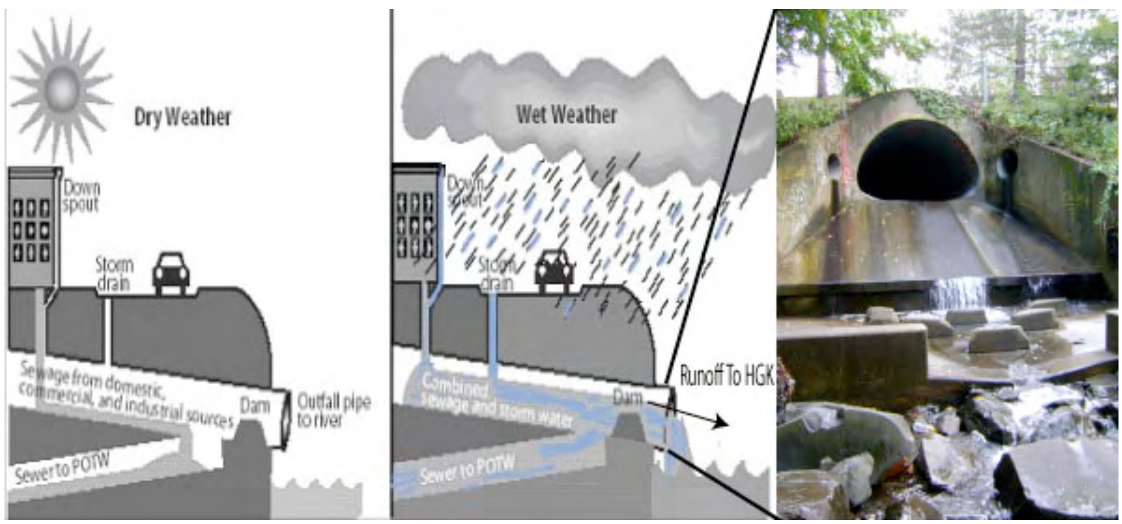

Figure 1: Schematic of the combined-sewer overflow system that may be in use in the Hans Groot Kill.

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CITIZEN PARTICIPATION: GRASSROOTS ORGANIZING TO IMPACT POLICY
DAM CONCERNED CITIZENS AS A CASE STUDY

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Organizing a grassroots advocacy group to affect public policy decisions can be very significant in achieving goals that reflect the public interest. In order to be effective, such a group must have a core of activists who embrace a clearly defined mission, and who are committed to work together for the long haul, represent the breadth of their public constituency, comprise a broad spectrum of skills and expertise, and make strategic decisions as a team as challenges evolve over time.

The experience of our organization, Dam Concerned Citizens, Inc. (DCC), may be of value to others as they seek to develop a similar coalition to address challenges facing their own communities. This abstract is intended to summarize the evolution of DCC over the past five years, and to share some of the lessons we have gleaned from that experience, in the hope that it might be useful to other such endeavors.

Gilboa Dam: a Galvanizing Crisis

In September 2005, the citizens of Schoharie Valley were alerted to a sleeping giant in their midst. The 80-year-old Gilboa Dam at Schoharie Reservoir --- the northernmost facility in a complex system supplying water to the City of New York --- was discovered to have serious seepage occurring at several points in its earthen embankment. Careful investigation revealed that the masonry structure of the dam was also seriously compromised, with the danger presented, in a worst-case weather scenario, of sliding and collapse.

The magnitude of such a collapse, were it to occur, would be catastrophic. It would send 24 billion gallons of water gushing downstream, sweeping with it roads, bridges, buildings, power lines, vehicles and tons of soil. On its swift course through three counties on its way to the Mohawk River, in addition to loss of life and obliteration of entire communities, the *tsunami*-like wall of water would destroy historic sites such as the Old Covered Bridge at Blenheim (a national historic landmark) and the Stockade District of Schenectady, and scour away the prime agricultural soil of Schoharie Valley, known as the Breadbasket of the American Revolution.

This perilous situation had been precipitated by neglect: the City of New York had deferred maintenance of the Gilboa dam for five decades, and the prospect of this weakened infrastructure jeopardizing lives and property was an abrupt wake-up call to residents who had never before contemplated this potential threat.

The magnitude and immediacy of such a danger served to focus the attention of many people living in the floodplain and beyond, and this sense of urgency was a catalyst for mobilizing citizens at the grassroots level to respond to the challenges presented.

The City of New York convened an urgent meeting of the emergency management officials in the valley, to apprise them of the situation and to coordinate in developing emergency response plans. In the series of public meetings in the downstream communities, a core group of citizens coalesced to ensure continuing public input as these plans evolved, and to hold New York City, as well as the local governments in Schoharie Valley, accountable for the highest safety standards. Those initial meetings were the genesis of Dam Concerned Citizens, Inc. (DCC).

Mission of Dam Concerned Citizens: Education and Advocacy

DCC began as an informal group of citizens who, in the process of attending and speaking out at public forums, decided to forge a coalition to mobilize residents throughout Schoharie Valley to ensure appropriate responses to the crisis at the dam. We were determined to insist that New York City, New York State, and our local and county governments be held accountable for doing things right to rectify this debacle, both in their emergency plans and actions, and in their long-term structural, operational and maintenance improvements.

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In the course of our first year, we formally incorporated as a not-for-profit advocacy group chartered under section 402 of New York State law and federal statute 501(c)(3). From the outset, DCC has been a resource of information, educating the public and governmental officials and tapping various sources of expertise. In the five years of its evolution, DCC has also been a strong, steady advocate for local citizens in Schoharie Valley, as measures have been undertaken --- from evacuation plans to interim repairs to the prospective long-term rehabilitation of the dam --- to address the safety issues posed by the dam.

The City of New York has undertaken substantial interim repairs to fortify the dam against the possibility of collapse. They installed 90 anchors of steel cables in the dam structure, opened a notch in the spillway, and installed four siphons to assist in drawing down water as needed.

The next step is the long-term rehabilitation of the dam, which is projected to cost more than $ 750 million over a six-year period; the preliminary phase has just begun. DCC has been actively involved in recommending improvements to the design. Our current priorities are to enhance flood mitigation; to ensure a minimum conservation flow downstream to restore the ecosystem of Schoharie Creek; and to create a task force to establish protocols for the operation and maintenance of the new low-level outlet.

DCC has persistently pressed the City of New York Department of Environmental Protection (NYCDEP) as the owner of the dam, the State of New York Department of Environmental Conservation (NYSDEC) as the oversight agency, and the county governments of Schoharie, Montgomery and Schenectady, as those responsible for emergency management, to adhere to maximum safety standards and to transparency in the process of developing and executing their plans.

The mission of DCC, as stated in Article III of our bylaws, is "to improve the safety, protection and welfare of Schoharie Valley residents from the threat of flood by causing speedy and thorough repairs to be made, and flood mitigation capability to be added to the Gilboa Dam; inform people about dam issues and flood hazard response; and provide the public a voice in dam and flood issues."

The organization recognizes widespread problems of dam safety, and seeks to accomplish the following goals both locally and globally:

- use of the highest standards for design, construction, operation, maintenance and inspection of dams
- independent oversight of design, construction, operation and maintenance of dams by qualified engineers, at no cost to local governments or residents
- dam owners' indemnification of downstream residents and local governments for financial costs and losses attributable to dams
- increased media awareness and improved quality of media reporting on dam and flood issues

Given this urgent situation as the context for the formation of DCC, we had to plunge in and swim immediately, multi-tasking to confront both immediate and long-term concerns affecting dam safety. Although the evolution of DCC was a spontaneous process, as we proceeded we were constantly regrouping to analyze a multitude of issues strategically, and determine how to most effectively share our research and ideas with public policy makers, the press and the public, to build broad support for our objectives. Looking back upon our five years of experience thus far, there are some key hallmarks of our organization that have been most helpful in accomplishing our goals.

TEN COMMANDMENTS FOR EFFECTIVE GRASSROOTS ORGANIZATION

I. Incorporation: Formally Instituting the Organization

Although it is not a legal requirement, we decided fairly early to formally incorporate DCC. In addition to being chartered under New York State law as a not-for-profit corporation, we decided to pursue 501(c)(3) status under federal law. Although the process took some time, it was well worth the extra effort. Not only does this give the organization enhanced credibility with the public; it also enables financial donors to claim a tax deduction for their contributions.

II. Communications: Website Wisdom and Media Savvy

In retrospect, probably the single greatest asset we had in launching DCC was our website. Our initial founding members included a retired newspaper reporter with technical skills who quickly developed the website as a powerful tool. DCC's website instantly became the generally recognized source of information about Gilboa Dam.

We include very practical information for people living in the flood zone, who have immediate concerns in the event of flood episodes. This includes weather forecasts, precipitation levels, evacuation routes, and guidance on how to register one's family with emergency agencies in the event of evacuation (including special needs such as persons with disabilities or pets). We also feature research which we share with the public, including various developments in key government agencies, research on geology and hydrology, graphs showing historic local precipitation trends which reflect climate change, and presentations we have made at public forums. We also provide links to other relevant websites, such as the NYCDEP and the National Weather Service. Timely and frequent updates are imperative; this keeps bringing people back to our website as a valuable resource.

Communications --- with the press, with the public, with government officials, and among members of the organization itself --- are imperative to keep moving the organization forward. It is critical to enlist someone with the skills needed for creating and maintaining an effective website, in order to maximize the organization's capacity to get information out in a timely manner, and to empower people to action on behalf of organizational goals.

Communications are not limited to the website. We publish our periodic Newsletter in both electronic and print format, recognizing that not everyone has access to the Internet. We also issue press releases to the list of regional media.

III. Teamwork: Balancing Diverse Talents

One key to our success has been the broad spectrum of skills and expertise that we have been able to marshal in the core group of volunteer members who have worked together to keep forging ahead.

We have been fortunate to have in our core group, from the very beginning, volunteers who include professional engineers, people with extensive construction and operational experience with dams, and professional geologists at the PhD level. We have several retired teachers, one of whom has developed extensive expertise in hydrology, another of whom has excellent computer and organizational skills. We include an insurance professional, whose expertise has been critical. We have a professional nurse with extensive experience in public health, and a horticulture professor with local government experience. We also have several successful farmers, whose intimate knowledge of the micro-ecosystem of Schoharie Creek, in addition to their leadership and contacts within the business sector, have been invaluable. Furthermore, we have benefited from having a person with a lifelong career in the media, who knew how to communicate effectively with the press. In addition, we have a person with a lifelong career in government, whose political skills and network of contacts have opened doors of access to convey our concerns at all levels of government. We have also tapped other resources beyond our board members; for example, we were fortunate to have a local attorney volunteer his services in helping us to navigate the complex process of legal incorporation.

Beyond their various fields of professional expertise, several of our members have excellent writing skills, which have been most effective in presenting our case to the public and policymakers. In addition to balancing a multitude of backgrounds and expertise, we have also reached out to broaden the geographic diversity of our board, by recruiting board members from all three counties in the Schoharie Valley. We have also been attentive to gender diversity.

IV. Non-partisanship / Multi-partisanship: Check Ideological Differences at the Door

It is natural that the people who have the passion to become immersed in an organization of this nature may also often be individuals who have passionate political opinions and affiliations as well. It is important to have a consensus from the outset that any partisan issues will be checked at the door. It is understood that when one is working within or on behalf of the non-profit organization, all activities and objectives are strictly non-partisan.

It is imperative that the organization be perceived, both internally and externally, as non-partisan. In reality, the individuals involved are likely to have partisan inclinations, and it can be advantageous to the organization to have a balanced, multi-partisan group, so that individuals can strategically be valuable, through their broader network of relationships, in building bridges to both sides of the political aisle in order to mobilize support and develop political allies for the common cause.

V. Fund Raising: Reach Out to the Community

Fundraising is a critical function to sustain any long-term organization, and a constant challenge. DCC has been fortunate to have many small donors in the region, and a few generous larger contributors. As indicated above, our legal status qualifying DCC for tax-deductible status of contributions provides an added incentive for potential contributors.

Our next challenge is to develop grants writing skills. Our goal is to obtain funding for a Public Inspector onsite during the critical construction of the dam renovation. This will require funding at a new level, and we need to identify possible sources of funding, whether foundations or public funding, and effectively pursue them.

VI. Volunteers: the Bedrock of Organizational Success

Despite many small donations that reflect the support and generosity of our community, DCC has operated on a shoestring budget from the beginning. With the exception of a brief transitional leadership period during which we hired a part-time executive director, and a current modest monthly investment to outsource the updates to our website, we have operated without paid staff.

We have found that we are most effective when our board members, all volunteers, roll up their sleeves to do the work that is needed, bringing their varied fields of expertise to the task at hand. With the skills within our diverse group, we have always been able to meet the challenges that have arisen.

VII. Transparency: Let the Sun Shine In

Just as we push for transparency on the part of the government agencies with which we interact, we maintain transparency ourselves. All DCC meetings are open to the public. Our Board of Directors meets monthly to sustain momentum and share ideas. In addition, our annual organizational meeting, at which we elect officers and have a public forum with relevant keynote speakers, is widely advertised. Additional board meetings, or intervening committee meetings, are convened as necessitated by events that may arise. We also have done community outreach at events such as the Schoharie County Sunshine Fair, to further educate the public and to recruit members.

VIII. Credibility: Establishing a Reputation as a Reliable Resource

DCC has acquired a reputation for factual accuracy and openness throughout our involvement in these issues. We share the results of our research with the county and local governments in the region, and they have come to view DCC, through experience, as a reliable resource of accurate information. This is the result of the board members bringing their expertise to the table and bringing it to bear on whatever issues arise.

For example, we have participated in various public hearings. During our first year, the New York State Assembly held public hearings on dam safety, at which DCC testified in detail with specific recommendations. More recently, we provided extensive recommendations when the NYSDEC held hearings to revise the state's dam safety regulations. In addition, we have monitored the public statements of NYCDEP officials at public hearings and other events. DCC has been a persistent voice for holding NYC accountable for its publicly stated commitment to flood mitigation, and to underwriting costs incurred by local government for warning sirens.

IX. Adversaries are not Enemies: Develop a Working Relationship

It is important to understand that the entity whose policies the organization is trying to change, while often being an adversary, is not the enemy. It is beneficial to have open lines of communication with key representatives of the agency, to be forthright in dealing with them, and to find common ground when possible. Rational, balanced presentation, and frequent interaction and sharing of ideas and concerns, are far more effective than emotional grandstanding or scorched-earth accusations in the public arena.

Despite differences, a mutually respectful relationship can be established.

We feel that DCC has a credible reputation with the NYCDEP, because we always strive to be factually accurate, avoiding hyperbole and presenting our ideas and research in a reasonable manner. We feel that we have established a relationship of mutual respect with the City of New York's staff; while we do not always agree, we have had some success in persuading the City to accept our ideas. For example, when we initially proposed siphons to draw down the water level at the dam, the City was not receptive to the idea; however, after continuing discussions with them, they did embrace the idea and installed four siphons, which have contributed significantly to avoiding major flooding.

There have even been occasions where we have been entrusted with candid, confidential information, which we did not broadcast publicly; that has enhanced our credibility with the City as an organization which seeks to work constructively to solve problems.

Nevertheless, there is, of course, by the very nature of the situation, the potential and even need for confrontation at times on the issues the organization is advocating. Sometimes that confrontation will be merely a push for more information; sometimes it may entail specific recommendations, which the organization is trying to advance; there may even be times when the organization must contemplate initiating litigation. Litigation is a last resort, but it is an option that may become necessary when all else has failed. If the organization should opt to pursue litigation, it will entail a substantial investment of resources, and more intense efforts at fundraising. In DCC's experience, litigation has been considered at several key junctures, but thus far we have not chosen to pursue that route; it is, however, always an option on the table to be revisited if necessary.

X. Influencing Public Policy: Build and Nurture Strategic Allies at Multiple Levels

To accomplish organizational goals in the public policy arena, it is critical to identify the public officials and agencies, at all levels, with an impact on the policies which you are seeking to influence.

DCC has established good working relationships with county, state and federal officials. Besides being an advocate for our cause, we are also a resource to them, sharing with them our research and expertise as well as policy recommendations.

Building strategic allies involves thoroughly understanding the political process. Identifying key players --- including staff, key committees, and minority as well as majority party officials --- is critical. For example, in addition to appearing regularly at monthly meetings of the county legislature, we regularly attend meetings of their flood committee, which has the most impact on our issues. In addition to meeting at key points with our Congressman, we have an ongoing relationship with his staff members, both in the district office and, for legislative initiatives, in the Washington office. In dealing with the State Legislature, it is important, in addition to our relationship with our local Assemblyman and Senator, to share information with both the majority and minority staff of key committees in both houses. While we have met with the Commissioner of NYSDEC, we communicate more regularly with the dam safety staff in that agency, which has regulatory oversight of the Gilboa Dam.

It is important to cultivate these relationships and maintain them, remaining consistently factual in every presentation, following up with written material to confirm and expand upon conversations, and providing frequent updates to keep the organization on their radar screen.

Credibility must be the hallmark of all the organization's activities, and nowhere is this more critical than in dealing with our public officials. It is important to do our homework, present our research and recommendations in a credible manner, sticking to the facts, without exaggeration. If a mistake has been made, it is important to acknowledge and correct it. Also, if officials have done something supportive of our agenda, it is important to thank them. Public officials often hear only the criticisms when constituents disagree with their actions; it is equally important to let them know when we support their actions.

Conclusion: Commitment to the Long Haul

Being actively engaged in a grassroots volunteer organization is a commitment of time and effort. While it involves work and persistence, it is also a rewarding opportunity to serve one's community meaningfully, and to develop relationships with knowledgeable, committed people of diverse backgrounds who share one's passion for the issues which have brought the group together. It is constantly challenging, with new issues emerging which push the group to stretch in new directions. Our organization has come a long way in our five years thus far, and we have had the satisfaction of seeing some of our recommendations embraced. Yet there is more to achieve, and we are fortunate to have dedicated board members who are committed to the long haul.

DCC has been a stimulating growth experience for the organization and its individual members. May others engaged in building similar community organizations find the work, and the returns, rewarding and productive.

US ARMY CORPS OF ENGINEERS – WATERSHED PLANNING

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The New York District Corps of Engineers completed the Mohawk River Watershed Reconnaissance Study in September 2009. The study was prepared to determine if Federal interests in watershed-based flood damage reduction, ecosystem restoration, navigation and other allied water resources problems and opportunities are advisable for the Mohawk River Watershed, New York. The study was authorized by a resolution adopted on September 20, 2006 by the Committee on Transportation and Infrastructure of the United States House of Representatives.

In light of the recurrence of fluvial flood damage over the past several years, including flooding, erosion, navigation impacts and road washouts from the storms of June 2005, October 2005, June 2006 and April 2007 the Corps of Engineers examined the entire watershed. These storms resulted in damages to the Barge Canal, operated by the New York State Canal Corporation, as well as flood damages throughout communities and municipalities in the Mohawk River Watershed, such as the Village of Catskill, Village of Mohawk, Village of Ilion, and Towns of Frankfort and German Flatts, as well as many others. The reconnaissance study examined the current field conditions and study criteria to determine whether any watershed-based opportunities for flood damage reduction, ecosystem restoration, navigation or other allied purposes exist for continued Federal participation during detailed evaluation and construction. As part of this study, the water resources problems in the area were identified and a determination was made that Federal interest does exist for a more detailed cost-shared feasibility-level study.

The feasibility study will determine whether there is a Federal interest in a watershed management program that may authorize specific projects that provide flood damage risk reduction, ecosystem restoration, navigation improvements or other allied purposes to the Mohawk River Watershed.

Although flood risk management will be investigated in the Mohawk River Watershed, but it should be noted that prior studies have shown that a single large scale solution to a significant flood event, similar to the June 2006 storm, have not been found to be cost effective. However, following the Corps' watershed study process, smaller, local solutions to flooding problems throughout the basin may be justified in urbanized areas. Solutions to erosion and sedimentation problems throughout the basin will likely be pursued through the Corps' environmental mission and in some cases may result in reduced flood damages for minor storm events. A watershed management feasibility study does not follow a traditional approach, as each watershed is unique. The preliminary expectation is that the watershed feasibility study will recommend a watershed program, rather than one project. A watershed program provides an umbrella authority to solve the water resources problems throughout the basin, based on the technical findings of the feasibility study.

In a watershed feasibility study, a "Watershed Program", featuring multiple projects, may be recommended to contribute to the overall improvement of the watershed system, including environmental river restoration and flood damage reduction. Each of these projects can be evaluated as a part of an overall comprehensive approach to the restoration of the watershed. An individual project may not be able to significantly improve the watershed health or reduce flood damages by itself; however, a watershed feasibility study may recommend various projects that together will address the problems identified and will maintain or improve the overall health of the watershed. Non-federal agencies and other stakeholder groups could propose individual projects. Projects proposed may then be evaluated for implementation based on how they may address the needs and opportunities of the entire watershed. The Watershed Management Plan (an appendix to the Watershed Feasibility Study) would serve as the one, comprehensive document that identifies the various initiatives and programs aimed at maintaining or enhancing water quality and overall ecosystem sustainability that have been developed throughout the watershed. As part of the feasibility study, a Watershed Management Plan would be created that would not only identify these initiatives and programs established by participating state, local and Federal entities, but also would also provide a planning tool for the region that evaluates all inputs to the watershed including minor tributaries and culverts. Additionally, the document would include recommendations for best management practices (BMP's) specific to each sub-basin in the watershed that can be implemented by local, state and Federal agencies.

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COMPARISON OF SELECTED HISTORIC FLOODS AND THE JUNE 2006 FLOOD IN THE MOHAWK RIVER BASIN

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The Mohawk River is a major tributary to the Hudson River in upstate New York. In June 2006 the Mohawk River basin, as well as the Delaware and Susquehanna River basins in New York, experienced major flooding which resulted in millions of dollars in damages and several lives being lost. Flooding along the Mohawk River is affected by inflow from major tributaries such as the Schoharie Creek and the East and West Canada Creeks. The quantity and timing of discharge inflow from these tributaries has a major affect on the magnitude and frequency of flooding along the Mohawk River. The U.S. Geological Survey is presenting a poster that highlights peak flood data from June 2006 and selected historic floods along the Mohawk River and major tributaries.

The U.S. Geological Survey has been collecting continuous stage and discharge data at the Mohawk River at Little Falls and Cohoes streamgages for over 80 years. The Mohawk River near Little Falls streamgage has been in continuous operation since October 1927 and recorded its period-of-record maximum stage and discharge during June 2006. The maximum discharge recorded during June 2006 at the Mohawk River near Little Falls streamgage was 35,000 ft^3/s. Before October 1927 the maximum discharge, since about 1898, occurred on March 27, 1913, prior to regulation from Hinckley Reservoir. The maximum discharge on March 27, 1913 was 34,800 ft^3/s, recorded at the Mohawk River at Little Falls streamgage, then located upstream from the current streamgage with a contributing drainage area that was about 4 percent less. The Mohawk River at Cohoes streamgage is located near the mouth of the Mohawk River and its confluence with the Hudson River and has been in continuous operation since July 1925. The period-of-record maximum discharge is 143,000 ft3/s recorded on March 6, 1946, as the result of an ice jam release from upstream. The second highest discharge for the period-of-record is 132,000 ft3/s recorded on January 20, 1996 and was not the result of an ice jam release. In comparison, the maximum discharge recorded for the June 2006 flood at the Cohoes streamgage was 96,400 ft^3/s.

The U.S. Geological Survey analyzed annual peak discharges at selected streamgages in the Mohawk River basin as part of a report prepared in cooperation with the Federal Emergency Management Agency (FEMA) to document the June 2006 floods in the Mohawk, Delaware and Susquehanna River basins in New York. Discharge hydrographs for selected floods at the Mohawk River at Little Falls and Cohoes streamgages are presented to illustrate differences in hydrograph shape. Annual peak discharges and selected flood frequencies are presented for selected streamgages along the Mohawk River and major tributaries to help visualize the magnitude of historic peaks relative to the recent June 2006 flood peaks and to help identify annual peak flow patterns. Peak water-surface elevations from the June 2006 flood are compared to published FEMA flood insurance study flood-profile elevations at a few selected locations along the Mohawk River to illustrate the depth of inundation. More information is available in the USGS Open-File Report 2009-1063, Flood of June 26-29, 2006, Mohawk, Delaware and Susquehanna River basins, New York.

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AQUEOUS PHOTOLYSIS OF ORGANIC ULTRAVIOLET FILTER CHEMICALS

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In 2002, the U.S. Geological Survey conducted a reconnaissance of U.S. streams and detected 82 organic wastewater contaminants, including PPCPs, hormones, and other organic compounds, with contaminants found in 80% of the streams studied.[1] The results of the study have generated significant interest in determining the environmental transport and fate of these contaminants of emerging concern. One class of contaminants that is of particular interest comprises organic ultraviolet (UV) filter chemicals. With annual production estimated to be in the hundreds of tons,[2] UV filter chemicals are used in high volumes as the active ingredients in sunscreens, cosmetics, hair products, lotions, and other personal care products. UV filter chemicals have been detected in Swiss surface waters and fish,[3] as well as in humans.[4] The application of these organic chemicals as a guard against harmful UV radiation requires that they resist degradation upon exposure to UV light. However, studies have demonstrated that several UV filter chemicals lose sunscreen activity upon exposure to simulated or natural solar radiation,[5] raising concern for the behavior of UV filter chemicals on our skin and in sunlit surface waters.

One focus of research efforts in the MacManus-Spencer lab is the photolysis of UV filter chemicals in natural waters. Photolysis may be regarded as a form of "natural attenuation," and thus it is important to characterize environmental half-lives for photoreactive contaminants. However, photolysis leads to transformations of the original contaminants to form new products, either by direct photolysis or by reaction with a photo-generated reactive species (i.e., singlet oxygen, superoxide, hydroxyl radical). The products of photolysis often exhibit different properties and reactivities than the original contaminants. In the case of Triclosan, for example, a relatively "safe" antimicrobial chemical is transformed in sunlight to a toxic dioxin.[6] Thus it is not only important to study the kinetics of photolysis but also to identify the degradation products.

In the MacManus-Spencer lab, researchers use a solar simulator (Atlas Suntest XLS+) to conduct photochemistry experiments under controlled laboratory conditions using a filtered xenon lamp that mimics solar irradiation. Experiments are also conducted outside under natural sunlight. In photochemistry experiments, aqueous samples are spiked with the contaminant of interest and irradiated in quartz tubes. Samples are taken periodically throughout the exposure, and the degradation of the contaminant, as well as appearance (and degradation) of degradation products, are monitored by high performance liquid chromatography with UV absorbance detection (HPLC-UV), HPLC with mass spectrometric detection (LC-MS) and gas chromatography–mass spectrometry (GC-MS). In photolysis experiments, samples are analyzed primarily by HPLC-UV to establish the kinetics of degradation. The change in contaminant concentration over time is used to calculate the half-life, and the photolysis of a chemical actinometer alongside the contaminant of interest is used to calculate a photolysis quantum yield (efficiency). When significant degradation is observed, samples that have been irradiated are analyzed further by LC-MS and GC-MS to identify formed products. When available, authentic standards of anticipated products are analyzed simultaneously to confirm the identities of suspected products.

Aqueous photolysis experiments have so far focused on three commonly used UV filter chemicals: octyl methoxycinnamate (OMC, octinoxate), benzophenone 3 (BP3, oxybenzone), and homomenthyl salicylate (HMS, homosalate). BP3 is fairly photostable under both direct and indirect photolysis conditions, owing to its ability to undergo excited state proton transfer upon excitation by UV light. OMC, however, degrades readily by direct photolysis; the kinetics of degradation have been measured and several degradation products identified by HPLC-UV, LC-MS, and GC-MS. HMS does not undergo direct photolysis but does degrade by indirect photolysis. Experiments to elucidate the mechanism point to singlet oxygen ($^1O_2$) as one reactive species that plays a role in the indirect photolysis of HMS.

Data obtained in studies such as these may be incorporated into models to predict the environmental fate of UV filter chemicals in

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surface waters. Such models will guide efforts by regulatory agencies to prioritize these and other emerging contaminants. They may also enable chemical manufacturers to use "smart chemical design" principles to create products that pose less risk to human health and the environment.

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A NEW LOOK AT THE FORMATION OF COHOES FALLS

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Introduction
A reexamination of erosional features at and near the mouth of the Mohawk River in east-central New York indicates that, contrary to interpretations proposed by Hall (1871) and Stoller (1918), the modern Mohawk River is an unlikely agent for development of Cohoes Falls, a ~60 foot high, 950 foot wide waterfall 2.5 miles from the mouth of the Mohawk. The bedrock gorge above and below the Falls and several distributary channels cut in rock just above the Mohawk's confluence with the Hudson River also appear unlikely to have been carved by flows comparable to the modern Mohawk since deglaciation.

Background
The course of the Mohawk River between Schenectady and Cohoes has long been recognized as post-glacial in origin (Cook, 1909, Simpson, 1949; Dineen and Hanson, 1983). The gorge containing Cohoes Falls has near vertical walls ~50 and ~110 feet high immediately upstream and downstream of the Falls respectively. Bedrock in the gorge is deformed Ordovician shale and greywacke with the angle of the fall roughly parallel to the dip of foliation (Kidd and Plesch, 1995). Across the base of the Falls, the depth and width of the plunge pool varies widely, ranging from almost nothing in a few small areas to depths of ~45 feet (below the bedrock floor of the gorge immediately downstream) (Hall, 1871), and a width of as much as 130 feet from the face of the Fall (Figure 1).

Downstream of the plunge pool, the gorge floor is exceptionally flat, but not smooth; Hall (1871) described the surface as similar to a tilled farm field in that it was flat on a coarse scale, but with local relief on the order of a foot. The uniformity of the gorge floor below the Falls is interrupted by a sub-channel with a width ranging from ~30 to 250 feet and a variable depth of ~10 to 20 ft. The sub-channel is in the approximate center of the gorge and rimmed in many locations by concave features, which appear to be the remnants of fluvial potholes. Several intact potholes set back from the lip of the sub-channel by generally no more than 30 feet support this interpretation. Intact potholes in this area have diameters in excess of 10 feet and are generally filled with gravel suggesting they are currently inactive.
Hall (1871) considered the Falls to be the result of headward erosion of the western edge of the Hudson Valley by the Mohawk River. He interpreted the sub-channel as a plunge pool, which in turn required the Falls to be much narrower during headward retreat. Hall argued that subsequent widening of the Falls and development of the present plunge pool, was the result of the resistive weakness of potholes which may have extended across the current position of the Falls from an area of large potholes he identified just east of the Falls. According to Hall, the widening along this line of potholes subsequently reduced the rate of retreat and allowed the gorge to widen by mass wasting.

Stoller (1918) also attributed Cohoes Falls to the headward retreat of the western wall of the Hudson Valley in post-glacial times. However, he considered much of the gorge containing the Falls to result from simple downcutting which he viewed as more efficient than headward erosion due to the orientation of foliation. Stoller made little mention of the plunge pool and sub-channel except to note that the sub-channel generally contained most summer flows. Stoller produced a block diagram (Stoller, 1918 Fig. 7) which has been widely used since to describe the Falls formation.

Significance of the Plunge Pool
If the position of the Falls is due to steady headward retreat driven by the modern river, we should expect the bedrock floor of the gorge downstream to grade to the level of the bottom of the plunge pool, which it does not. We should also expect the floor of the gorge to be uneven, similar to the varied depths of the plunge pool, but rather the floor is exceptionally flat across the gorge with the notable exception of the sub-channel. The varying depth and width of the plunge pool along its length appears to reflect the relative volumes of water spilling over the Fall during high-flow conditions today; therefore it seems reasonable that the modern river has

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produced the plunge pool. The depth and overall morphology of the plunge pool relative to the elevation of bedrock immediately downstream indicates the flow conditions that formed the gorge downstream of the pool are different from those observed today.

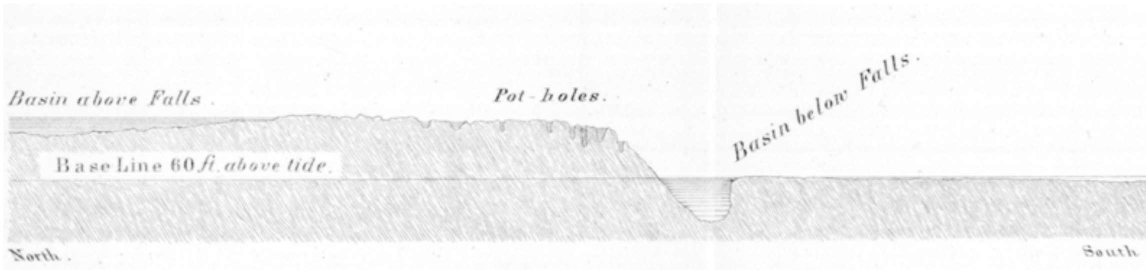

Figure 1 - Mohawk channel bottom profile above and below Cohoes Falls. Scale is approximately 200 feet to the inch. (Surveyed and drawn by G.K. Gilbert *in* Hall, 1871)

Distributary Channels

Downstream of the Falls, just east of the western Hudson Valley wall, are several bedrock islands separated by distributary channels of the Mohawk River; through these channels the Mohawk enters the Hudson in three locations. The islands have near vertical walls of up to 50 feet height. Each of the channels contain knickpoints and/or bedrock rapids, the largest of which has ~15 feet of fall (the full height may be partially drowned in backwater from the Green Island Dam). Knickpoints typically form in response to a lowered base level (Ritter, 1978) suggesting the channel above the knickpoint developed in response to a base level ~15 feet higher than today. The mouths of the channels are at sea level (ignoring backwater from the Green Island Dam), which has been rising in the Hudson Valley since deglaciation (Stanford, 2009). This difference suggests the channels above the knickpoints cannot be the work of the modern Mohawk. Formation of these knickpoints may be in response to the abrupt decrease in Hudson Valley flow (and base level) ~13,000 years ago (Rayburn and others, 2007) following the diversion of Great Lakes drainage from the Champlain and Hudson Valleys to the newly ice-free St. Lawrence Valley.

Further argument against the modern Mohawk steadily developing these distributary channels since deglaciation comes from the height of the bedrock islands themselves. It seems entirely unlikely for all the distributary channels to become so deeply entrenched, in dissimilar sized channels without one channel becoming dominant or one channel being abandoned by piracy of flow. Development of the bedrock islands and channels seems much more plausible if they were cut rapidly by an exceptionally high volume of water.

Potholes

Hall (1871) documented the dimensions of 226 fluvial potholes (Figure 2) across the area just upstream of Cohoes Falls. The extreme dimensions of a few of these potholes, notably one with a width of 3 feet and depth of 23 feet again suggest a set of hydraulic conditions not seen under modern flow conditions. "Conventional" pothole development by circulating grindstones is difficult to invoke to explain the formation of a hole with such dimensions based on the amount of energy likely lost to friction. Cavitation may be a more plausible mechanism for carving such a deep and narrow pothole, and a large basin in the channel floor just upstream of the pothole area (Figure 1) may support the hydraulics necessary under certain conditions. The question of how these potholes with extreme depth-to-width ratios formed would benefit from more detailed hydraulic analysis, but either mechanism would likely require much deeper and faster flows than observed today.

The 1866 discovery of the Cohoes Mastodon in a large pothole adjacent to the Falls gorge prompted a search for similar features around the gorge. G.K. Gilbert's mapping of the area (Hall, 1871) depicts several exceptionally large potholes adjacent to the gorge in an area devoid of glacial overburden. Hall (1871) called these potholes "ancient" and considered the modern Mohawk River incapable of carving features of this scale, instead he attributed their formation to water discharging from moulins in glacial ice. Stoller (1918) made no reference to these "ancient" potholes, but considered the area adjacent to the gorge as having been "laid bare…by the flooded Mohawk waters of late glacial time". Hall and Gilbert were unaware of these "flooded waters" which are more commonly referred to today as the Iromohawk River.

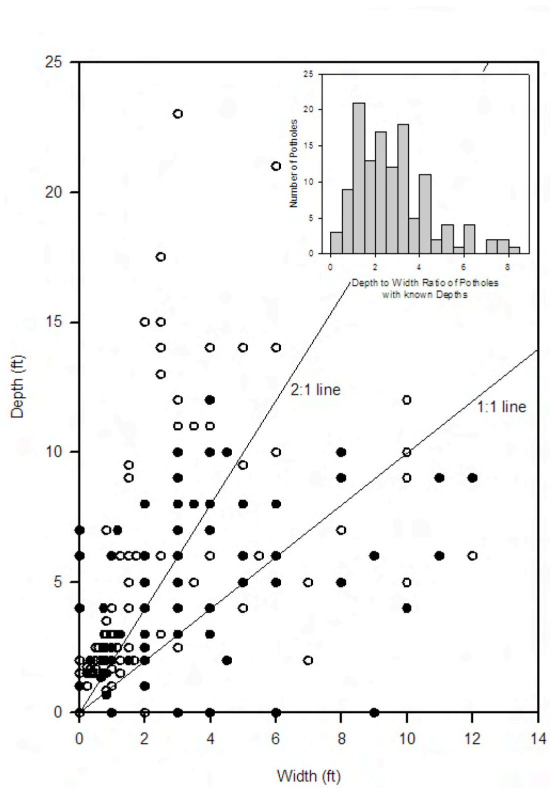

Figure 2 - Dimensions of channel-bottom potholes above Cohoes Falls described by Hall (1871). Open circles are empty potholes, closed circles indicate partially filled, filled, or no information (true depth unknown).

The Iromohawk River

For approximately 500 years runoff from much of the Great Lakes watershed plus glacial ice to the north drained into a large lake (Glacial Lake Iroquois) that occupied the lowland that lies south of and includes Lake Ontario. The Iromohawk River drained Lake Iroquois through the Mohawk Valley (Muller and Prest, 1985) until ice retreated from the northern flank of the Adirondacks ~13,000 years ago (Toney and others, 2003; Rayburn and others, 2007). With retreat of the ice, the Mohawk Valley was no longer the low point for Ontario Basin drainage and lake-outflow was rerouted into the Champlain Valley and eventually through the St. Lawrence Lowland. Wall (1995) estimated the maximum Iromohawk discharge was at least ~1.5 million cubic feet per second - roughly 10 times the highest discharge recorded on the Mohawk over the last 90 years and more than 200 times "typical" flows observed today. LaFleur (1979) considered the Iromohawk a possible agent for initiating formation of the gorge, but not for its complete development.

A New Hypothesis

The depth of the plunge pool relative to the channel bed downstream of the pool suggests flow conditions that carved the gorge are different than those observed today. The largest distributary channel knickpoint suggests the channels upstream of the bedrock rapids and knickpoints were formed when Hudson Valley base level was ~15 feet higher than today. The number and dimensions of the distributary channels (and islands), the amount of glacial overburden removed from the area adjacent to the gorge, the exceptionally large potholes found in that area, and the apparent need for much greater water depths and velocities than seen today to form the potholes just upstream of the Falls, all suggest higher flows than observed in the Mohawk today.

If higher Mohawk flows and a higher Hudson Valley base level than today are required to explain these observations in a post-glacial section of the Mohawk, the agent responsible is almost certainly the Iromohawk River. The evidence points to the Iromohawk as having eroded nearly the entire gorge containing Cohoes Falls and all of the distributary channels near the mouth of the Mohawk. It appears that the modern Mohawk is responsible for the plunge pool at the base of the falls, but the Falls have retreated no more than the width of the plunge pool under post-Iromohawk flow conditions. This is an exceptionally slow rate of retreat for any waterfall - it is explained by the fact that the Mohawk River is underfit in the gorge and its erosive power is spread thin across the channel. The sub-channel also appears to be a product of the modern Mohawk developed from an interconnection of Iromohawk potholes.

The elevation profile of the gorge and adjacent landscape suggests the headward migration of two knickpoints are responsible for the gorge and the position of the Falls today. The upper knickpoint was the western wall of the Hudson Valley, as first proposed by Hall (1871); this knickpoint migrated upstream to at least Crescent where it may have diminished in size in response to a lower bedrock surface elevation. The lower knickpoint, Cohoes Falls, started immediately west of the present day Hudson

River and carved the network of distributary channels at the mouth of the Mohawk then coalesced and continued to migrate upstream as a single massive falls deepening the cut initiated by migration of the upper knickpoint.

The Iromohawk introduced a huge influx of meltwater and sediment into the Hudson Valley eroding glacial and glaciolacustrine sediment from the area around the Hudson-Mohawk confluence, exposing bedrock, and carving Hall's "ancient" potholes. The headward migration of the upper knickpoint initiated channelization of the Iromohawk in the area and formed the gorge above the Falls. Simultaneous headward retreat of the lower knickpoint carved the distributary channels that eventually coalesced to deepen the gorge below the Falls. When the northern Adirondack flank deglaciated, the Iromohawk flow ceased, causing the headward retreat of the lower knickpoint (Cohoes Falls) to stop.

Further development of this hypothesis would benefit from detailed mapping of the Mohawk channel-bottom elevation and study of archive records depicting the condition of the channel prior to the construction of dams now in place between Crescent and Green Island.

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SCHENECTADY COUNTY ENVIRONMENTAL ADVISORY COUNCIL

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The Schenectady County Environmental Advisory Council was established by Local Law No. 5-1971, which was enacted by the County Legislature in 1971 under Article 47 of the New York State Environmental Conservation Law. The purpose of the Council is to solicit the expertise of the community in order to preserve and improve the quality of natural and man-made environments within Schenectady County. It is also intended that the Council will facilitate cooperation between various governmental agencies, as well as between County Government, private institutions and the public, in addressing environmental issues. Actions of the Council include:

- Advise the County Legislature
- Study environmental issues
- Inform the public and hold hearings
- Promote coordination and liaison with other agencies
- Prepare an Annual Report and State of the Environment Report