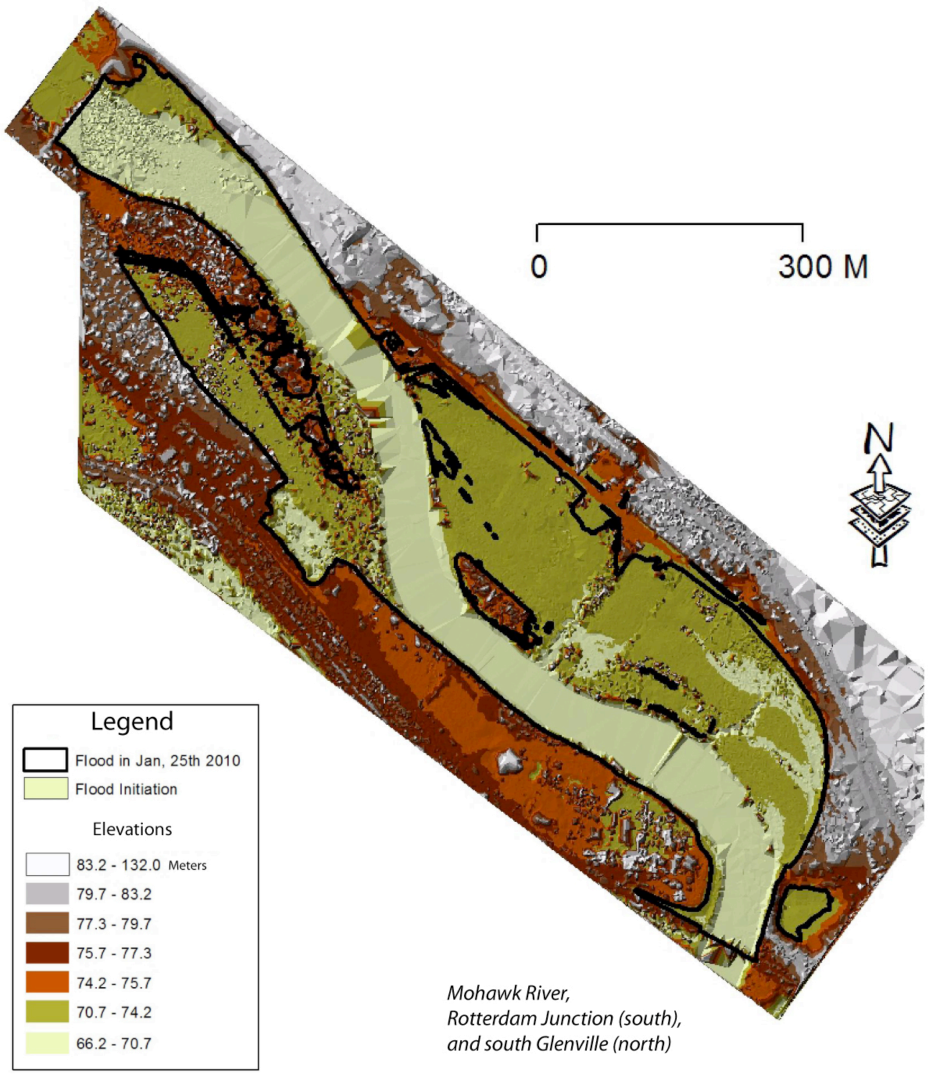
Mohawk Watershed Symposium

2011



Mohawk River,
Rotterdam Junction (south),
and south Glenville (north)

Abstracts and program

Olin Center, Union College
Schenectady NY
18 March 2011

PREFACE

We continue to make progress in several important aspects related to our scientific understanding of the watershed, engineering solutions, and the policy and economics of the River and its tributaries.

This year the Coalition of Conservation districts presents the second report on progress that group is making towards developing a comprehensive watershed management plan. This enormous undertaking involves the coordination of a number of important stakeholders in the basin and the progress they have made is impressive. The issues they face surround understanding the watershed, envisioning the watershed in twenty or thirty years from now, and developing a blueprint for getting there.

Given the economic challenges we currently face in NY State, it is remarkable that we have made the progress we have in the last year. Many stakeholders understand that the River and the tributaries can serve as an economic engine for the region, and given our need for clean energy there is opportunity. Congressman Tonko's Mighty Waters Initiative provides a map for economic opportunity and development. The Mighty Waters initiative seeks to create a "*climate of investment, recovery and public awareness for the waterways and communities of the upper Hudson and Mohawk Rivers, Erie Canal and related waterways by mobilizing federal resources that encourage policy reform, economic development, public access and enjoyment and effective environmental and cultural resource management.*"

As many work to develop a watershed management plan, and as communities look for waterfront development ideas, we continue to ask questions about the hydrology of the basin and how that is changing over time. A key challenge, therefore is to develop and manage a watershed that appears to be a complex system that is changing and dynamic. Hydrological data suggest more water is entering the watershed and a variable and complex way. How do we plan for this? How do we manage a watershed that is changing?

This is the third annual symposium on the Mohawk Watershed and we are delighted to host this full program of talks and posters that cover a wide range of topics. Here at Union College, we are proud to help serve as a catalyst for initiating and fostering those conversations that will hopefully drive positive change 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: On the cover: LiDAR image of the lower reaches of the Mohawk River in Schenectady County (see Marsellos et al., this volume). The image shows the extent of flooding related to the January 2010 ice jam in Rotterdam Junction and the southern part of Glenville. On the southeast part of the image is the Boston & Maine railroad bridge that forms a constriction in the floodplain and is the jam point for this event. Also in the south east of the image is the Schenectady International Plant (west side of the river). Lock E9 is visible near the NW edge of the image. This image relies on returns of laser light from an aircraft, in during data acquisition water bodies (the Mohawk here) do not return laser light, so the triangulation results in coarse images in and adjacent to water. This image was used to make volumetric calculations for the January ice jam. Image courtesy of Antonios Marsellos.

Mohawk Watershed Symposium - 2011

18 March 2011, Olin Center, Union College, Schenectady NY

- Final Program -

Friday 18 March 2011

Oral session (Olin Auditorium) - Registration and Badges required

8:30	*9:00*	***Registration, Coffee. Olin Foyer***
9:00	*9:10*	**Introductory remarks** *John I. Garver, Geology Department, Union College, Schenectady, NY*
9:10	*9:35*	**Sediment in the Mohawk, the Big Picture** *Simon Litten, Department of Environmental Conservation, New York State*
9:35	*9:53*	**Changes in the hydrology of the Mohawk Watershed and implications for watershed management** *John I. Garver, Geology Department, Union College, Schenectady, NY*
9:53	*10:11*	**Analysis of Flood on October 1, 2010** *Howard Bartholomew, Dam Concerned Citizens*
10:11	*10:29*	**Evaluating discharge patterns in rivers across New England** *Jaclyn Cockburn, College of the Atlantic, Bar Harbor, ME*
10:29	*10:59*	***COFFEE and POSTERS (see below for listing)***
10:59	*11:24*	**Hydroelectric power in the Mohawk River Watershed: Past present and future** *James Besha, Albany Engineering Corporation*
11:24	*11:42*	**A Comparison of Hinckley Reservoir Operation for Selected Years** *Elisabetta T. DeGironimo, Mohawk Valley Water Authority*
11:42	*12:00*	**Emerging aquatic contaminants** *Laura MacManus-Spencer, Department of Chemistry, Union College, Schenectady, NY*
12:00	*12:18*	**LiDAR Examination of Meander Migration in the Mohawk River Watershed** *Ashraf Ghaly, Department of Engineering, Union College, Schenectady, NY*
12:18	*12:36*	**High frequency monitoring in the Mohawk Valley** *Alene Onion, Hudson River Estuary Program, NYS DEC*
12:36	*13:56*	**- LUNCH -**
13:56	*14:21*	**Unlocking the Utica Harbor: A restoration case study** *Howard Goebel, Canal Hydrologist, NYS Canal Corp*
14:21	*14:39*	**Watershed management: Considering groundwater and dependent ecosystems** *Kenneth Smith, Local and Regional Programs, New York State Department of State*
14:39	*14:57*	**Using Lidar and Ancillary Data to Answer Water Resource Questions** *Ricardo Lopez-Torrijos*
14:57	*15:15*	**Watershed based floodplain coordination and outreach** *William Nechamen, Floodplain Management Section, NYS DEC*

15:15	*15:45*	***COFFEE and POSTERS (see below for listing)***
15:45	*16:10*	**Water rights in the balance: The MVWA vs NYS Canal Corp. Dispute** *Frank Montecalvo, Consultant, West Canada Creek Riverkeepers*
16:10	*16:28*	**The Schoharie River Center's Environmental Study Team: A community based watershed education program progress report 2010** *John McKeeby, Jessica Jones, Mary Rachael Keville, Zach McKeeby, Schoharie River Center*
16:28	*16:53*	**Working toward a Watershed Management plan: a progress report from the Mohawk River Watershed Coalition of Conservation Districts** *David Mosher, Schenectady County Soil and Water Conservation District*
16:53	*17:03*	**Discussion and Conclusions** *Jaclyn Cockburn, College of the Atlantic, Bar Harbor, ME*

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

Poster session (all day)

F1 **Sedimentation in the Schoharie Reservoir**

Sherrie Bartholomew, Howard Bartholomew, Alexander Bartholomew, Dam Concerned Citizens and SUNY New Paltz, NY

F2 **Predicting trigger level for ice jam flooding of the lower Mohawk River using LiDAR and GIS**

J.A. Foster, A.E. Marsellos, J.I. Garver, Department of Geological Sciences, University of Florida Gainesville and Geology Department, Union College, Schenectady, NY

F3 **Sedimentary provence and paleoflood history of the Mohawk River as recorded in Collins Pond, Scotia, NY**

Kaitlin Clark, Donald Rodbell, Geology Department, Union College, Schenectady, NY

F4 **Hydroelectric power potential in the Mohawk River Basin**

Ashraf Ghaly, Department of Engineering, Union College, Schenectady, NY

F5 **Using ArcMap to measure meander migration of the Normanskill River, Albany NY**

Caitlin Lauback, Stephanie Maes, Paul Benzing, Department of Geology, The College of St. Rose, Albany, NY

F6 **Schenectady County Environmental Advisory Council (SCEAC) and its activities related to water and climate**

Mary Werner, Laura MacManus-Spencer and Kathy Rowland, Schenectady County Environmental Advisory Council

Symposium Reception (Old Chapel) 5:30pm – 6:30pm
Dinner and Keynote to follow

Keynote Address

Congressman Paul Tonko – Mighty Waters Initiative

Honorable Congressman Tonko will present the Might Waters Initiative as our Keynote Address at the third annual Mohawk Watershed Symposium.

Congressman Paul D. Tonko is serving his second term in Congress representing the 21st District of New York, which includes the state's capital city, Albany. Paul comes to Washington, DC with over two decades of administrative, legislative and policy experience having served in the New York State Assembly from 1983 to 2007, and as President and CEO of the New York State Energy Research and Development Authority (NYSERDA) from 2007-2008.

Congressman Tonko has been a strong voice for responsible energy policy, job growth in Upstate New York, unionized labor and affordable and accessible healthcare for all. In Congress, he is a member of the House Committee on Education and Labor and serves on the subcommittees for Higher Education and Healthy Families and Communities. Building on his work in the New York State Assembly, where he fought for one of the nation's strongest mental health parity laws (known as "Timothy's Law"), Paul has always promoted fair and equitable healthcare policies that strengthen our communities and protect our most vulnerable citizens.

Congressman Tonko is also a member of the Committee on Science and Technology, which merges his energy expertise with his environmental agenda. Serving on subcommittees for Energy and Environment, Research and Science Education and Technology and Innovation, Paul hopes to spur an environment where innovation and cutting-edge research and design spur economic development in the 21st Congressional District.

An advocate for a “green economy” and “green-collar jobs”, Congressman Tonko has promoted wind development in Upstate New York and successfully lobbied GE to locate their growing GE Wind operations in Schenectady, NY. In the New York State Assembly, Paul was a lead sponsor of the Power for Jobs program, which provides low cost power to employers throughout New York State and has retained or created 300,000 jobs statewide. In 2006, Paul successfully negotiated for Beech-Nut to keep their plant in Montgomery County, and expand their operation by relocating their corporate headquarters. The new Beech-Nut headquarters will be a green building and retain 356 jobs while creating 135 new positions.

Congressman Tonko also has strong ties to local government, which he sees as a crucial partner in delivering programs and services to constituents. At age 26, Paul was the youngest person in the history of Montgomery County to be elected to the county’s Board of Supervisors. He served as chairman of that body until 1981. Prior to his election to the Assembly in 1983, Paul was an engineer in the New York State Department of Transportation and also served on the staff of the Department of Public Service. Paul has been a longtime member of the Public Employees Federation (PEF) and proudly serves as the first PEF member elected to Congress.

Paul graduated from Clarkson University with a degree in mechanical and industrial engineering. He is a lifelong resident of the city of Amsterdam, New York.

Mighty Waters
Defining Our Past ★ Directing Our Future

Congressman Tonko's Mighty Waters Initiative:

In July of 2010, Congressman Tonko hosted what was then known as the *Mighty Waters Conference* at Schenectady County Community College. The original conference focused on promoting sustainable and responsible waterfront development projects as a means to improve the quality of life in communities along the Hudson and Mohawk Rivers and Erie Canal.

The interest generated from this initial meeting sparked the creation of a task force to submit further recommendations to Congressman Tonko about how he can use his office to: assure that federal agencies and resources are used more effectively to benefit the region, attract additional federal resources where necessary, and galvanize local and regional interest in waterway related projects and policies.

During a convening meeting in September of 2010, the *Mighty Waters Task Force* adopted the below mission statement and broke into six separate subcommittees to complete a series of goals and objectives. By early December of 2010, final committee reports were submitted and condensed into a series of findings and recommendations for further action.

The Congressman and his task force are currently conducting a listening tour to solicit feedback and further recommendations from constituencies and stakeholders beyond the makeup of the original task force. It is our hope to maintain an open and substantive dialogue among all partners as we strive to promote, protect and enhance the myriad of communities tied to our region's waterways.

MISSION STATEMENT

The mission of the Mighty Waters Task Force is to help create a climate of investment, recovery and public awareness for the waterways and communities of the upper Hudson and Mohawk Rivers, Erie Canal and related waterways by mobilizing federal resources that encourage policy reform, economic development, public access and enjoyment and effective environmental and cultural resource management.

Please direct all comments and recommendations to Sean Shortell or Dylan Carey in my Albany office at 518-465-0700 or mighty.waters@mail.house.gov

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ANALYSIS OF FLOOD ON OCTOBER 1, 2010

Howard R. Bartholomew

Director Dam Concerned Citizens, Inc.

Rainfall totals for the storm of October 1, 2010 for the drainage basin of the Schoharie Reservoir upstream of the Gilboa Dam; information provided by NOAA and Steve DiRienzo, Service Hydrologist NOAA.

Tannersville, NY-9.00"
Maple Crest, NY-8.50"

"On average, the upper part of the basin south of Prattsville had 6-9 inches. North of Prattsville less with averages in the 4-6 inch range." Steve DiRienzo

The Daily Mean Discharge for Prattsville, NY, USGS gauge station #01350000 for October 1, 2010 is 18,700 cubic feet per second, (cfs). This is the third highest daily average recorded at this site since records began being kept. The daily mean discharge of Oct. 1, 2010 at Prattsville has only been exceeded by the flood of October 16, 1955, which had a whopping daily mean discharge of 26,200 cfs and the flood of January 19, 1996 that produced a daily mean discharge of 22,000 cfs. Both of these floods caused major property damage downstream of the Gilboa Dam, as well as in areas above or upstream of the Schoharie Reservoir. The flood of Jan. 19, 1996 caused death by hypothermia and subsequent drowning of two people in Schoharie, NY. It is only because of the fact that the water level of the Schoharie Reservoir was at 1096.57', 7:00 pm Thursday, Sept. 30, 2010 and of the presence of the 220' long x 5.5' deep "notch" in the 1324' long Gilboa Dam spillway, that a major flood downstream of the Schoharie Reservoir was averted.

The Schoharie Reservoir was roughly half full at the onset of the storm of Oct. 1, 2010, which was in reality, the residue of tropical storm "Nicole". The presence of the "void" as storage space in the reservoir coupled with the "notch" served to attenuate or lengthen the time it took the Schoharie Reservoir to "fill and spill" across the entire length of its 1324' spillway. By the time this occurred around 7 pm, Friday, Oct. 1, 2010, the water level and stream flow upstream of Prattsville had already begun to drop as this remnant of tropical storm Nicole made its exit from the Catskills. The "void" in the Schoharie Reservoir prior to the onset of this storm was the result of a prolonged drought in the area. The month of September 2010 was "on its way" to becoming one of the driest Septembers on record, when the rains arrived on Sept. 29th. By Sept. 30th, the precipitation, in the watershed in particular, and area in general, ended up being above average.

This is a strikingly similar scenario to the flood of Sept. 11, 1960 that had a daily mean of 12,900 cfs as measured at Prattsville, NY, USGS gauge state 0135000. The pool elevation of the Schoharie Reservoir at the onset of this flood, caused by rains from Hurricane Donna was 1097' above sea level. At this water level the reservoir is more than half empty and is 33' down from the top of the spillway. **A 220' long x 5.5' deep "notch" did not exist in the 1324' masonry spillway in 1960**. When the Schoharie Reservoir filled 18.5 hours after the onset of the storm, it immediately ran over the entire 1324' long spillway causing much higher water levels downstream of the Gilboa Dam than did the spillage from the floodwaters of tropical storm Nicole, October 1, 2010.

A comparison of the daily means discharge, expressed in cfs for Prattsville and Burtonsville in the floods of Sept. 11, 1960 and Oct. 1, 2010, amply demonstrates the "peak shaving" powers of the 220'x5.5' "notch" in the Gilboa Dam. The peak daily means for these two floods are shown in Table 1.

Table 1: Comparison of the daily mean discharge for Prattsville and Burtonsville

Prattsville, NY USGS 0135000		Burtonsville, NY USGS 01251500	
12,900 cfs	Sept. 12, 1960	17,000 cfs	Sept. 13, 1960
18,700 cfs	Oct. 1, 2010	14,900 cfs	Oct. 2, 2010

It is interesting to notice the "rolling" crest that takes place on the Schoharie Creek in times of flood, in terms of apogee between Prattsville and Burtonsville, a distance of about 40 miles.

The conclusions that can be drawn from the data above are important.

1. A void of approximately 50% in the Schoharie Reservoir, when used in concert with an unobstructed "notch" in the spillway of the Gilboa Dam, can greatly attenuate spillage and thereby reduce the impact of flooding downstream of the Gilboa Dam. By its own reckoning, NYCDEP recommended a Schoharie Reservoir pool elevation of 1093' for a snowpack of 40" coupled with a rainfall of 4.5". This is a probably worst-case scenario.

2. The impact of the flood of Oct. 1, 2010 would have been much worse had the level of the Schoharie Reservoir been higher and/or the "notch" not been in place.

3. A protocol should be firmly in place regarding the lowering of the Obermeyer Gate System, soon to be installed in the 220'x5. 5' "notch", in advance of a flood so as to use its maximum capacity for flood mitigating and spill attenuating potential.

The flood of Oct. 1, 2010 can be compared as well as contrasted to the flood of Sept. 11, 1960. **Similarities**: **1**. Both floods occurred after a prolonged drought; **2**. Starting elevations at the beginning of each event for the Schoharie Reservoir were virtually identical; **3**. Rainfall totals for both storms were somewhat similar with the edge going to the storm of Oct. 1, 2010. **Differences**: **1**. Daily means was roughly 30% greater at Prattsville, NY-USGS 0135000 in the Oct. 1, 2010 flood than that of Sept. 12, 1960; **2**. Daily mean at Burtonsville, NY-USGS 01351500 was 2100 cfs less in Oct. 1, 2010 than that of Sept. 12, 1960. **3**. Most Important is the fact that no one died as a result of drowning, Oct. 1, 2010.

Due to the flood mitigating influence of the half empty Schoharie Reservoir in both of the aforementioned floods and the enhancement of the mitigation exercised by the "notch" in the 2010 flood, the full, devastating impact of these floods upstream of the Gilboa Dam is hard to appreciate, unless on actually experienced one or both of them or visited the areas affected shortly after they took place.

The bridge over the Battaviakill, just south of Prattsville, at the junction of rts 23 & 23A was washed out in the 1960 flood and Paul Alle, Chief of the Ashland Hose Company drowned when a portion of Rt. 23A washed out.

In conclusion, it is safe to say that a void of + or – 50% in the Schoharie Reservoir, whether created intentionally for the purpose of flood mitigation downstream of the Gilboa Dam or simply by drought, can be a significant factor in reducing flooding in the Schoharie Valley north of the Schoharie Reservoir. This is especially true if the "notch" if allowed to function to its full capacity, when the proposed Obermeyer Gate System is in place. **Having an intelligent protocol for the operations of these gates and the proposed new Low Level Outlet that takes into consideration the best interest of all parties involved is imperative!**

SEDIMENTATION IN THE SCHOHARIE RESERVOIR

Sherrie Bartholomew[1], Howard R. Bartholomew[1] and Alexander Bartholomew[2]
[1]Board Members of Dam Concerned Citizens, Inc., PO Box 310, Middleburgh, NY
[2]SUNY New Paltz, 1 Hawk Drive, New Paltz, NY

The Schoharie Reservoir is the smallest of the New York City Department of Environmental Protection's West of Hudson Reservoirs, as well as the second oldest in the Catskill System. Based on the small volume of the reservoir relative to its highly productive 314 sq. mi. catchment area, we posit that the Schoharie Reservoir has been subjected to more severe siltation than the other West of Hudson impoundments over the more than eight decades it has been in existence (Fry, 1950). Located 2 miles downstream of the intake chamber of the 18.1 mile long Shandaken Tunnel, the Gilboa Dam functions as a diversion dam to shunt water through the tunnel into the Esopus Creek to the Ashokan Reservoir, and ultimately via the Catskill Aqueduct to the Kensico Reservoir east of the Hudson River. The diminutive Schoharie Reservoir is, in reality, a giant "stilling pool" for seasonally silt laden water, allowing for some detention time before it discharge through the Shandaken Tunnel. However, the turbid water conditions that frequently prevail in times of heavy run-off in the Schoharie Basin are subject to the terms of a SPDES permit (www.catskillstreams.org/pdfs/EKSMP/38_appen_D.pdf). As a result, the Shandaken Tunnel intake chamber is frequently closed and no water is diverted to the Ashokan Reservoir.

Figure 1: Aerial view of sediment below 1065' immediately in front of the Shandaken Tunnel Gatehouse. Photo courtesy D. Wood, c. 1993

On average, sixteen per cent (16%) of the drinking water consumed annually in New York City is supplied from the 314 sq. mi. catchment of the Schoharie Reservoir. Prior to the emplacement of the 220' long x 5.5' deep notch in the spillway of the Gilboa Dam in 2006, when at full pool elevation of 1130', the Schoharie Reservoir had a capacity of 22 billion gallons or 67,515.2 acre-feet of water, with a surface area 1142 acres. Since 2006, the existence of the notch in the spillway has, for much of the year, lowered reservoir water levels behind the Gilboa Dam to 1124.5' or less, with a full pool volume at 1124.5' of 17.5 billion gallons or 53,705.52 acre-feet. Exceptions occur in times of heavy rain and/or snow melt induced run-off, leading to spillage through the notch or over the full length of the 1134' masonry spillway. These conditions are usually accompanied by a reduction or actual cessation of discharge through the Shandaken Tunnel.

As the waters of the Schoharie Creek carry a wide range of particle sizes, in times of high flow, precipitation and deposition of stream burden occurs throughout the full 5-mile length of the Schoharie Reservoir. The fact that the Schoharie Creek can be a very silt laden stream is amply illustrated by the presence of high turbidity in its lower reaches below the dam. The source of this turbidity is frequently spillage or discharge of agitated waters from the Schoharie Reservoir. Turbidity is both observable and persistent downstream of the Gilboa Dam/Schoharie Reservoir long after waters have cleared in the upper reaches of the Schoharie Creek.

Figure 2: Silt and sediment on eastside of original Schoharie Creek channel. Photo courtesy D. Wood, c. 1993

Fry (1950) refers to siltation problems that typically occur behind diversion dams such as the Gilboa Dam: "The amount of silt that is brought to a reservoir on any stream is influenced by the watershed characteristics above the reservoir, such as the geology, types of cover, and the climate that prevails over the area. The amount of sediment that remains in the reservoir is a function of the retention times of the water in the reservoir. The life of a reservoir is dependent on the ratio of the reservoir capacity in acre-feet to the watershed area in square miles. Where this ratio is large, with other conditions being the same, the life of the reservoir will be correspondingly long.

"In the design of many reservoirs, provision is made for dead storage and live storage. The former ordinarily is considered to provide space for the deposition of sediment for a considerable period of years. It is important in the life of a project to determine whether sediment deposits in the dead-storage space or whether it deposits in the live space and thereby encroaches on the purposes for which the reservoir was built.

"The level at which a reservoir is operated is an element of significance in reservoir sedimentation. Some reservoirs, usually single-purpose, are operated with relatively constant levels. Multiple-purpose reservoirs that utilize storage space jointly at different seasons of the year are operated at other than constant levels and with a range in reservoir elevations dictated by the various purposes for which the reservoir was built. This variation in water level in a multiple-purpose reservoir is significant in the deposition of silt in a reservoir and also in the movement of silt through the reservoir. At the higher reservoir elevations the silt is first deposited in the live storage space, but, as the reservoir is drawn down and succeeding storms occur, this sediment is flushed down into the lower elevations of the reservoir and eventually, after a number of cycles, is likely to find its way into the portion of the reservoir originally provided for dead storage."

The ratio of the acre-feet storage capacity of the 6 West of Hudson reservoirs, relative to their respective catchment areas, is shown in Table 1. It is evident that the Schoharie Reservoir has the smallest ratio of capacity to catchment area, a factor further exacerbated by the presence of the spillway notch since 2006. Taking this into account, it is highly likely that the processes described above have occurred within the Schoharie Reservoir. The removal of silt from an area 50' x 300' at the mouth of the intake chamber of the Shandken Tunnel further supports this assertion.

This excavation was for the purpose of clearing a channel for water to pass into the gatehouse and intake chamber. The picture below shows the Schoharie Reservoir, in a "dewatered" condition, as it appeared in the early 1990's. The base elevation of water in the Schoharie Reservoir's "live storage" area is 1065' above seal level. Pictures taken in front of the Gate House show a pool level several feet lower than the intake base level of 1065'. In order to dewater the Schoharie Reservoir to the extent shown in the pictures, the two 30" blow-off valves under the western end of the 1324' long spillway were opened. These aged and woefully under fit release works have not been used since these pictures were taken, nearly 20 years ago. The intake of these drains is now buried under many feet of sediment. This, coupled with the fact that they are 85 years old and obsolete, renders them unusable. These old "blow-off" valves are to be replaced by a new Low Level Outlet when the rehabilitation of the Gilboa Dam/Schoharie Reservoir is completed.

Figure 3: Water in fig. 1-3 constitutes "dead storage" of Schoharie Reservoir. Photo courtesy D. Wood, c. 1993

Building from the information presented above, it is possible to make the following conclusions/recommendations:

1. Extensive siltation has occurred in the Schoharie Reservoir since it was first filled in 1927.
2. The "dead storage" area of the reservoir above the intake chamber of the Shandaken Tunnel has been greatly reduced.

3. The original watercourse of the Schoharie Creek, prior to the construction of the Gilboa Dam is visible in the pictures and shows that there has been very heavy siltation on the stream's western side.

4. On September 30, 2010 the Schoharie Reservoir was at el. 1096.57'. As the reservoir water level rose by more than 33' in 24 hours, the four-month period of high turbidity in the Schoharie Creek downstream of the Gilboa Dam following the flood of October 1, 2010 was most likely due to the presence of the vast quantities of silt entrained by floodwaters entering the reservoir. This rapid influx of run-off into the reservoir incised the silt beds and elevated its fine particles in a long-term state of suspension.

5. Since the adoption of the Upper Esopus Creek Management Plan in January of 2007, the main recipient of reservoir-induced turbidity has been the Schoharie Creek downstream of the Gilboa Dam. This turbid water reaches downstream of the dam via the route of the 4 siphons surmounting the spillway as well as spillage through the notch.

6. It would seem prudent to periodically remove sediment from the Schoharie Reservoir on a routine basis. The large delta of sediment at the upstream extremity of the reservoir obstructs water flow to the intake chamber and contributes greatly to turbidity in times of high run-off. The benefits that would occur in both economic and environmental terms would off set the cost of removal. The vast quantity of silt in the reservoir constitutes a nuisance in its present state, but is of a valuable agricultural resource whose natural course of downstream deposition has been interrupted by the presence of the Gilboa Dam.

Bibliography

Fry, A.S., 1950, Sedimentation In Reservoirs *in*: "Applied Sedimentation", Trask, P. ed. John Wiley & Sons, Inc., NYC, NY, 347-363.

Table 1: Ratio of acre-feet storage capacity for six reservoirs west of the Hudson River.

RESERVOIR	DRAINAGE AREA mi^2	CAPACITY In Billion Gallons/Acre feet	RATIO Reservoir capacity /Catchment Area
Delaware System			
Pepacton	376	140.2/609,740.00	1621.75/1
Cannonsville	450	97.5/450,000.00	1000.00/1
Rondout	95	49.6/202,800.00	2134.75/1
Neversink	92	34.9/112,000.00	1217.39/1
Catskill System			
Ashkoan	256	122.9/577,166.25	1473.30/1
Schoharie	314	22.0/67,515.52	215.01/1 (pre-notch) 171.03/1 (post-notch)

HYDROELECTRIC POWER IN THE MOHAWK RIVER WATERSHED: PAST, PRESENT & FUTURE

James A. Besha , P.E.
President, Albany Engineering Corporation, 5 Washington Square, Albany NY 12205

Albany Engineering Corporation specializes in hydroelectric project design and development. Founded in 1924, the company prides itself on its innovative approach to hydropower projects while working within the environmental context and historic setting of each site. Their portfolio of proposed projects includes four hydroelectric projects at existing dams within the Mohawk River Watershed. The projects are Delta Hydroelectric Project, Middle Mohawk Hydroelectric Project, Cohoes Falls Hydroelectric Project and the Green Island Hydroelectric Project Expansion.

THE PAST

A 1908 New York State map shows a generous number of water power developments across the state. Within the Mohawk Watershed, the map indicates 68 developments with generation ranging from less than 100 to as much as 7,000 horsepower. Most of the developments powered grain mills, saw mills or other industrial operations. It is doubtful that any of them generated electrical energy.

THE PRESENT

Today in 2011, there are six hydroelectric projects totaling 90.2 megawatts (MW) on the main branch of the Mohawk. Another nine projects totaling 81.9 MW operate on major tributaries such as the East and West Canada Creek. Half of these 15 plants are vintage (built 1915-1920), and half were constructed in the 1980s. In addition, there is a large hydroelectric pumped storage project at Blenheim-Gilboa; it does not use the Schoharie Creek flow per se but cycles impounded water from a lower and upper reservoir to generate on-peak power. For its off-peak energy supply, it uses sources outside the watershed.

THE FUTURE

The four projects detailed in this abstract will increase the existing 172 MW of hydroelectric capacity by another 204 MW (117 MW of incremental capacity) for an increase of more than 165%. In addition, on the tributaries of the Mohawk, there are 50-100 more developed hydropower sites, but most are only a half-megawatt or less (for a total of perhaps 50 MW). Most of these small sites are not technically difficult to develop but are problematic due to institutional barriers as well as possible aesthetic and other issues.

Delta Hydroelectric Project
Capacity: 5 MW
Energy: 14,000 MWh
Head: 69 feet
Developer & Owner: City of Watervliet
Status: Preliminary Permit granted by FERC, Application for License (April 2011). Anticipated construction, 2012. Completion, June 2013.

The Delta Dam was built in 1912 when New York State flooded 3,000 acres to create Delta Lake as a water source for the Erie section of the Barge Canal. The existing cyclopean masonry dam is 1,016 feet long and 76 feet high with an operating head of 69 feet. Controlled releases from the reservoir emit from outlets in the eastern and western sections of the dam. The eastern outlets discharge into a stilling basin; the water then flows over a weir and into the Mohawk River. The western outlet supplies the NYS Fish Hatchery.

The features proposed for the new Delta Dam Hydroelectric Project include an intake structure integral to the existing dam at its west abutment, a new powerhouse, an excavated tailrace channel extending about 200 feet downstream, a new underground 13.2 kV generator lead, and fully automated control system. There are no penstocks, existing or proposed. The plant will operate in run-of-river mode.

Middle Mohawk Hydroelectric Project
Capacity: 50.8 MW
Energy: 93,700 MWh
Head: 91 feet (total for eight developed sites)
Developer & Owner: Albany Engineering Corporation
Status: Preliminary Permit granted by FERC, Application for License pending (March 2011).

The Middle Mohawk Hydroelectric Project is a proposed hydroelectric project consisting of eight hydraulically linked developments designated by their associated New York State Canal System lock numbers (Locks E-8 through E-15), all on the Mohawk River. Each of the eight locks has an existing gated, movable, bridge-type dam constructed primarily of steel. The dams range in length from 460 to 588 feet, and each has a spillway ranging from 360 to 570 feet in length. The dam heights vary from the lowest at 8 feet to the highest at 15 feet. Each dam has two-tier or three-tier slide gates. Locks E-9 and E-12 have highway structures on the dam. The plants will operate in run-of-river mode.

Each development features two standard, identical, floatable, modular steel powerhouses that rest on a foundation consisting of four concrete pylons and connect to the dam via an inflatable seal. Each powerhouse will have a water intake structure with an integral positive exclusion fish protection and bypass system for both upstream and downstream passage. Each powerhouse will contain nine turbines rated at 333 kW each. The estimated average annual energy output of each lock development will fall between 6,879 and 16,440 MWh. The installed capacity of each development is 6.35 MW with a total project capacity of 50.8 MW.

Cohoes Falls Hydroelectric Project
Capacity: 100 MW
Energy: 300,000 MWh
Head: 100 feet
Developer & Owner: Green Island Power Authority
Status: Contested regulatory status at Federal Energy Regulatory Commission (FERC) and at the U.S. Second Court of Appeals.

The Cohoes Falls Hydroelectric Project is a new hydroelectric development to be located on the Mohawk River between Cohoes, Colonie and Waterford, just upstream from the existing School Street powerhouse (owned by Erie Boulevard Hydropower, L.P.). The existing 1911 powerhouse would be repurposed as a Cultural Resource Center within the Harmony Mills Historic District. A new state-of-the-art hydroelectric facility, constructed completely underground, will sell about 50% of its power to local and state governmental agencies and 25% to regional companies as an economic development incentive.

The project will completely re-water the currently dry sections of the Mohawk River and provide continuous veiling flow over the falls 24 hours a day, 7 days a week. Aerial transmission lines will be relocated out of sight under the new project dam. There will be protection for fisheries and safe passage facilities for migratory species as well as safe access for fishermen and boaters. Scenic overlooks, parks, canoe portages and hiking trails will encourage recreational use.

The installation will include two high head Kaplan vertical turbines and generators that will be capable of utilizing the full river flow range between 522 and 16,000 cubic feet per second. There will be partial removal of the non-conforming crest on the existing historic dam, originally built c. 1831. The plant will operate in run-of-river mode.

Green Island Hydroelectric Project Expansion
Capacity: 48 MW
Energy: 152,000 MWh
Head: 22 feet
Developer & Owner: Green Island Power Authority
Status: In relicensing (License issuance anticipated March 2011).

This project is not on the Mohawk River. However, a large portion of its drainage area is from the Mohawk, because it is immediately downstream of the confluence of the Mohawk and Hudson Rivers. Thus, issues impacting the Mohawk River also affect the project.

The existing federal-owned concrete dam extends across the Hudson River from Green Island to Troy. Built in 1914, the dam consists of a main and ancillary spillway and flashboards on the main spillway allowing a maximum impoundment pool elevation of 18.5 feet mean sea level (MSL). The existing powerhouse, built by Henry Ford in 1921, contains four hydroelectric generating units with a combined total installed capacity of 6,000 kW. The current and proposed projects operate in run-of-river mode.

Future plans include lowering the fixed crest of the main spillway to 12.5 feet MSL and adding steel crest gates to maintain the impoundment pool at 18.5 feet MSL. The historic powerhouse will be expanded to the east and west to provide housing for four new turbines and generators; the four turbines and generators in the existing powerhouse will be replaced. A new trash boom will collect river debris. Fish passage systems, including upstream and downstream provisions for migratory fish and eels, are planned. Recreational amenities will include an accessible river walk, fishing platforms and added parking.

CONCLUSION

Generating power from our rivers is an age-old practice that today provides renewable energy to the people and businesses along its path much the way it has for centuries past. With careful planning and proper management, hydroelectric plants can continue to do so long into the future.

SEDIMENTARY PROVENANCE AND PALEOFLOOD HISTORY OF THE MOHAWK RIVER AS RECORDED IN COLLINS POND, SCOTIA, NY

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Geology Department, Union College, Schenectady, NY

Collin's Pond (42°50'N; 73°57'W; 64 m asl) is a small (0.25 km^2), shallow (z_{max}=8.5 m), eutrophic pond on the floodplain of the Mohawk River near Scotia, New York. The small drainage basin of Collin's Pond is similar in size to the lake itself, yet Collin's Pond has accumulated sediment at a high rate (~7 mm yr^{-1} for the last 1000 years). Cores contain discrete laminae 0.1 to 10 cm-thick of normally graded medium sand to silt 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 clastic layers were deposited by density-driven undercurrents during flooding of the Mohawk River.

The bedrock underlying the Mohawk River drainage basin varies considerably: the northern part of the Mohawk River drainage basin is underlain mainly of gneiss, the central part by calcareous shale and dolostone, and the southern part by carbonates and Paleozoic red beds of the Catskill Mountains. Modern Mohawk River alluvium was sampled throughout the drainage basin to elucidate geochemical fingerprints of different sectors of the catchment. Major element geochemistry of the <63 μm fraction indicate that K_2O ranges from 2.79% in the north (the headwaters of East and West Canada Creek) to 2.03% in the southern Schoharie region; likewise, samples from the northern part of the drainage basin have a higher percentage of Nb, ~50.5%, whereas the Central Mohawk and Schoharie Valley sectors yield 32% and 36%, respectively. Finally, Al_2O_3 is higher in samples from the southern sector (10.9%) relative to samples from the northern part of the drainage basin (8.8%). Samples from an ~7.5-meter long sediment core from Collins Pond indicate that the majority of clastic sediment that has entered the pond was derived from the central Mohawk and southern Schoharie Valley regions.

The base of the lake core contains wood that is overlain by a layer of coarse sand. The radiocarbon age of the wood suggests that the lake formed ~6100 yr BP, however three new radiocarbon dates, all from macro-vegetal material from near the base of the core, are much younger that the 6.1 ka wood age. The anomalously old age from the basal wood may reflect recycling of wood on the landscape for thousands of years prior to deposition in Collins Pond.

EVALUATING DISCHARGE PATTERNS IN RIVERS ACROSS NEW ENGLAND

Jaclyn Cockburn[1] and John I. Garver[2]
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In the Mohawk River basin, we have seen a discernable shift in the distribution of flow through the hydrological year over the last century (Kern, 2008). Records show more water and an earlier peak in flow across the Mohawk Watershed. This shift to earlier peaks and higher discharge volumes presents unique challenges to natural systems as well as to those who work in water systems management. Furthermore, models predict more precipitation for the region and a higher portion of this precipitation to fall as rain rather than snow (Frumhoff et al., 2007). Looking beyond the Mohawk into other watersheds across New England, similar patterns of change to the distribution of flow, as well as a trend towards earlier peak flow. This study discusses the trends in discharge across northern New England as an indicator of long-term and on-going shift in discharge as a function of climate change and/or possible shifts in the position of the North Atlantic Oscillation.

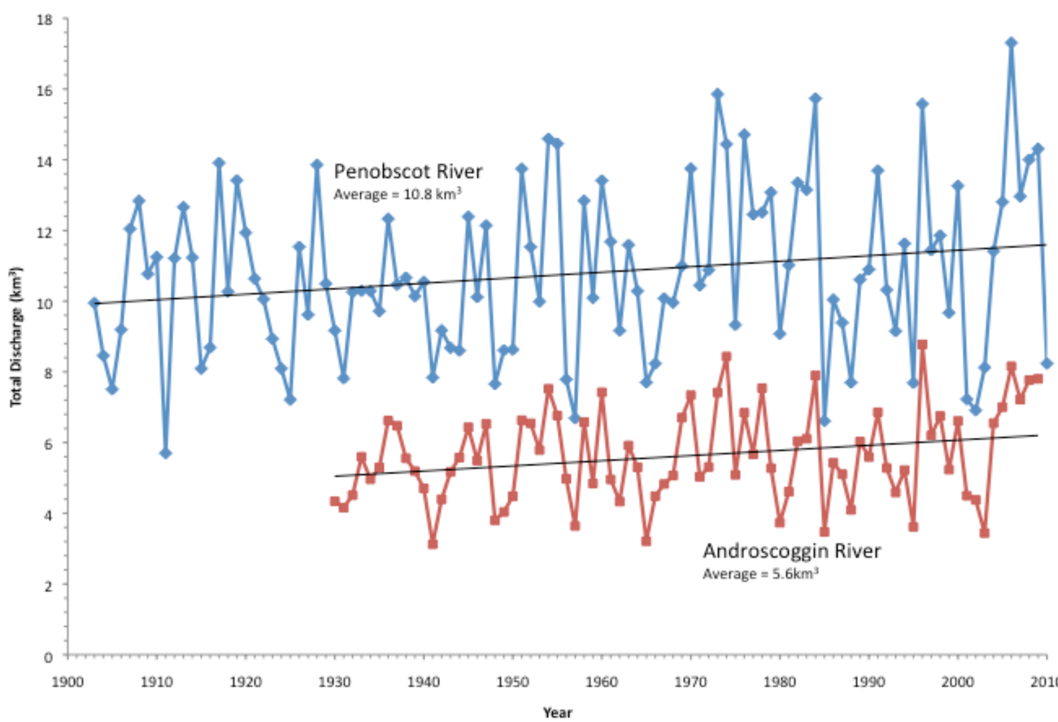

Figure 1: Annual discharge through the 20th Century for Penobscot and Androscoggin River in Maine. Variability has persisted throughout these records, but there is a notable increase throughout.

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A COMPARISON OF HINCKLEY RESERVOIR OPERATION FOR SELECTED YEARS

Elisabetta T. DeGironimo, MSc, GISP
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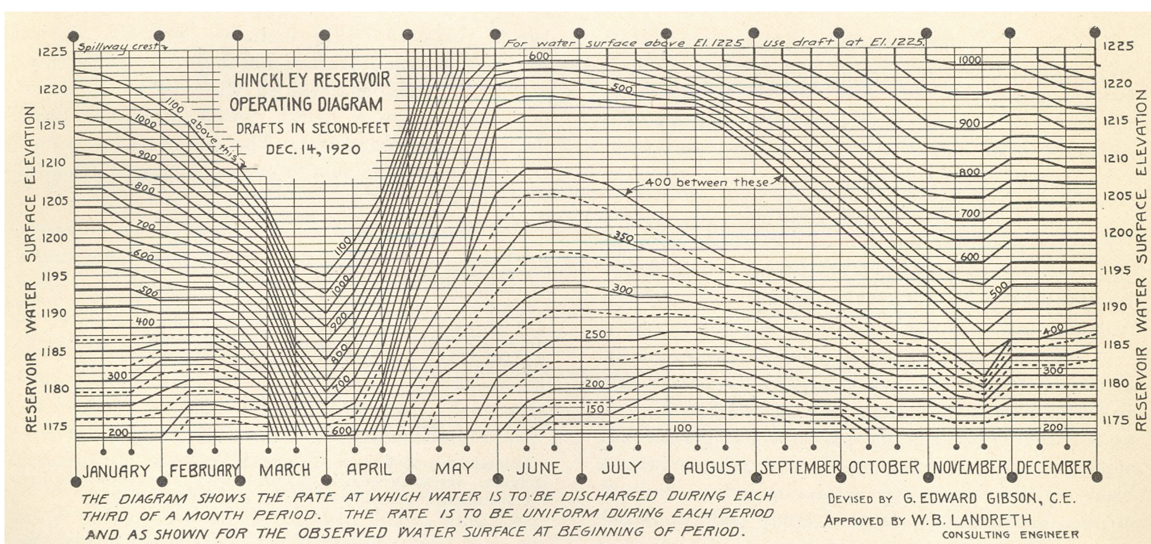
Hinckley Reservoir was created on the West Canada Creek by the State of New York in 1915 as a source for the Barge Canal. The dam that created the Hinckley Reservoir is operated by the New York Power Authority under the jurisdiction of the New York State Canal Corporation. The Hinckley Reservoir watershed is 374 square miles.

Prior to the construction of the reservoir, the West Canada Creek served as the drinking water supply to the City of Utica. The drinking water intake was located above the location of the dam. When the dam was constructed, the drinking water intake was relocated to the dam structure.

"When Hinckley Reservoir was constructed in 1915, its operation for canal purposes was alleged to injure downstream hydropower interests and claims were brought against the State by Utica Gas & Electric Company, of Utica, N.Y. In December 1920, the State developed an operating diagram that established the release of water from Hinckley Reservoir based upon varying reservoir levels throughout the year. The 1920 Operating Diagram established the rates (in cubic feet per second) at which water is to be discharged from Hinckley Reservoir during each third of the month period based upon the observed reservoir elevation at the beginning of each period." ("Report to the Governor by the Hinckley Reservoir Working Group," April 30, 2008. p. 13)

More specifically, the releases from the reservoir were to be set by using the Operating Diagram at third of a month intervals (on the 1st, 11th, and 21st days of the month). A release rate is determined by plotting the date (x axis), and the surface elevation (y axis) and interpolating the release rate from the diagram.



Hinckley Reservoir Operating Diagram. Retrieved February 25, 2011 from:
http://www.canals.ny.gov/waterlevels/hinckley/1920-hr-op-diagram-big.jpg

In order to manage reservoir elevations and to protect the drinking water supply, deviations from the Operating Diagram have regularly occurred. Reservoir management has implications that affect canal levels, the drinking water supply, FERC licenses, power generation, DEC required flows in the lower West Canada Creek, and recreational users. The long-standing practice of deviating from the Operating Diagram by reducing releases has proven an effective reservoir management practice in dry/drought years.

Reservoir elevation data from four recent years (1995, 1999, 2007, & 2010) are presented as examples of reservoir management practice. In 1995 and 1999, release deviations occurred proactively to manage the elevation of the reservoir. Beginning in mid-2007, it appears reservoir management practices were changed to adhere strictly to the Operating Diagram. On several occasions since this change, reservoir elevations have dropped to new historic low levels (for the 63 years of recorded elevations*). Reservoir elevations from 2007 & 2010 are presented to show the effects of this change of management practice.

1995

Historic past practice of reducing releases when reservoir levels were approaching 1200' elevation proved effective in 1995

Releases were reduced from 400 cfs to +/- 290 cfs on September 6th

Deviation allowed reservoir levels to stabilize around 1200' until early October when heavy rainfall over the watershed filled the reservoir

1999

Precipitation from January to June was 5 inches (24%) below average and the reservoir level was at its lowest level since 1987 for late June

Releases were reduced from 400 cfs to 300 cfs on June 25th

Deviation continued throughout the summer until September 24th when reservoir levels rebounded due to rainfall

2007

Beginning in early June, water levels were lower than both 1995 and 1999, yet over- releases (release rates higher than prescribed in the Operating Diagram) were called for on two occasions to meet the operational needs of the Canal

In late June, releases were increased from 400 cfs to +/- 580 cfs until July 10th (draining an additional 1.5 billion gallons from the reservoir)

A second over-release occurred between August 3rd (when reservoir levels were within 2' of recorded low levels) and August 8th (draining an additional 980 million gallons)

By August 7th, the reservoir was at the lowest recorded elevation for that date

Despite reducing releases to 120 cfs on September 25th, new daily recorded low elevations* continued until October 10th when rainfall filled the reservoir

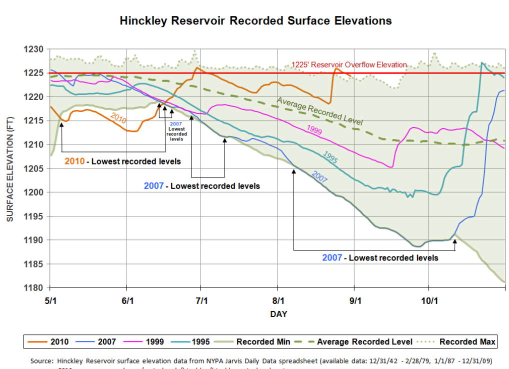
2010

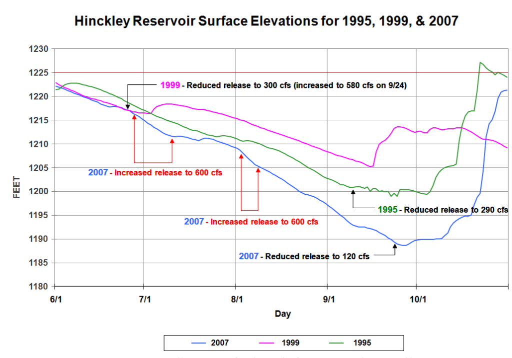
On May 5th, the reservoir reached a new daily recorded low elevation of 1215.4', which is 9' lower than the average recorded elevation for that day

Record low elevations continued through May until mid-June

As of June 8th, the reservoir was at 1215.1' which is 2.6' below recorded low levels for that day, and 8.8' below average

* Recorded Elevations – Daily reservoir elevation levels are available for approximately 63 years (12/31/41 – 2/28/79, and 1/1/87 – today)





PREDICTING TRIGGER LEVEL FOR ICE JAM FLOODING OF THE LOWER MOHAWK RIVER USING LIDAR AND GIS

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Introduction
Along the Mohawk River in upstate New York, ice jams are an annual occurrence that commonly results in significant flooding especially when the progress of the ice is impeded by obstructions to the channel and flood plain (Johnston and Garver, 2001; Lederer and Garver, 2001; Scheller and others, 2002; Garver and Cockburn, 2009). Jams occur when the frozen river breaks up and movement of ice is restricted at channel constrictions, locks, and areas of reduced flood plain. The lower Mohawk is particularly vulnerable to jams and the hazards associated with them (Fig. 1). To better understand ice jam flood events, it is important to know the flood trigger level.

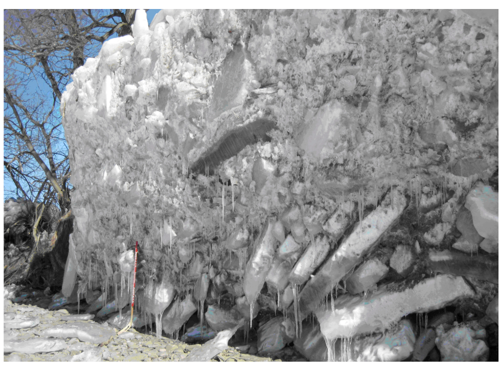

Figure 1: Ice Jam event up river from the B&M railroad bridge. The bank-lining ice is 4.5 to 6 m thick (hockey stick for scale) (Photo: J.I. Garver).

Flooding typically occurs when water gets backed up behind ice dams (Robichaud and Hicks, 2001; White and others, 2007). Ice jams may be self-regulating and break apart as increase in water levels floats the ice (Jasek, 1999). However, the break up of an ice jam may cause a release wave to move downstream, and this can also result in flooding (Watson et al., 2009).

For the Mohawk River, it is important to know the trigger level of flooding so that we can better understand chronic jam points and begin to model what will happen as jams occur. A better understanding of jamming and trigger points may reduce the chance of flooding and avoid the costly damage associated with these hazards.

Methods
To evaluate the flood trigger level, Air-LiDAR elevation data were used to reconstruct a digital elevation model of the study area, to simulate a flooding event, and to determine the flooding trigger level. The study area is located on the lower Mohawk River between the New York State Canal System Lock 9 (E9 Lock) and the B&M Rail Bridge at the Schenectady International (SI) Plant (Fig. 1). This specific area is well known for the ice jam flooding event that took place in January 25th, 2010. This ice jam resulted in flood levels at 74.4 m in the upper portion of the study area (Lock 9) and at 73.4 m in the lower portion (SI plant; Marsellos et al., 2010).

Through the use of Geographical Information System (GIS) software, we extracted all the elevation LiDAR points from the lower and upper areas of the flood area and converted it to a Triangulated Integrated Network (TIN). A polygon surface with a variable elevation from 66.2 m to 80.3 m using increments of 0.3 m was used to simulate the flood in different flood levels. The TIN and the elevation polygon surface were used to calculate the volume and surface of the flood area. To facilitate the computational process, the polygon surface was broken into 154 sectors (Fig. 2). Approximately 7,400 surface and volume calculations were taken for the entire simulated flood area.

3D Analyst Toolbox (TIN Management and polygon volume) from ArcGIS 10 was used to calculate volume and surface area at the different elevation levels through polygon volume calculations. The data from the volumetric calculation was plotted against elevation (Fig. 4, 5), to find a point where there was a drastic change, signifies the trigger point for flooding. Finally, the elevation point for triggering a flood was confirmed by draping a polygon with an elevation equal to the trigger level over the TIN.

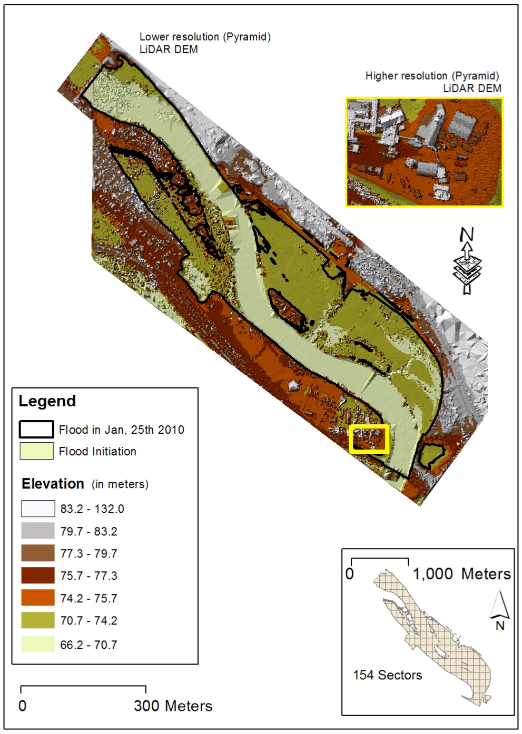

Figure 2 : LiDAR DEM that shows the flood trigger level (flood initiation) at 70.7 m. Polygon of study area broken into 154 sectors for analysis. Also on the cover.

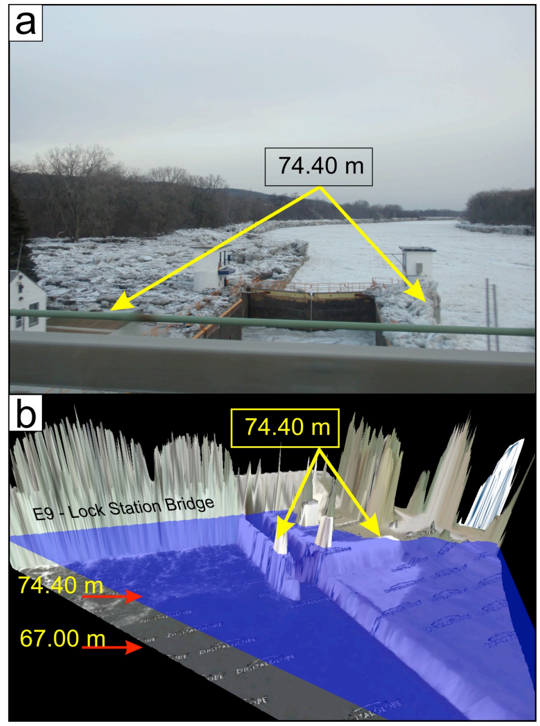

Figure 3: (a) Field observations from the E9 Lock station (from January 2010 Ice Jam); (b) water flood model derived from the LiDAR DEM (0.11 m resolution) to determine the accurate flood elevation level (Marsellos et al., 2010).

LiDAR volumetric calculation model

LiDAR data were used in this study because, flood model applications using LiDAR are successful where topographic relief is low and changes occur gradually. Digital elevation models (DEM) are useful in flood simulation for rural or urban areas. An accurate calculation of the flood volume requires a digital elevation model of better than 1-meter accuracy. The area used for this study 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. 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. Data processing is supported by a field survey (Marsellos et al., 2010) to obtain specific observations and elevation measurements of highest observed water levels during the 2010 Ice Jam flood (Fig. 3).

Results

Flood simulation shows that from 66.2 m to 70.7 m the river was rising due to water that backed up behind the ice dam formed by the ice jam. At 70.7 m water elevation the ice dam back up behind a solid dam, the ice dam did not disintegrated by the river rising, and it triggered the flooding. The flood trigger point for this study area was determined to be at an elevation of 70.7 m (Fig. 4, 5). At this point, the water was higher than bank full and water spread over the flood plain.

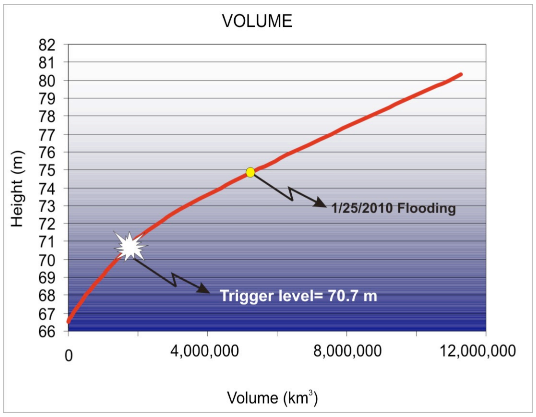

Figure 4: Graph displaying volume (km^3) compared to elevation (height (m)) illustrating the trigger point for flooding being at 70.7 m.

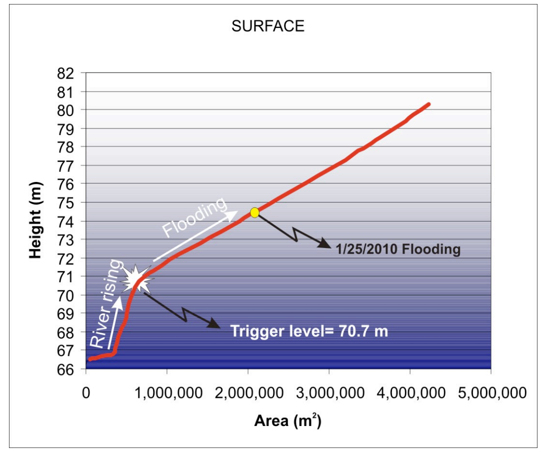

Figure 5: Graph displaying surface area (m^2) compared to elevation (height (m)) illustrating the trigger point for flooding at 70.7 m.

Conclusion

A water flood simulation using a LiDAR elevation model allows accurate water level measurements for determining trigger levels of ice dam flooding. This simulation shows that as the ice jam formed it caused water to accumulate behind the ice front and a key threshold was met when the water level rose to 70.7 m. At this point, flooding was triggered and the flood plain was inundated. Though continued studies, the same methodology can be applied to find the trigger points for flooding along other sections of the Mohawk River constrained by lock stations, and it may provide critical knowledge as to how to better manage the hazard of flooding due to ice jams.

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CHANGES IN THE HYDROLOGY OF THE MOHAWK WATERSHED AND IMPLICATIONS FOR WATERSHED MANAGEMENT

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The Mohawk Watershed in upstate New York is a unique and distinctive basin that is the main tributary to the Hudson River. The drainage basin is 8961 km^2 with principal tributaries reaching far south into the Catskill Mountains (Schoharie Creek) and tributaries reaching into the Adirondacks to the north (West Canada Creek). The main trunk of the Mohawk River and the Mohawk Valley itself has played a key role in the early settlement of the North America, and the westward expansion in the United States because it is one of the few natural avenues through the Appalachian Mountains.

Of interest throughout the basin is how changes in global climate, especially in the Northeast (Hayhoe et al., 2006; Frumhoff et al., 2007), may impact the temporal and spatial distribution of precipitation across the Mohawk watershed. It may well be that change has occurred and is ongoing: it would appear that we are seeing more precipitation and that that precipitation is not distributed evenly over the basin (Burns et al., 2007; Kern, 2008; Cockburn et al., 2009). By all accounts we have entered a wet phase in this history of the basin, by some metrics, the wettest in recorded history (Figure 1). This wet phase is demonstrated by an increase in precipitation and discharge in the basin, and this has resulted in an increase in slope instability, bank erosion, and sediment transport in the main channels and their tributaries. This part of the Northeastern United States appears to be difficult to model for future climate change, and this is likely a function of the difference in the way in which storms track through eastern NY (Frei et al., 2002). Climate models for the Catskills, show that projected changes in mean annual precipitation range from an increase of ~10% to a decrease of 30% by the latter part of this century (Frei et al., 2002): thus modeling may not be helpful for guiding management decisions.

The geography of the basin is uniquely positioned to reveal important changes in the hydrologic regime in this part of the Northeast US. The Mohawk Valley itself allows for subtle west-to-east atmospheric transfer, and the low-lying Hudson Valley commonly serves as a funnel for Atlantic storms. But the positions of the two principal tributaries provide a unique natural laboratory to study how climate change and precipitation patterns are affecting this part of the Northeast. The basin is essentially partitioned to sample Atlantic tracking storms (south and east) and to sample continental systems (north and west).

The long-term average annual precipitation recorded by NOAA since 1925 is 0.93 m or 36.5 inches near the confluence with the Hudson (37.0 inches/yr since 1825; NOAA, Albany NY). Integrated over the entire basin, this would imply that a total of about 8.3 km^3 of precipitation falls in the basin annually. The annual discharge records from Cohoes Falls (U.S. Geological Survey station) would suggest that the average annual discharge of the Mohawk is 5.2 km^3, thus there is a difference of about 3.1 km^3 or about 37% loss annually. This difference is almost certainly lost through evaporation and transpiration (or evapotranspiration). If we iterate to solve for the amount of precipitation lost through this process, we estimate that this accounts for approximately 13.5 inches annually. This value is reasonable, but lower than what is traditionally assumed for this region (15 -25 inches per year - see Hansen, 1991). Thus there might be other mechanisms to consider for loss of water in the basin, but give the imprecision in our numbers we have used to make these estimates, these sorts of exercises are probably not warranted. Recall that a primary assumption here is that the annual total precipitation measured by NOAA at Albany applies evenly across the basin: this is certainly not the case. Nonetheless, these numbers serve as a useful first approximation of the volume of water in the system. Note that the only significant out-of-basin transfer of water is from the Schoharie Reservoir through the Ashoken tunnel to the Esopus Creek and eventually on to the New

York City water supply. If we assume that that water is pumped continuously, all year, at 300 cfs, this transfer would result in a net loss in the basin of 0.27 km^3. While this is not significant on a regional scale, this is potentially a significant number for the Schoharie Creek, where the mean annual discharge is about 1.0 km^2. Also note that we assume here that the amount of water lost through groundwater recharge is in dynamic equilibrium. There is a possibility that regionally groundwater tables are rising with increased precipitation, but we are unaware of data to support this, but it is a reasonable hypothesis worth consideration because precipitation has increased in the last decade (Figure 1).

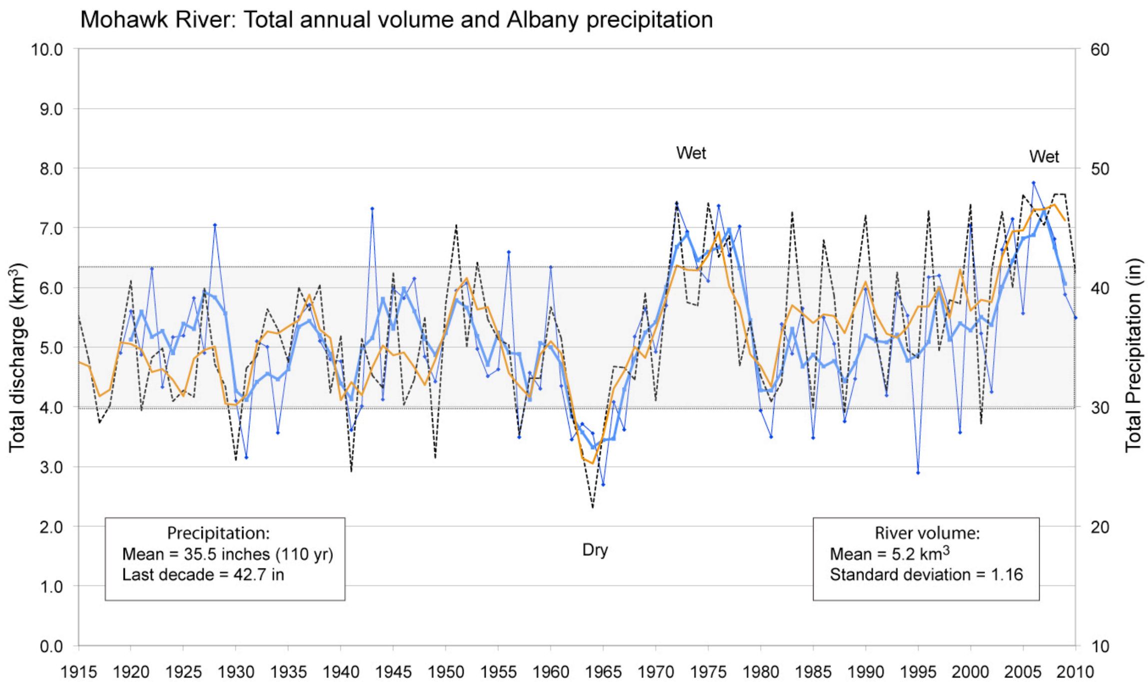

Figure 1. Annual discharge in km^3 of the Mohawk River from the USGS gage at Cohoes Falls. The total cumulative volume of water is given for each water year, which is 1 Oct to 30 Sept. The thin blue line is the annual totals, and the heavy blue line is an equal-weighted 3-point moving average. The orange line is 3 yr moving average of annual precipitation and the dotted black line is annual values (from NOAA Climate archives, Albany). For precipitation, a mean of 35.5 inches is the calculated annual totals from 1900 to 2010, and the "last decade" is eleven-year period from 2000 to 2010. The long-term mean precipitation annual total (1825-2010) is 37.0 inches (NOAA, NWS data; Stephen Dirienzo, personal comm., 2011).

To evaluate the total discharge, we take mean daily discharge records for every day of every year on record and calculate the volume of water for each day and then sum them for each water year, which is 1 October to 30 September. This means that the 2010 water year started on 1 October 2009, and ended in September of 2010 (it also means that the October 2010 floods are not considered in this analysis). The precipitation records considered are based on NOAA data that correspond to calendar years (i.e. January to December): so there is a slight difference in these records. The plot of the average annual discharge on the Mohawk River shows us that the mean flow is about 5.2 km^3 per year. The plot very closely corresponds to the average annual precipitation as recorded by NOAA, and thus we feel satisfied that the globally recognized relation between correlation between precipitation and river discharge applies here as well.

There are several significant excursions of discharge on the Mohawk (Figure 1) that are significant from a planning and management perspective. The first is the drought in the early 1960's, which was the most significant negative excursion the basin has seen in recorded history. The second is a period of abnormal precipitation that followed this in the early 1970's. It is not clear from the literature what external factors may have driven either of these excursions, and studies suggest that there is no clear link to the North Atlantic Oscillation (NAO), nor El Nino-La Nina (Hurrell et al., 2003; Kern, 2008). Finally, we note that we are in a period of very high discharge that apparently peaked in 2006, and has fallen slightly since. We note that this recent period of high discharge on the Mohawk corresponds to the wettest decade on record at Albany (NOAA), where records extend back to the early nineteenth century.

There are lessons in these long-term discharge records for watershed management, especially if a management plan involves understanding and optimizing water flow and availability as a resource. Consider the change in the basin hydrology going into the drought in the early 1960's, discharge dropped more than half in the five-year period from 1960 to 1965. Rapidly increasing annual flows can also be problematic due to flooding: between 1965 (2.7 km^3) and 1972 (7.4 km^3) discharge increased by a factor of 2.75 in less than a decade. Our current situation is not much different in that we appear to have an abundance of water, but we have entered this wet period gradually. Since 2003 the annual discharge has been above the historic mean, and in a few of these years it has been over the historic mean by more than 2 km^3. The highest total annual discharge in recent recorded history was in 2006, which coincides with the devastating June floods in the upper part of the watershed (Suro et al., 2009). These periods of high average discharge have important management implications, which are discussed briefly below.

To explore the significance of changing discharge in the basin, we look to variations within the basin to help us understand the regional implications for the patterns we are seeing. For simplicity we partition the Mohawk watershed into three manageable units that allow for us to explore differences in the basin. Actually these subdivisions are the two main tributaries – the West Canada Creek (WCC) to the NW and the Schoharie Creek (SCH) to the SE, and by default we then isolate the rest of the basin, which is largely the Mohawk Lowlands between these two sub-basins. This is a nice natural division by surface area: the Schoharie (26% surface area) and West Canada (16% surface area) together account for 42% of the entire basin while the reminder that is dominated by the Mohawk lowlands accounts for is 58% of the surface area in the basin. The strategic advantage here is that the hydrologic records for WCC at Kast Bridge (Figure 2), and SCH at Burtonsville (Figure 3) are relatively long (at least 50 yr), and therefore are useful in understanding annual and decadal trends in discharge. We have calculated the average annual discharge for the Mohawk (Cohoes Falls), and these two main tributaries: Schoharie Creek (Burtonsville, data since 1940) and West Canada Creek (Kast Bridge, data since 1925). Our analysis shows that the on average the WCC supplies 23% of the water to the basin while the SCH contributes 18%. Because the WCC drainage basin is slightly smaller, it is easy to conclude that the WCC historically has greater annual precipitation than the Schoharie. This of course assumes that there is no significant external reason for this difference, which seems like a reasonable assumption. Although the WCC has a significant reservoir as part of the system (Hinckley), that reservoir has existed since these hydrologic records begin, and there is currently no significant out-of basin transfer that we need to worry about. There are two significant reservoirs on the SCH, Gilboa and Schoharie. The Gilboa pump storage project is water neutral, but the Schoharie Reservoir does lose water through out-of-basin transfer through the Shandaken tunnel.

When the annual contribution to the watershed of each of these main tributaries is plotted, we see an interesting trend. While the long-term record suggests that the slightly smaller WCC basin contributes about 23% of the water to the Mohawk, the percentages are changing and have changed most significantly since 1996 (Figure 4). Since this time, the annual contribution of the WCC has decreased and the annual contribution of the SCC has increased to a point that 8 of the last 15 years (53%) the contribution of the SCH has been greater than the WCC. Prior to that in the 56 prior years, the SCH topped the annual contribution only 16% of the time. Thus we conclude that the relative flow from the SCH has increased relative to the WCC since 1996. This change could reflect greater precipitation in the southern part of the basin, decrease precipitation in the northern part of the basin, or both.

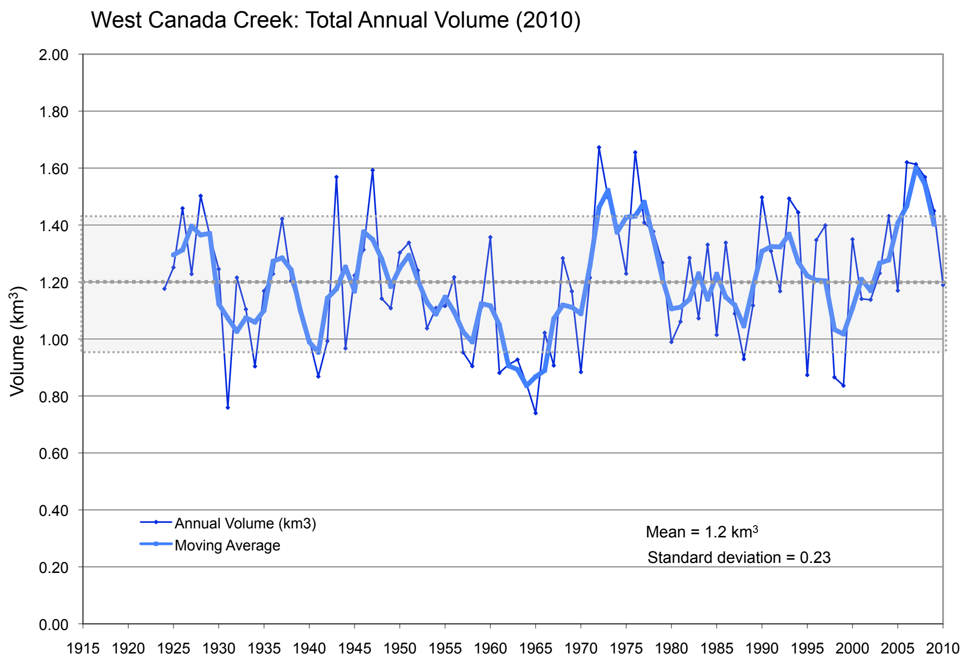

Figure 2. Annual discharge in km^3 of the West Canada Creek from the USGS gage at Kast Bridge.

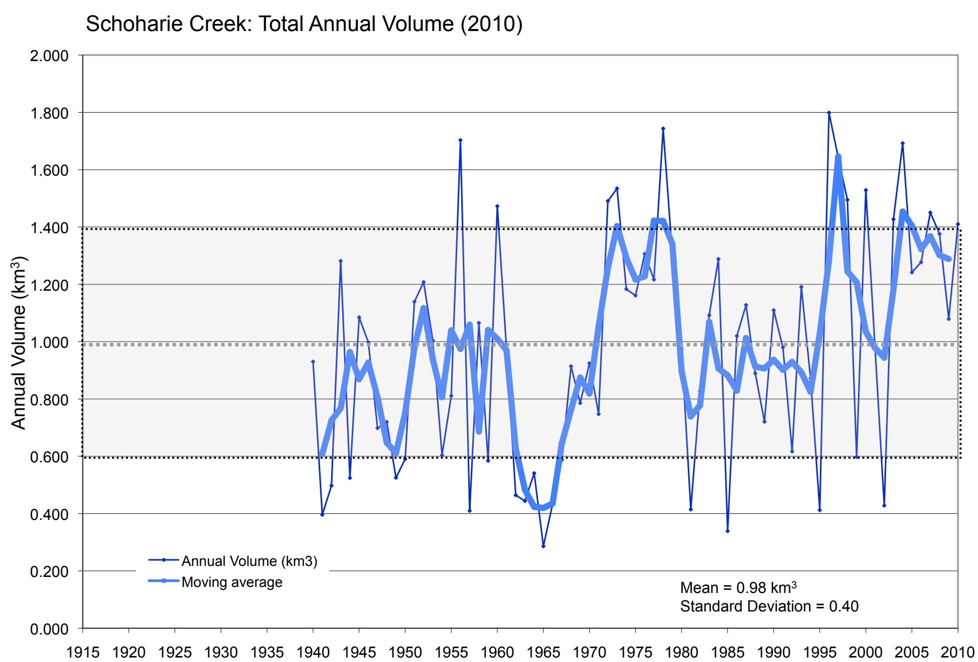

Figure 3. Annual discharge in km^3 of the Schoharie Creek from the USGS gage at Burtonsville.

Next we turn to the calculated annual discharge in the West Canada and in the Schoharie creeks (Figure 2 and 3). The West Canada Creek has a mean annual discharge of 1.2 ± 0.23 km^3 (standard deviation about the mean) and it does not appear to have significant variation from year to year (Figure 2): the flow is constant and consistent, certainly relative to the Schoharie.

The Schoharie Creek has a highly variable discharge with a mean of 0.98 ±0.40 km^3 and the record shows dramatic and wild inter-annual swings (Figure 3). For example compare 2002 (0.43 km^3) to 2003 (1.43 km^3). One of the hallmarks of the Schoharie Creek is the highly variable nature of its annual discharge. The mean discharge for the last eight years (2003 to

2010) has exceeded the long-term mean of 0.98 km^3 (Figure 5). The abundance of water in the Schoharie Creek presents highly significant management challenge partly because much of this water appears to be associated with high discharge events, many of which have caused significant and damaging flooding that is locally chronic.

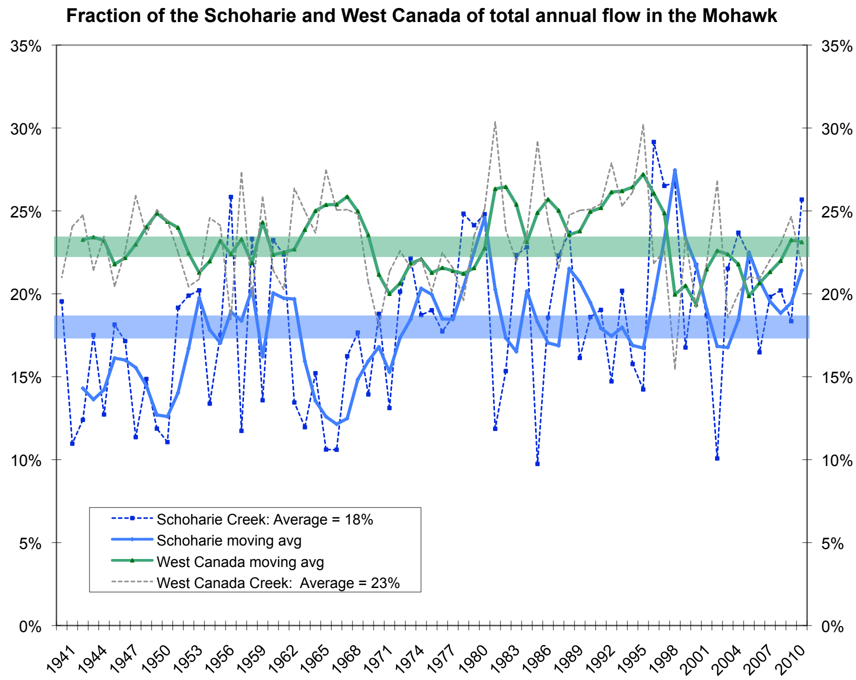

Figure 4. Relationship between the percentage of the annual flow from the two main tributaries of the Mohawk Watershed.

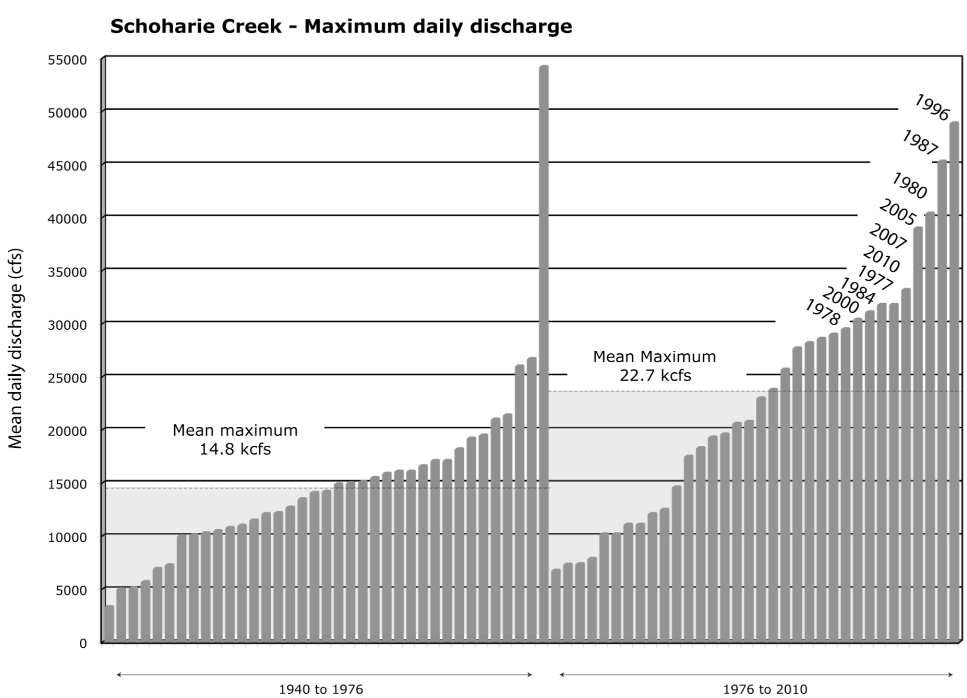

Figure 5. Maximum mean discharge of the Schoharie Creek spilt into pre-1976 and post 1976 intervals. Data are the ordered from maximum to minimum. The top ten floods in the recent interval are labeled.

A remarkable outcome of this analysis is that the Schoharie basin appears to have such a dramatically different and changed hydrology compared to other areas in the basin. It is clear that many of the floods are Atlantic-tracking storms that occur almost any time of the year. Recent work has shown that regionally there has been an increase in the number of heavy and very heavy precipitation events (Groisman et al., 2004), and the number of cyclonic systems in the East has increased over the last 30 yr (Briggs, 2007). In fact the number of Atlantic hurricanes peaked between 1984-2006, and many of these moved north and affected NY State (Vermette, 2007; Changnon, 2008). Notable storms are Nor'easters that dump snow that thaws quickly (Jan 1996), extratropical storms (hurricane Floyd, Sept 1999; Frances, Sept. 2004), and other coast-tracking systems. The importance of these events is that they can result in locally very high precipitation in the headwaters of the Schoharie (up to 10 inches or more in a few recent events), and very little precipitation elsewhere in the basin. Thus we hypothesize that the most dramatic and significant change in the hydrology in the Mohawk watershed is related to Atlantic-tracking storms, which have had a significant effect on flooding in the southernmost part of the watershed. We suggest that future studies focus on the meteorological and climatological implications of this hypothesis.

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LiDAR Examination of Meander Migration in the Mohawk River Watershed

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Meander migration is a phenomenon observed along curved segments of waterways. Erosion and sedimentation occur at opposite sides of the waterway at bending sections. The rate of erosion and sedimentation is dependent on many parameters including the type of soil, bend geometry, and flow velocity. The flow pattern includes velocity along the path of the waterway as well as that of the helical flow sweeping dense eroded materials that aggravate and accelerate the processes of erosion and sedimentation. The Mohawk River and two major tributaries in its watershed (Schoharie Creek and West Canada Creek) display significant number of meanders with various geometrical formations. Meander migration is exacerbated with higher flow velocity, softer soil, and sharper bends. The problem of soil scour can be costly to infrastructure facilities in the zone subjected to erosion as it results in the destabilization of supporting foundations. It can also impact developed communities as the banks of the river shift adding area to one side and subtracting area from the other. This paper uses high-resolution LiDAR images to detect the pattern of meander migration at certain sections along the Mohawk River. It shows the density of the suspended transport in the flow at meander sections. An analysis of the LiDAR images will also show the relative clarity of the water in straight sections of the river when compared with that in meander sections. Soil protection or river banks at meander sections will also be discussed including facilities such as bulkheads, retaining walls, gabions, sheet piles, and geosyntheics.

Oral Presentation

HYDROELECTRIC POWER POTENTIAL IN THE MOHAWK RIVER BASIN

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The present day Mohawk River basin consists of roughly 6,656 miles of rivers, streams, and canals and 135 lakes, ponds, and reservoirs, which are greater than 6.4 acres in size. There are several major tributaries to the Mohawk, which constitute a substantial number of river miles within the basin. These include Schoharie Creek, West Canada Creek, and East Canada Creek. The largest ponded bodies of water within the Mohawk River basin are human-made reservoirs. Together the Hinckley Reservoir, Delta Reservoir, Schoharie Reservoir, and Peck Lake make up 42% of total lake acres (NYSDEC 2003). A number of hydroelectric electric power projects have been developed in the Mohawk River basin over the years. These plants include Cohoes Falls, Vischer Ferry, and Hinckley. In addition, the Blenheim-Gilboa pumped storage is an example of a project designed to store water to generate power at peak demand times. From Cohoes, where the Mohawk River joins the Hudson River, to Rome one hundred miles inland, where the New York State Barge Canal continues on to Lake Ontario and Lake Erie, the difference in elevation is 420 feet. Twenty locks make up this gradual climb. Most of these locks, in addition to some dams such as Gilboa Dam, spill water with no provision to use the difference in water head to generate hydropower. This paper is concerned with discussing the potential of generating hydroelectric power from existing hydraulic structures presently serving various functions in the Mohawk River basin. It aims at illustrating that existing facilities have the capacity to produce renewable, clean, and inexpensive energy that can aid in the economic development of this part of the State of New York.

Poster Presentation

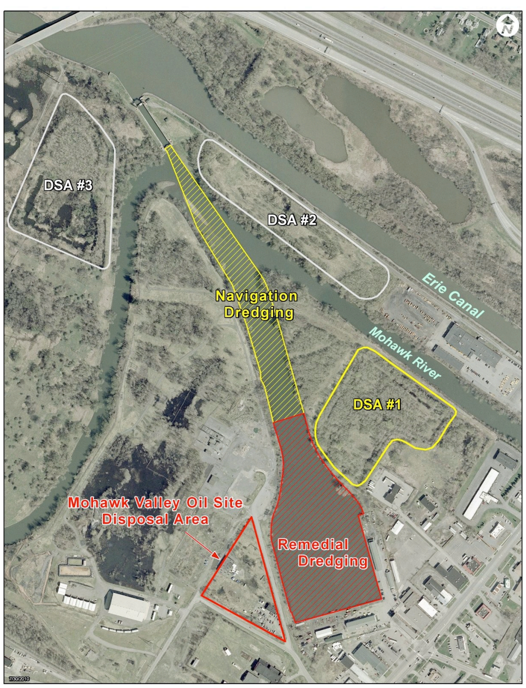
Unlocking Utica Harbor: A restoration case study

Howard M. Goebel, P.E., P.H.

Canal Hydrologist, New York State Canal Corporation

Utica Harbor was created during the 1918 expansion of the Erie Canal. This newly-constructed manmade harbor provided expanded water borne transportation to meet the developing industrial needs of the City of Utica. Harbor Point is approximately 140 acres of land located between Utica Harbor and the Mohawk River. The New York State Canal Corporation operates a canal maintenance facility on the southern and eastern sides of the harbor, a navigation lock to connect Utica Harbor to the Erie Canal, and a dam spanning the Mohawk River to maintain stable water levels in Utica Harbor conducive to navigation. The Utica Canal Maintenance Facility serves to provide rehabilitation of the Canal Corporation's water based equipment.

Harbor Point was developed for industrial purposes in the mid 1800's and has been the site of two manufactured gas plants (MGPs), a coal-fired steam plant, a petroleum storage and distribution facility (Mohawk Valley Oil) and a tar products plant (New York Tar Emulsions Products (NYTEP). Based on the intermodal connection provided by the Erie Canal, Harbor Point was the location of the largest energy-producing complex in North America in the 1920s.



Utica Harbor General Overview

Coal tar, a byproduct of manufacturing gas, was released to the environment resulting in the contamination of soil and groundwater at the Harbor Point site and contamination of sediment within the Utica Harbor. Several environmental remedial programs are being implemented to address this contamination.

National Grid has undertaken a large-scale soil removal project and a sediment dredging project as part of the environmental cleanup of the Niagara Mohawk Harbor Point and Mohawk Valley Oil inactive hazardous waste disposal sites. The cleanup activities were performed by National Grid with oversight provided by the New York State Department of Environmental Conservation through New York's State Superfund Program. The New York State Canal Corporation completed the navigation dredging of Utica Harbor.

A case study of the restoration of the Utica Harbor, including remedial and navigation dredging, the navigation lock, and the Utica Harbor Dam will be provided to illustrate the steps that are being taken to return Utica Harbor to a fully functional component of the New York State Canal System and to increase the economic development potential of the region.

The City of Utica's ultimate vision for Harbor Point is addressed in the 2008 legislation that calls for the transfer of the remediated Canal Corporation's Utica Harbor lands to the City of Utica for the purpose of restoring Utica's economic vitality of the Utica Harbor area. This proposal offers an historic opportunity to expand the local economy, provide job opportunities, expand tourism and recreational related industry, and increase municipal revenue for the City of Utica and the overall Mohawk Valley region.

USING ARCMAP TO MEASURE MEANDER MIGRATION OF THE NORMANSKILL RIVER, ALBANY, NY

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Department of Geology, The College of St. Rose, Albany, NY

A geomorphic assessment was completed along the Normanskill, a tributary of the Hudson River watershed located west of Albany, NY, in order to provide baseline data for long term monitoring of the stream. The assessment of the stream includes an evaluation of bank stability and channel conditions at four locations along the stream and the measurement of meander migration. Using ArcMap, the current and past locations of the stream are mapped and meander migration rates determined. The current location of the Normanskill is established by digitizing aerial photographs and satellite images from Google Earth (2007-2010). The Google Earth time slider tool and historic maps of Albany and Schenectady Counties (Stone & Stewart, 1866) are used to determine short- and long-term rates of meander migration over the last 13 and 144 years, respectively. For meanders that appear to have migrated, the locations of meander loops from the past and present are compared in ArcMap and the measure tool is used to determine rates of meander migration. As an example of meander migration of the Normanskill, at one assessment location the stream migrated towards the south west between 1866 and 1995. At this same location prior to 2001, a rehabilitation effort was completed to restore bank stability. As a result, the meander bend was moved back towards its 1866 position. This project compliments previous ecologic assessments of the stream (May 2010) and helps establish the procedure for long-term assessment of the Normanskill. The data collected now and in the future will be used to monitor geomorphic alterations of the stream.

Sediments in the Mohawk: The big picture

Simon Litten
HRECO, Dept., Environmental Conservation

Sediment transport is a natural function of streams. Fresh sediments are necessary for maintaining habitat and as sea level rises, to raise the bed of the Hudson Estuary. Sediments arise from overland runoff and from side and bottom scour in streams, particularly during hydrological events. A very small number of events accounts for most of the sediment transport in the Mohawk. Between 2004 and 2009 half of the total sediment load of 2.6 million tons came out in 19 days, or in three events. One day, 6/29/2006, saw 39% of the average yearly sediment total (202,000 tons) exiting at Cohoes. During the same period the larger (4,606 sq miles versus 3,450 sq miles in the Mohawk) and more heavily forested Upper Hudson watershed put out 1.2 million tons of sediment. The Upper Hudson lost 53 tons of soil per square mile per year while the Mohawk lost 149 tons. The Upper Hudson is also less flashy; it required 54 high-sediment load days to pump out half the five year total load.

Natural soil and terrain factors favor agriculture in the Mohawk; 52% of the Mohawk basin is "prime farmland" whereas only 21% of the Upper Hudson is so classified. Anthropogenic factors influencing sediment loading include land use and stream modification.[1-6] Forest and pasture landscapes allow precipitation to soak into the ground. Leafy cover increases transpiration, evaporation, and decreases mechanical disruption of soils. Hard, impervious surfaces such as roads, roofs, and parking lots, speed water into stream channels. Streams become over-charged with water and severe bank and bottom scour results.[4] Trees topple, public structures are damaged, and private property is lost. Soil from plowed lands is also more easily mobilized by precipitation events.

Historically, the Mohawk Valley experienced deforestation where wood was used as fuel, as building materials, tan bark, and as sources of potash needed by industry. Careless use of fire by farmers, loggers, hunters, and industry resulted in enormous forest fires.[7-10] By 1880 only 25% of New York remained forested, and that was mostly in the Adirondacks and Catskills.[11] The 1900 sediment load in the Hudson was 20 times background.[12] Alternative fuels such as coal and petroleum, alternative structural materials such as steel and concrete, measures to reduce forest fires, and chemical preservative such as coal-tar creosote, pentachlorophenol, and copper-chrome-arsenate maintain structurally competent wood for longer times. These measures have greatly reduced pressures on forests.[8] On the other hand, pulp wood for paper making became significant after the technology was developed in the 1870s.

Cleared land in the Mohawk became a prime wheat growing district of great strategic importance during the American Revolution.[13,14] Poor land management, introduction of an invasive pest from Europe, and fresh wheat lands to the west made accessible by the Erie Canal pushed Mohawk Valley lands to pasture.[15] This pasture supported sheep that became the basis of a significant textile industry.[16,17] By the mid-19th Century Mohawk Valley dairy cattle became part of the New York City "butter and cheese-shed."[18] In 1915, 22% of US farm area went to feeding draft animals. Tractorization in the early 20th Century released much of this land, mostly back to forest.[19] New York is now 62% forest. Changes in agricultural technology have dramatically increased yields. Dairy, the dominant agriculture in the Mohawk Valley, now uses less pasture and more corn. Due to improved nutrition, antibiotics, breeding, and bovine growth hormone milk yield has quadrupled.[20,21] Corn crops increase sediment yield over pasture. Alternative agricultural practices, notably "no-till", reduces erosion, soil oxidation, and fuel use at the expense of more pesticides and costly and specialized seed drills.[22,23]

Loss of the textile and other industries, military base realignment, the rise of automobiles, and urban disinvestment have severely damaged Mohawk Valley cities.[17] Sprawl can be seen in population growth occurring outside of existing high-density areas while densely inhabited areas are losing people. Sprawl harms wildlife through habitat fragmentation, barriers to animal migration, elimination of wetlands, application of lawn chemicals, and presence of pets.[24,25]

Sprawl increases energy use through operation of motor vehicles and through less efficient buildings. It increases public costs of school buses and greater per capita costs for providing emergency and environmental services. Existing public infrastructure becomes underutilized. Suburban development requires hundreds of times more asphalt per person than urban development.

The Mohawk Valley contains about 550 dams with a median age of 66 years. Many of these dams have outlived their purpose and many are poorly maintained. Dams disrupt stream function by changing flow patterns, temperature regimes, and migration routes. They trap sediment and normal dam water releases causes downstream scour. Dam failures release very large amounts of sediment.[6]

Excessive sediment harms aquatic life by reducing primary productivity, reducing visual acuity of predators and prey, by reducing habitat suitability, and by damaging filtration and respiratory structures.[26] Sediment fills navigational channels and berths requiring dredging.[27] Dredging costs are affected by the presence of regulated toxic chemicals, quantity, and by regulatory operational constraints. These include temporal windows to protect migrations and sensitive life stages, disturbance mitigation (dredge type, speed of operation, barge overfill), and disposal practices (beneficial use, disposed at sea, hazardous waste?). While there are locally contaminated sediments in the Mohawk, analyses of suspended sediment at Cohoes do not indicate high concentrations of actionable substances.[28] The cost of navigational dredging impact private businesses, the Canal Corp, the Port of Albany, and the Port Authority of New York/New Jersey. The Port Authority is responsible for 270,000 regional jobs, $11.2 billion in personal income, $36.1 billion in business income, and over $5 billion in federal, state, and local taxes.[29] It is in stiff competition with other east coast ports and measures taken in the watershed to reduce sediment loads and to improve sediment quality affects the region's economy.

Some of the on-going research into sediment transport is supported by the NYS Department of Environmental Conservation in cooperation with the US Geological Survey and other partners. A network of permanent high-frequency water quality and meteorological observing stations (www.HRECO.org) has been established in the Hudson Estuary and there is a possibility of extending it into the Mohawk, particularly in the Schenectady area. Sediment observing stations have been operating at Cohoes, Waterford, and Poughkeepsie since 2002 and five Estuary turbidity stations have recently gone on-line, including on the Mohawk at Cohoes. We hope to see more installed on major Mohawk River tributaries. This monitoring would develop better understanding of how much and where sediments originate and, if the system is maintained, will show how changes in climate and land use affect sediment delivery. This information will be useful in targeting limited resources.

Solutions to the problem of excessive sediments require attention to a wide variety of factors requiring cooperation across many disciplines including conservation, agriculture, industrial development, forestry, urban planning, and transportation. Environmental problems are often the results of failures to address urban and rural social and economic problems.

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USING LIDAR AND OTHER ANCILLARY DATA TO ANSWER WATER RESOURCE QUESTIONS

Ricardo López-Torrijos

Anecdotal observations suggest that many groups working within the Mohawk don't realize that terrain elevation Lidar data is out there, and how it might be used. This is an attempt to provide pointers and encouragement to work with it. There is much we can learn from the dense and precise characterization of the terrain, its vegetative cover and its built infrastructure.
There is available Lidar Data in all Mohawk watershed, with the exceptions of:

- West Canada Creek and Delta Reservoir catchments.
- Disconnect between the Mohawk and the lower Schoharie Creek.
- No data on the Saratoga County side of the lower Mohawk.

Data ingestion

- LAStools: converting, filtering, viewing, processing, and compressing LIDAR data in LAS format, http://www.cs.unc.edu/~isenburg/lastools. E.g. to interpolate ground points from *mohawak.las* and store DEM in GeoTIFF: > las2dem -i mohawk.las –o mohawk.tif -keep_class 2
- ArcGIS: LAS → multipoint dataset → terrain → DEM/TIN. GeoCue's LP360 add on allows direct LAS manipulation, www.geocue.com/lidar/qcoherent/lp360arcgis.html
- AutoCAD/MicroStation: need thinning of point cloud. Terrasolid's TerraScan add-on for direct LAS manipulation - www.terrasolid.fi
- libLAS: http://liblas.org, start here if you plan to write LAS manipulation code.

Lidar Derived DEM analysis

- ESRI implemented a collection of tools as its ArcHydro toolset, some of them are for raster analysis.
- The above and additional raster analysis functionality, in open source license, from USU's Hydrology group TauDEM toolset.
- GDAL - Geospatial Data Abstraction Library format conversion, grid algebra, www.gdal.org/
- Tool catalog in OpenTopography's Tool Registry. If you write code, look there for building blocks,
  //opentopo.sdsc.edu/gridsphere/gridsphere?cid=contributeframeportlet&gs_action=listTools

Hydrologic Analysis TauDEM functions

Functions for:

- Pit removal by flooding to ensure hydraulic connectivity within the watershed.
- Computation of flow directions and slopes using single and multiple flow direction methods.
- Contributing area using single and multiple flow direction methods.
- Multiple methods for the delineation of channel networks including geomorphology-based methods sensitive to spatially variable drainage density.
- Objective methods for determination of the channel network delineation threshold based on stream drop analysis.
- Delineation of watersheds and subwatersheds draining to each stream segment and association between watershed and segment attributes for setting up hydrologic models.

D8 vs. D-infinity flow

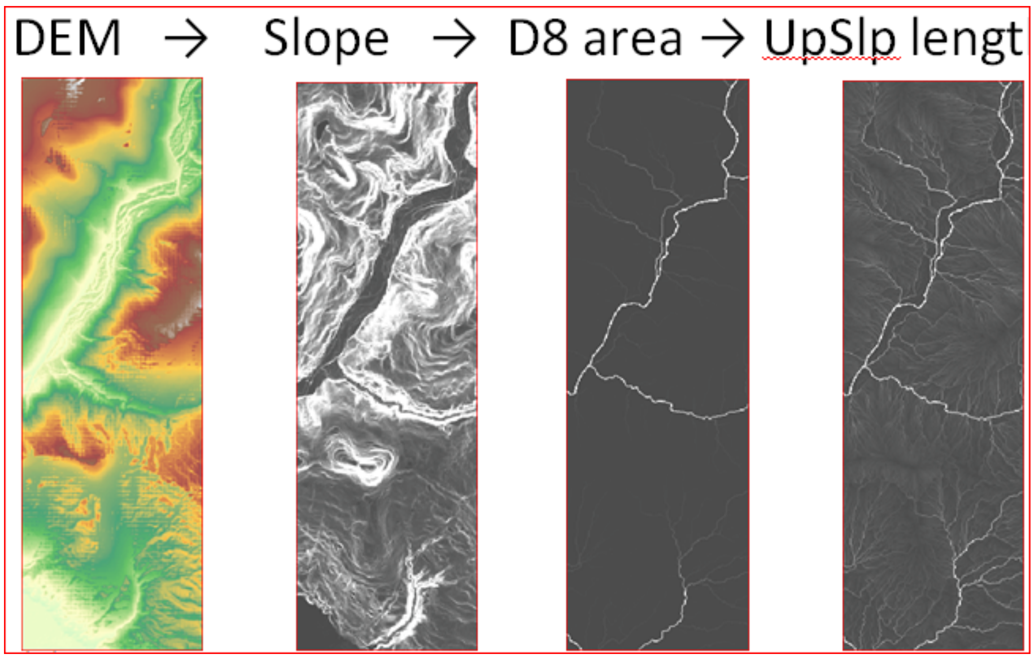
- D8 Flow Direction Coding: 1 - East, 2 - Northeast, 3 - North, 4 - Northwest , 5 - West, 6 - Southwest, 7 - South, 8 – Southeast
- D-infinity Flow direction is encoded as an angle in radians counter-clockwise from east as a continuous (floating point) quantity between 0 and 2pi. Important for diffuse flow analysis.

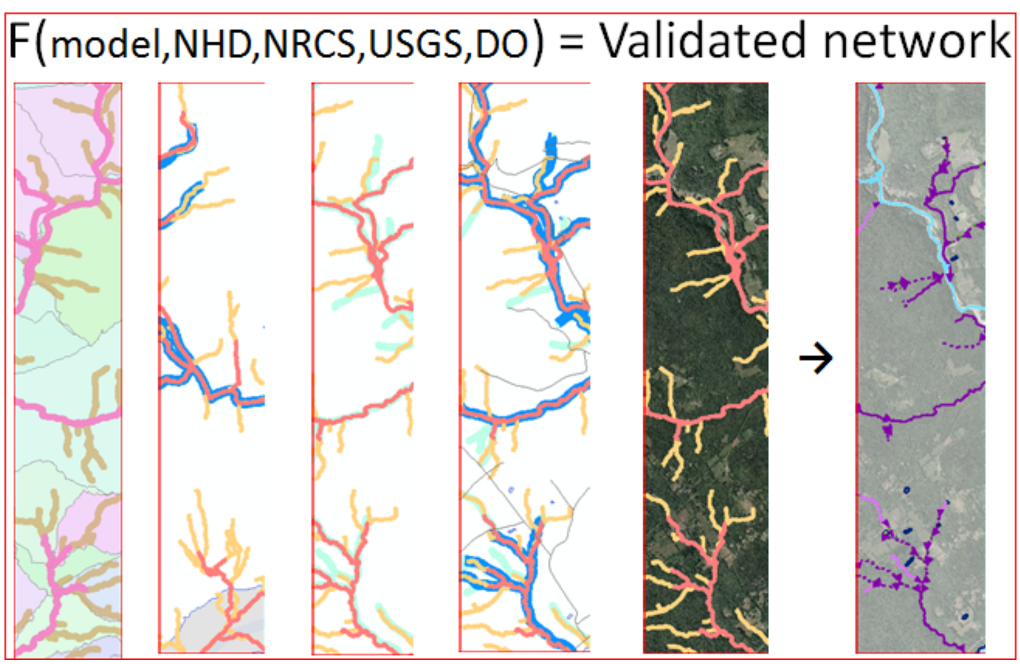
E.g., we can obtain Slope, contributing area and upslope length for every cell in the DEM:
Some of the stream network functions are:

- PeukerDouglas: I interpret it as a landscape 'concavity' index.
- DropAnalysis: objective selection of stream delineation threshold.
- Threshold: Input, any grid. Output an indicator (1,0) grid of cells that have values ≥ threshold.

- StreamNet: Produces vector network from a stream raster grid and corresponding subwatersheds draining to each stream network link.

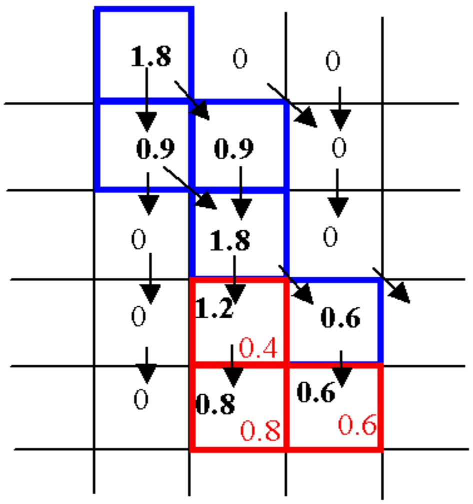
Stringing them together appropriately allows the extraction of a stream network based in a geomorphology statistical analysis of channel network characteristics, sensitive to the characteristics of each specific catchment. By comparing the model results with ancillary data –USGS hydrography and hydrologic study data for the area, NRCS soil maps, transportation infrastructure, aerial photography, etc., we can then extract a validated new stream network. Then it is an exercise in network parameter differences to see how the new information compares with that previously held –stream network length, sinuosity, etc changes.





Terrain Analysis TauDEM functions

There are functions for Slope over specific catchment area ratio, which is the inverse of the wetness index; Upslope dependence function to map the locations upslope where activities have an effect on a downslope location; Decaying accumulation that evaluates upslope contribution subject to decay or attenuation; etc. For example, the D-Infinity Reverse Accumulation function allows evaluation and map of the hazard due to activities that may have an effect downslope, e.g. land management activities that increase runoff. If runoff could trigger debris flows, the weight grid can be read as a terrain stability map.



Reverse accumulation of field weights indicated in red

Resources – Tools

- Martin Isenburg at UNC LAStools: http://www.cs.unc.edu/~isenburg/lastools/
- David Tarboton et al. at USU TauDEM 5: http://hydrology.usu.edu/taudem/taudem5.0/
- ArcGIS
  - ArcHydro toolset works with ESRI grids
  - TauDEM 5 (v. 9 only) works with TIFF grids
- Grid conversion:
  - GDAL_Translate utility: http://www.gdal.org/gdal_translate.html
    > gdal_translate -ot Float32 -of GTiff -a_nodata -9999 Mohawk.flt Mohawk.tif
  - ArcGIS → Data → Export.

Resources – Datasets

NYS lidar data collections: call the NYS Office of Cyber Security, 518-474-5212

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EMERGING AQUATIC CONTAMINANTS

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Water bodies across the country are impacted by so-called legacy contaminants, which are chemicals that remain in the environment long after they were first introduced. Polychlorinated biphenyls (PCBs) are examples of legacy contaminants in the Mohawk and Hudson Rivers. Legacy contaminants are well studied, and cleanup methods to reduce their concentrations have been developed. However, in addition to legacy contaminants, hundreds – perhaps thousands – of "emerging contaminants" impact our waterways. Better termed "contaminants of emerging concern," these contaminants are not routinely monitored but can enter the environment and have known or suspected negative ecological and/or human health effects. Examples of emerging contaminants are pharmaceuticals and the chemicals in personal care products, among others. Such chemicals enter our waterways either directly (i.e., sunblock washing off a swimmer) or indirectly (i.e., through wastewater treatment plants). The sheer numbers of chemicals in the products we use every day means that we do not have a complete knowledge of their environmental toxicity and fate, nor are they currently regulated in wastewater effluents and/or drinking water. Though introduced at relatively low concentrations, many of these contaminants are stable and therefore persistent, such as perfluoroalkyl acids, which are used in the manufacture of stain-resistant coatings, insecticides and fire-fighting foams. In addition, these contaminants are released to the environment in a constant stream, so long-term low-dose exposures are of concern. In order to make decisions about the regulation and remediation of emerging contaminants it is important to understand their fate in the aquatic environment, which is affected by many processes (Figure 1). This presentation is focused on defining and identifying emerging contaminants and exploring their routes of introduction to the aquatic environment. In addition, information about the occurrence and fate of select contaminants will be presented.

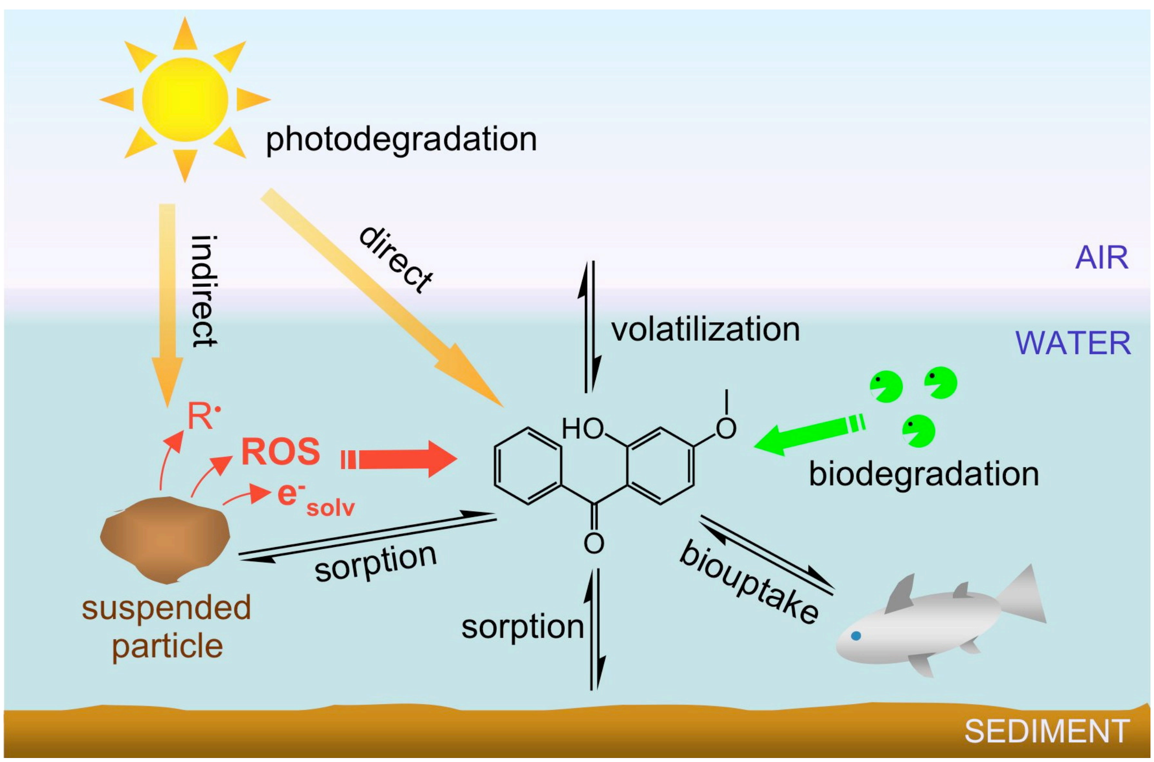

Figure 1. Processes that affect the fates of emerging contaminants in the aquatic environment.

The Schoharie River Center's Environmental Study Team A Community Based Watershed Education Program Progress Report 2010

John McKeeby[1], Jessica M. Jones[2], Mary Rachael Keville[3], Zach McKeeby[3]
[1]Schoharie River Center, [2]Schoharie High School, [3]Duanesburg High School

The Schoharie River Center, Inc is a non-profit environmental education and cultural arts organization located in the Schoharie and Mohawk River Watershed. Formed in 1999 to promote environmental consciousness, education and understanding about the ecology of the Schoharie Creek and the history, folklore and culture of its people, the SRC produces a variety of family friendly, community centered activities open to the public, in order to forge a connection between the natural history and ecology of the Schoharie Watershed and the people who live and work in the areas it flows through. To accomplish our mission the River Center (SRC) responds to community needs and provides a variety of unique community and community based and centered programming focused on increasing our community members' (adults and youth) capacity to learn, grow, and develop socially, physically and intellectually.

The SRC programs are family focused and we encourage parental participation in all programs. Regular programming includes a Silent Movie series (since 2003) featuring live musical performance and a locally focused Citizen Scientist speaker series (since 2007). Youth Development programming includes the Environmental Study Team EST (2002) and the Archeology Field School (2003). SRC presents community celebratory events as well: the Bronze-Back Round Up which is an annual fishing derby and pancake breakfast (since 2002) and Old Home Sunday which is our fall music series featuring local artists and musicians (since 2004). SRC also supports ongoing traditional folk arts and culture programs funded through the New York State Council on the Arts (NYSCA).

The SRC's Environmental Study Team youth development program is a year round environmental science based, career / life skills development program for youth ages 13 – 18. The Environmental Study Team's focus is to assist and encourage youth members to be aware of and active in the monitoring, improvement, and stewardship of their local environmental and fresh water resources through participating in ongoing community based, professionally supervised water quality & biomonitoring assessments projects, organized stream bank clean-ups, and community education activities. In operation since 2002, the SRC's EST program operates in a diverse and wide variety of local communities including the City of Schenectady (Mohawk Watershed), the Duanesburg-Esperance-Burtonsville Area (the Normans kill and Schoharie Creek watershed), and in the Gilboa-Conesville-Blenheim area (Schoharie and NYC watersheds). The program encourages and assists youth team members to utilize, integrate, and apply what they are learning in their academic studies (Science, Math, History, Language, and Arts) as well as their own interests and talents, to local environmental studies and field biology research, community archeology, and out-door recreational activities of the EST program. Working with over 50 youth and their families attending seven different area school districts, EST activities offer youth an opportunity to participate with both peers and adults in positive, constructive, task oriented projects which both enhance the quality of life of the community and reinforce goal directed, personally responsible behavior among environmental study team members. The EST program is a long term, supportive involvement with youth as they grow and develop from ages 13 -18. Typically youth and their families participate in the EST program for 3 – 5 years, from middle school (7-8 grade) through graduation (12th). Often youth members recruit their friends and siblings into the EST program and strong friendships between youth from different communities and backgrounds evolve through their on-going involvement in the program. In addition, the program also focuses on encouraging youth members to be physically fit and active throughout their life by involving them in life-long mastery based, out-door recreational activities and hobbies such as hiking, cross-country skiing, snow shoeing, swimming, sailing, kayaking & canoeing, fishing, orienteering, nature photography and maple-syrup making. Through all the activities of the program, EST strives to foster in the youth members a sense of personal competence and self-confidence, to encourage their life-long interest in learning, to instill the value of stewardship for our local environment, and to promote positive social behavior and an involved citizenship.

Over the past year, (2010) the Schoharie River Center's EST programs have conducted monitoring, assessment and survey activities on a variety of streams and rivers within the Mohawk and Schoharie Watershed for a variety of purposes, including Youth development skills practice, educational, recreational, and scientific monitoring. Streams sites being monitored regularly by EST teams during 2010 include the Schoharie Creek and its tributaries (Wilsey Creek, Fox Creek, Bowman's Creek, Mine kill) from the Gilboa Dam to the Mohawk River, the Mohawk River and tributaries (the Alplaus creek (Glenville) and the Plotter kill), the headwaters of Normans kill (and Bozenkill), and the Manor kill (NYC watershed). In addition to stream monitoring, EST youth have participated in ongoing stream bank clean-ups at all sites where they have tested, as well as organized formal riparian area clean-ups and natural vegetation plantings. The EST groups work to document wildlife and biodiversity, threats to natural habitat, invasive species, and the impacts of human activities on local ecology.

In addition to stream monitoring activities, since 2003, EST program youth have worked with archeologists from Hartgen Archeological Associates to conduct archeological investigations along the Schoharie and within the watershed. This year, two, week long Archeology Field Schools were conducted by the SRC and Hartgen for EST youth within the Schoharie Watershed in Burtonsville and at the NYS Power Authority's Lansing Manor Visitor's Center in Blenheim. Exhibits of the artifacts uncovered during the archeology field schools are displayed at both the Power Authority and at the Schoharie River Center.

In 2010 EST youth from all three local chapters competed in the regional Envirothon Competition. Twenty-seven EST program youth made-up five teams at the annual competition sponsored by County Soil and Water Conservation Districts and held at the New York Power Authority in Blenheim, NY.

The most significant impact of this project has been how it has been able to engage and interest a wide range of young people (teenagers) in learning about the natural world and in the realization that the local environment (the area of the Schoharie and Mohawk River Watersheds) belongs to them to both enjoy and protect. The youth members have come to understand the connection and interrelationship between their life and the life of the natural world around them. They learn to experience empathy and gain respect for the many forms of life that inhabit and depend upon the local fresh water streams, rivers and creeks. Through participating as part of the Environmental Study Team, our youth members come to recognize that they have skills, talents and interests that often have gone unrecognized to themselves, their families, and their teachers. They become concerned about how human activity impacts the places in the natural world they care about. They realize that they have the power and responsibility to take action both as individuals and collectively, to act to improve and protect the local environment, and pass on their sense of stewardship to others. They also learn the skills and gain the self-confidence to take a leadership role within their schools and community to promote and encourage responsible and healthy behavior, practices and attitudes among their peers in the community.

Through EST youth have the opportunity to learn about the natural world and themselves. They learn to master the skills necessary to conduct valid scientific research, navigate through the environment, and interact positively with other people (adults as well as youth) as fellow human beings, concerned about their local environment and community. The EST program provides interested youth with a community or group they can belong to, invest in and feel positive about because they are contributing to the well being of the community. Their contribution is recognized also by their community, with various community organizations and individuals seeking out the EST team as exhibitors and local experts about their local fresh water streams and the local environment. The EST program works to create a new generation of environmentalists, concerned about how to preserve and create a better world for all living creatures.

What makes the SRC EST model successful is its emphasis on community involvement, the inclusion of rigorous scientific based field research, and its holistic approach to ecology where youth participate as a group year-round in activities that follow the natural cycles of nature and the seasons. (Fresh stream water quality monitoring, hiking, winter forest ecology, forestry, Maple syrup, etc.) Participation in the Environmental Study Team is not contingent upon maintaining a certain grade, or being able to afford expensive out-door gear or equipment. Rather, all that is necessary is an interested youth and a parent or guardian willing to agree to let the youth participate. This program model is especially suited to community-based organizations that are interested in local youth development, and community based watershed education and outreach. Regardless of location (whether rural, suburban, or urban), the model can be adapted to fit the unique environmental and cultural characteristics of any community.

The program has been recognized nationally, most recently in 2011, by the Sea World / Busch Garden Conservation Matters Program, with an Environmental Excellence Award. Youth from the program will be traveling to Sea World in Orlando Florida in April to accept the award.

In December 2010 the Schoharie River Center purchased a 20-acre property on the Schoharie Creek in Burtonsville to establish a community based Environmental Education Center and Riparian Area Nature Preserve. The property that includes a small house, two car garage and 20 acre natural hardwood forest along the Schoharie Creek is being transformed into a biological research station available both the use of youth in the EST program and outside researchers and students interested in any aspect research within the watershed. The SRC is interested in creating a site that will foster and support research interest in the watershed by area and regional university students and faculty. The facility will enable short-term residency for researchers as well as access to onsite laboratory facilities, meeting space, and easy access to natural areas for research activities. The Environmental Center is located, on the Schoharie Creek (about ¼ mile frontage on the Creek) and very near over 3000 acres of protected NYS forest (Charleston State Forest) and nature preserve lands (300 acre) owned by the Hudson Mohawk Land Conservancy. For more information about the Schoharie River Center please contact John McKeeby, Executive Director, schoharierivercenter@juno.com or go to our website: www.schoharierivercenter.org.

Environmental Study Team 2010, Schoharie Creek

WATER RIGHTS IN THE BALANCE: THE MVWA VS. NYS CANAL CORP. DISPUTE

Frank Montecalvo
Consultant, West Canada Riverkeepers

The abundance of New York's water resources makes disputes over their use relatively rare compared to other parts of the country. However, we now have a regional dispute between the Mohawk Valley Water Authority (MVWA) and the State in the form of the New York State Canal Corporation (Canal Corp.). My intent is not to give an in-depth legal analysis but, rather, to place the dispute in an historical context that gives insight into why it developed, to report on recent legal proceedings, and to suggest potential outcomes for the future.

Most people in the Mohawk Valley are familiar with the Canal Corp., a subsidiary of the NYS Thruway Authority, which is responsible for operation of the state's canal system. Canal Corp. is the current successor to other state agencies, which were responsible for the canal system in the past.

MVWA is the successor to The Consolidated Water Company of Utica (CWCU) and the City of Utica. An entity created by the state legislature under the Public Authorities Law, MVWA owns and operates the public water supply system that serves approximately 130,000 people in the City of Utica and all or parts of 15 Towns and Villages located nearby in Oneida and Herkimer Counties. MVWA obtains all of its water from the Canal Corp.'s Hinckley Reservoir on the boundary of Herkimer and Oneida Counties, and this reservoir obtains its water from the West Canada Creek. It is the MVWA's use of the Canal Corp.'s reservoir that sets the stage for today's dispute. To understand how this evolved, we must look back more than 100 years.

In the late 1800s and early 1900s, the City of Utica was growing and needed a large, reliable supply of water to supplement its several smaller supplies. West Canada Creek, about 18 miles northeast in Herkimer County, could fill this need, so the CWCU went about acquiring water rights from riparian owners along the Creek. Many individual agreements were involved. Most were relatively short, and either just involved the exchange of money or had simple requirements that assured the landowner of sufficient water for livestock or crops located on the riparian tract of land. Others, however, were complex, particularly those involving mill or power company owners where flowing water is energy. Those agreements contained provisions intended to ensure that when the Creek's flow was naturally low, the effect of CWCU's use of the Creek would be mitigated. CWCU was required to either stop taking water or to release water into the Creek from a CWCU storage reservoir to make up for what it removed. This release is called a “compensating flow,” and the storage reservoir may be called a “compensating reservoir.” To meet these requirements, CWCU in 1906 constructed a 1.17 million gallon compensating reservoir at Gray, located on Black Creek, a tributary of the West Canada Creek.

At about the same time, to meet an increased commercial need, the State of New York decided to enlarge its canal system. This expansion required large, reliable supplies of water and the West Canada Creek was one of those chosen. The state appropriated lands and water rights, including some of those owned by CWCU, but reserved from the appropriation a flow of 100 cubic feet per second (cfs) for CWCU's purposes. The 25 billion gallon Hinckley Reservoir (state reservoir) was constructed to store water from the West Canada Creek for use in the canal. This cut CWCU off from its storage reservoir at Gray Dam. A number of lawsuits resulted from CWCU and the State both seeking the same resource.

The lawsuits were ultimately resolved by an agreement between CWCU and the State signed 12/27/1917 (the “Agreement”), which recited all their conflicts. The 1917 Agreement declared that “The flow of said water in West Canada creek is sufficient, if properly conserved and regulated to permit of its use for two public uses and purposes, to wit, canal uses and purposes, and as a source of water supply” for CWCU. Among its many provisions, the parties agreed that the State's appropriation of West Canada Creek water would be construed to reserve from the appropriation 75 cfs to CWCU rather than 100 cfs; that CWCU would be allowed to use the state dam and reservoir “as a settling basin and as a transporting agent for stored water from [CWCU's] storage reservoir or reservoirs” and would be able to take its flow from two 42" pipes in the state dam for municipal water supply purposes. The parties agreed that CWCU and its successors would "at all times" maintain a storage reservoir(s) above the state dam on West Canada Creek that would permit CWCU to fully comply with the provisions of certain attached earlier agreements with third party riparian owners, the intent being to maintain CWCU's relationship with those owners as if the state dam had not been built. The parties also agreed that, if CWCU or successors failed to provide and operate the storage reservoir(s), it would have NO right or authority to take water from the state reservoir or West Canada Creek above Trenton Falls, except in specified emergency situations.

The Agreement went on to express State's concern that the third party agreements might be changed, done away with, or construed to postpone or relieve CWCU's obligations to store water and make compensating flows. The state desired to fix and define a minimum low flow in the West Canada Creek "below which no water shall, under any circumstances or conditions (except as herein expressly provided for) be diverted by [CWCU], its successors, grantees, or assigns unless compensation or contribution be made." The parties mutually agreed that 335 cfs would be the "low flow" below which CWCU would be prohibited from taking water without it making a contribution. The parties also agreed that when CWCU's diversion averaged 25 cfs (10 cfs more than when the agreement was made), the dimensions of the compensating reservoir(s) would be enlarged to store not less than 2 billion gallons, and that for every additional 10 cfs taken, the reservoir(s) would be enlarged an additional 800 million gallons until the storage would be not less than 6 billion gallons [note: about ¼ the size of Hinckley] when the full 75 cfs is drawn. The Agreement reiterated that, if CWCU failed to provide and operate the storage reservoir(s), it had no right to take any water from the state reservoir or from the creek above Trenton Falls.

Utica continued to grow and acquired CWCU during the 1930s, after receiving a permit from the state's Water Power and Control Commission (now the Dept. of Environmental Conservation) to do so. At mid-century, Utica's population both peaked and its withdrawals had reached the 25 cfs threshold at which expansion of the storage reservoir was required. The city, 16 square miles in size, was essentially at full build-out. Perhaps Utica leaders tried to avoid an expense, realizing that an expansion of the storage reservoir would only benefit suburban municipalities. Perhaps no one enforced the compensating flow obligation (there is no clear evidence compensating flows were *ever* made). Perhaps there was confusion in the state as to who was responsible for enforcing the Agreement (e.g., the entity running the canals, the attorney general, or the entity supervising water supply systems). Perhaps the effects of non-compliance were not noticed among the fluctuations caused by the state's normal operation of its reservoir. Regardless of the reason, no expansion of Utica's storage reservoir was made or demanded.

The region's population continued to grow, as did withdrawals from Hinckley. In 1968 a comprehensive water supply study had been commissioned by Oneida and Herkimer Counties and the NYS Department of Health to ensure that the region's water resources would be properly managed to accommodate a regional population expected to grow to 800,000 by 2020. That Study acknowledged that Utica would need 6 billion gallons of storage capacity, if it were to take the full amount of water allowed under the Agreement with the state; and that even with the storage, the Utica area could face a water shortage if the region grew as predicted. The Study, however, may have been motivated by more than regional growth. A year earlier, in 1967, a comprehensive water supply study for the City of New York and Westchester County included plans to develop the Hinckley reservoir watershed for downstate use. By 1969, Utica's withdrawals had reached the 35 cfs threshold that required a second expansion of the storage reservoir. Perhaps people were waiting to see what New York City was going to do with Hinckley; perhaps no one noticed adverse effects from Utica's non-compliance with the storage and contribution requirements; or perhaps it was unclear who in the state should enforce the 1917 Agreement. Regardless, no expansion of the storage reservoir was made or demanded.

Something changed around 1970. Perhaps it was the reapportionment of the State Senate in the late 1960s, which reduced Upstate New York's voice in state government; perhaps it was the changes to state policy that followed; or perhaps it was due to other reasons; but the anticipated growth in the Utica area never materialized. Instead, the region began losing population, the Utica Water Board began losing customers, withdrawals from Hinckley started to drop, and financial pressures on municipal operations started to mount.

Utica allowed its dam at Gray to fall into disrepair. Due to safety concerns, about 1989 the gates to Gray Dam were fully opened, and it could no longer hold reserve flows. In the early 1990s, Utica built a costly new filtration plant near Hinckley to meet federal drinking water requirements. The city eventually abandoned all water sources other than Hinckley because it became impracticable to treat them.

In 1996, the City of Utica ceded ownership of its water supply system to the MVWA, due to financial considerations, after MVWA received a water supply permit from NYS Department of Environmental Conservation (NYSDEC) to assume ownership. The water supply permit was premised on MVWA's right to take water under the 1917 Agreement. Under pressure from NYSDEC safety concerns, MVWA in early September 2001 advertised that it was seeking a permit to demolish Gray Dam. Perhaps it was because the notice failed to mention that a water supply permit could be affected; or perhaps it was because people receiving the notice in September, 2001, had other things on their minds; but no one objected to the proposal to demolish Gray Dam. The dam was subsequently removed in 2002.

Shortly afterward, MVWA aggressively sought to expand its reach to obtain new customers. In 2002 it instituted a new cheaper rate tier for very high volume customers. In 2003 it entered an agreement to sell water to the Town of Verona, beyond its statutory service area. Although the agreement contemplated delivery of, at most, less than 2 million gallons per day (MGD), news accounts indicated that the proposed pipeline would be capable of delivering 7 MGD (almost 11 cfs), which would be a 1/3 increase over existing use. A 2003 MVWA bond prospectus indicated MVWA was courting the nearby City of Sherrill and Town of Vernon, both also beyond its statutory service area, as potential customers. It should be noted that under the 1968 Comprehensive Water Supply Study, none of these municipalities were to receive Hinckley Reservoir water. It should also be noted that Sherrill and Vernon were customers of other water suppliers, and that MVWA's NYSDEC permit prohibited it from competing with other water suppliers. In 2003, MVWA applied to DEC to expand service in four other towns.

Perhaps MVWA's aggressiveness woke people up to the idea that Hinckley Reservoir and their rights might be affected by MVWA's actions. People discovered the 1917 Agreement. People objected to MVWA's proposed expansions and registered them with NYSDEC. A power company served MVWA with a notice of claim, indicating MVWA's failure to make compensating flows was causing it harm. The Canal Corp. objected to expansions and demanded payments for the water taken from its Hinckley Reservoir.

MVWA responded in 2005 with a lawsuit against the State, the Canal Corp., and Erie Boulevard Hydropower (the power company) asserting seventeen causes of action. Canal Corp. and Erie filed counter claims. Discovery took place followed by various motions to dismiss or for summary judgment, as well as a motion to intervene by West Canada Riverkeepers and several individual property owners. Judge Hester made rulings in May 2009 on the various motions. The State and MVWA subsequently appealed to the Appellate Division, which handed down rulings during November, 2010, and, later, during February, 2011, denied a motion to reargue or for permission to appeal to the Court of Appeals. The matter is now back before Judge Hester.

It is easier to understand what happened and where we are now in the litigation by looking at the different legal theories the parties proceeded upon and what the courts did with them, rather than examine each pleading chronologically.

Regarding the potential intervention by Riverkeepers and others, Judge Hester denied the motion to intervene. Judge Hester found that based on his other rulings intervention was moot. He also found that the motion was untimely, noting that intervention was sought 2½ years after the litigation had commenced and after discovery had taken place without a reason given for the delay. This determination was not appealed, and the potential intervenors are now out of this specific litigation. They can, however, institute a separate proceeding to adjudicate their rights.

Regarding issues involving Erie Hydropower, MVWA sought a declaration against Erie alleging that MVWA acquired a prescriptive right against Erie to divert water without compensation to Erie (Causes 9, 17). This theory is similar to "adverse possession," where someone who builds a structure partially on your property after so many years acquires a right to leave it there. MVWA also sought a declaration under Environmental Conservation Law §15-0701 that its diversion was "harmless" as defined by that provision relative to Erie and, thus, was legal (Cause 16). Erie counterclaimed against MVWA for damages due to the reduction in flows through its turbines, due to MVWA's failure to make compensating flows. MVWA contended that in 1958 Erie's predecessor released MVWA's predecessor from any obligation to make compensating flows, thus barring Erie from seeking compensation now. MVWA also contended that Erie's common law right to flows in the West Canada Creek were abrogated by its own 1921 agreement with the State, where it essentially gave up those rights to the State. Erie moved for partial summary judgment against MVWA, and MVWA cross-moved for summary judgment against Erie. Judge Hester agreed with MVWA and concluded that Erie failed to establish the existence of any rights against MVWA with regard to the flow of the West Canada Creek at the Hinckley dam. Judge Hester also concluded that Erie had no right as a third-party beneficiary to enforce the reservoir or compensating flow requirements of the 1917 Agreement. Judge Hester, thus, did not have to reach the issues of potential prescriptive rights or harmless actions by MVWA. Judge Hester granted summary judgment to MVWA dismissing Erie's counterclaim. The Appellate Decision upheld Judge Hester, concluding that MVWA established that Erie has no rights against MVWA with regard to the flow of West Canada Creek at Hinckley Reservoir and that Erie raised no triable issue of fact. These rulings effectively take Erie out of the picture in future proceedings. They also suggest that others who may try in the future to claim third-party beneficiary status under the 1917 Agreement will be unsuccessful.

With potential interveners and the power company out of the way, we are left with plaintiff MVWA and the State defendants. Overall, MVWA wants a declaration that it has unconditional rights to take 75 cfs of water from West Canada Creek at Hinckley Reservoir. MVWA's claim of an unconditional right to draw water is based on (per Cause 1, MVWA's Second Amended Complaint) its original acquisition of property and riparian rights from landowners along the West Canada Creek prior to 1912, when the state filed its appropriation papers for the canal system; and (Cause 2) the appropriation map and CWCU's deed of its rights to the state, which did not give the state any ownership in the unappropriated 75 cfs of flow. Judge Hester rejected this theory and granted the State's motion to dismiss these causes, concluding that all of MVWA's riparian rights were surrendered and replaced with the rights and obligations that arise from the 1917 Agreement. This determination was not appealed. This ruling simplifies further litigation by making the 1917 Agreement the starting point for determining MVWA's rights.

MVWA alleged several causes of action based on statute of limitations, lack of material breach, and equitable concepts such as waiver, estoppel, assent and discharge, and laches. MVWA noted that it had never made compensating flows nor been asked to do so. It noted a lack of evidence that the 335 cfs "low flow" had ever occurred. It argued that DEC made it destroy Gray Dam while knowing that even if the entire contents of the Gray Reservoir were dumped into Hinckley, it would not be noticeable. It noted how the 25 and 35 cfs withdrawal thresholds had been crossed without anyone ever asking for an expansion of storage capacity. In essence, MVWA argued that any breach of the 1917 Agreement was insignificant, and, regardless, the state should not be allowed to enforce the Agreement now because no one from the state did anything to enforce it for some 90 years.

Judge Hester found MVWA's arguments persuasive – to a point. The judge noted that, while the Agreement required devices to measure MVWA's withdrawals from Hinckley and the flows released from the storage reservoir, no devices were required to measure the inflow into Hinckley. How would anyone know if the "low flow" level of 335 cfs had ever been reached – and the requirement for compensating flows triggered? Because of the lack of evidence of the need to ever make a compensating flow, the judge concluded that no violation of the compensating flow requirement had been proven, and the need for the storage reservoirs had not been established as well. Yet, the judge acknowledged that MVWA's rights were defined by the 1917 Agreement. The judge gave MVWA partial summary judgment for two causes of action (Causes 4 and 11) based on MVWA's arguments waiver and estoppel. In plain language, the judge would allow MVWA to do in the future what the State had allowed MVWA or its predecessors to do in the past without the need for any compensating flows or reservoirs. Judge Hester defined this as allowing MVWA to withdraw up to an average of 35 cfs without restrictions. Usage above that amount would require compliance with the 1917 Agreement. The judge dismissed the rest of MVWA's causes of action as "moot," and granted MVWA summary judgment dismissing all of the State's counterclaims.

The Appellate Division found that the court erred when it dismissed the State's first counterclaim, which alleged that MVWA was barred from taking water from Hinckley because it had breached the 1917 Agreement. The counterclaim was reinstated. The Appellate Division also found in error the partial summary judgment on Causes 4 and 11 which declared MVWA has the right to divert Hinckley reservoir water at a rate not to exceed 35 cfs without compensation. The State and MVWA both contended that the record did not support the 35 cfs number. The Appellate Division agreed and vacated the judge's declaration. The Appellate Division felt there was "conflicting evidence" whether MVWA's obligations under the Agreement were ever triggered by "low flow" conditions, which raised "triable issues of fact" whether the State defendants intended to relinquish their rights under the Agreement, whether they should be prevented from enforcing the Agreement, and whether the State's delay prejudiced MVWA such that laches should preclude the state from enforcing the rights. The Appellate Division also noted that the court dismissed four causes of action (numbers 6, 7, 13 and 14) among others as "moot," concluded that those causes must be reinstated, and that MVWA abandoned all others dismissed as "moot." Causes 6 and 13 allege that DEC's determination that Gray Dam constituted a safety hazard, and the knowledge that release of the entire contents of Gray Reservoir would not impact flows into or out of Hinckley Reservoir, were events that frustrated the purpose or made it impossible for MVWA to meet the compensation and reservoir provisions of the 1917 Agreement, thus relieving MVWA of those requirements. Causes 7 and 14 allege, among other things, that if there was a breach by MVWA, it was not material.

Other than narrow down the participants and identify the 1917 Agreement as the source of MVWA's rights, litigation thus far leaves a lot of significant issues for Judge Hester to resolve in the MVWA v. State dispute. Will the storage requirement be considered immaterial when withdrawals require expansion of storage to be almost ¼ the size of Hinckley? Will past immateriality of non-compliance excuse future non-compliance when impacts might be significantly greater? Does the State have a duty to remind MVWA of its obligations and to enforce the Agreement's provisions at all times, or only when breaches threaten serious consequences? We anxiously await Judge Hester's ruling.

WORKING TOWARD A WATERSHED MANAGEMENT PLAN: A PROGRESS REPORT FROM THE MOHAWK RIVER WATERSHED COALITION OF CONSERVATION DISTRICTS

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Coalition Chairman – 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."

By enacting the Erie Canalway National Heritage Corridor Act in 2000, US Congress created opportunities for the Mohawk Valley by 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 Oceans and Great Lakes Ecosystem Conservation Act of 2006 created a council of state agencies and charged the council with preparation of a report to the Governor to identifying actions to advance the principles of ecosystem-based management. This created the opportunity for the Coalition to address the watershed based needs of the region through the development of a **Comprehensive Watershed Management Plan.**

In 2009, the Coalition partnered with Montgomery County, which applied to the NYS Department of State, and was awarded a grant via the "Waterfront Revitalization Program" to do just that.

Since receiving the Environmental Protection Fund Local Waterfront Revitalization Program grant, the Coalition has begun preliminary work on creating a repository of GIS data layers for each county to inventory features of the natural basin, land uses, and pollution sources. The coalition has contracted with a consultant to evaluate and analyze local governmental roles, laws, programs and practices, related to the river and watershed. In the past few months the coalition has created a Watershed Advisory Committee (WAC), with the intent to involve stakeholders in the development of the watershed management plan. Several sub-committees have been formed, comprised of individuals that may specialize in a specific subject area. Recently the WAC created an education and outreach sub-committee to develop the framework for presenting the goals of the watershed management plan to the municipalities and the general public. This outreach committee has divided the Mohawk River Watershed into three distinct sub-regions for the purpose of bringing the message of the goals of the coalition to the watershed stakeholders. This will allow the districts the ability to deliver this message to different areas using a regionalized approach, as well as, solicit input from the communities as to local needs and concerns. Additional sub-committees will be formed to focus on agriculture, storm water, and other watershed issues including; invasive species, biodiversity, stream bank erosion, forestry, and wetlands.

The objective of writing this watershed management plan is to create an effective framework for future conservation focused work within the Mohawk Watershed, and to engage the public in the identification of actions to protect and restore the watershed. Members of the Coalition will use management strategies identified in the plan to support conservation initiatives within the region. The plan will be a spring board for implementation and program growth in the Basin, appealing to local, state and federal interests The Coalition, along with the individuals, NGO'S and state and federal agencies that make up the WAC will look to incorporate experience, knowledge and previously successful program methods to develop a sensible, workable plan for the Mohawk River Watershed.

For more information about the MRWCCD or its LWRP award, please contact the Coalition Chairman, David Mosher at SSWCD@nycap.rr.com.

WATERSHED BASED FLOODPLAIN COORDINATION AND OUTREACH

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The New York State Department of Environmental Conservation (DEC) is the state's National Flood Insurance Program coordinating agency. As such, DEC is responsible for working with communities to help them maintain full compliance with the Federal Emergency Management Agency's (FEMA) National Flood Insurance Program requirements. In return for federally backed flood insurance being available within a municipality, the town, city or village agrees to pass and enforce local requirements to reduce the risk of flooding to new and substantially improved development. DEC undertakes its responsibilities through community visits and other contacts, workshops, local law assistance and technical assistance. DEC also works with FEMA and local communities to help plan and adopt new flood maps.

After the 2006 floods, state agencies including DEC focused flood related activities on areas hit hard by those floods, including the Mohawk Basin. FEMA was able to access additional funding to develop a series of flood advisory maps in the Mohawk, Delaware and Susquehanna basins. As part of FEMA's flood map modernization effort, FEMA prioritized counties in the Mohawk Basin, including Montgomery, Herkimer and Oneida Counties, for development of updated digital Flood Insurance Rate Maps. DEC, under a Cooperating Technical Partner arrangement with FEMA, undertook county-wide flood mapping for Schenectady County.

The Digital Flood Insurance Rate Map products are not yet complete for Herkimer and Montgomery Counties. However, when the new products are delivered, there will be a need for outreach to affected communities to help them properly use the maps for floodplain development and planning purposes. In order to assist with that effort, DEC obtained a competitive grant from FEMA to utilize new digital mapping products to provide tools for communities to better manage their flood risk.

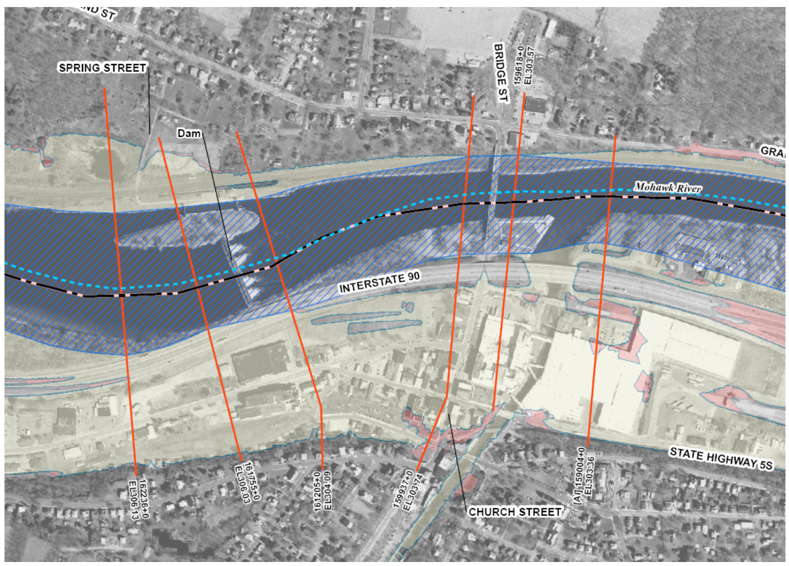
The project is just getting underway. Deliverables include the following:

- Utilize either preliminary or final digital Flood Insurance Rate Map data, or digital data from FEMA's flood advisory maps, to evaluate the number and types of structures that are at risk from floods of different magnitudes.
- Utilize historic flood information to evaluate community losses from flooding.
- Evaluate natural flood storage areas, including wetlands, that if preserved would help to reduce future flood losses.
- Identify properties most at risk for future flood damages and develop a prioritized list of properties for future flood mitigation efforts. Include an analysis of critical facilities that, if flooded, present a danger to human life or health, a long term risk to the regional economy, or a significant pollution hazard.
- Evaluate source areas for erosion and sedimentation that contribute to poor water quality that can be mitigated through appropriate floodplain and land use measures.
- Provide materials in the form of flood mitigation approaches that local communities may utilize as part of their hazard mitigation plans.
- Develop outreach materials for state, county and local government agencies, and for the general public. Materials for government agencies should include specific steps that can be taken within the Mohawk Basin to reduce future flood damages. Materials for the general public should include steps that residents and businesses could take to reduce the physical and financial threats of flood damage.
- The techniques and information materials developed will focus on the Mohawk River

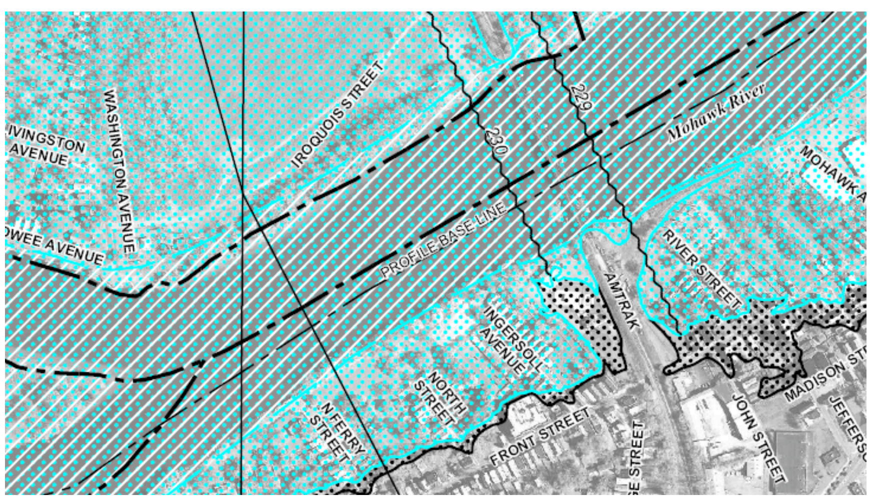
Basin, but should be easily adapted to other watersheds.

In developing this proposal for funding, the DEC Floodplain Management Section recognizes that it is unlikely that structural flood control measures can be developed that significantly reduce the risk of flooding to Mohawk River communities. Non-structural approaches, such as land use planning, flood-proofing or elevating buildings, and maintaining natural floodplains as much as possible, are a more effective, as well as cost effective way to minimize future flood damages. We also recognize that there are overlaps between water quality management approaches and flood risk reduction approaches. For example, wetland preservation helps improve water quality while absorbing flood waters. Poor land development techniques can lead to erosion, increasing sedimentation downstream, and increasing flood risk while degrading water quality.

A key component of the project will be a series of coordination and outreach meetings. A kick off meeting will be held with key state, county and regional officials. There will also be a symposium at which findings will be presented. Finally, there will be a session for the general public. We hope that the process will result in accurate and useful information for government bodies and the general public so that the nature of flooding is better understood and steps can be taken to minimize the future impact of flooding. Floods cannot be stopped. However, the devastation that floods bring can be reduced.



Flood Advisory Map, Montgomery County



Preliminary Flood Insurance Rate Map, Schenectady County

HIGH FREQUENCY MONITORING IN THE MOHAWK VALLEY

Alene Onion

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NYS Department of Environmental Conservation

High frequency monitoring captures rare events, rapid fluctuations, and episodic pulses which manual approaches to data collection cannot. It provides a robust baseline from which we can detect change and develop models to predict future conditions. A high frequency observational network is an essential tool for management efforts and the continued beneficial use of the Hudson River and its tributaries.

The Hudson River Environmental Conditions Observing System is a network of water quality and weather stations in the Hudson River collecting data at a high frequency and reporting this data in near-real time to a public website (www.hrecos.org). This network is operated by a consortium of government, academic, and NGO partners and is used for research, regulation, ecosystem management, river forecasting, navigation and education.

Proposed HRECOS Monitoring in the Mohawk River

The HRECOS team proposes a new monitoring station in the Mohawk River located at the Canal Corporation's lock 8. This station will report near-real time water quality and weather conditions and will be operated jointly by the USGS and the NYS DEC.

This station will benefit multiple users in the lower Mohawk valley and is actively supported by the Canal Corporation, Union College, Schenectady Office of Emergency Management and the National Weather Service.

Benefits to Flood Prediction

The lower Mohawk River has chronic ice jam problems. Conditions are particularly difficult between the Stockade District and Rexford Knolls where water levels have repeatedly risen fifteen feet or more (Garver and Cockburn, 2009; Marsellos, Garver and Cockburn 2010).

The new HRECOS station at the Lock 8 will allow us to provide advanced flood warnings to Schenectady County Emergency Managers. Water levels from this station will be compared to measurements collected at the USGS gauge at Freemans Bridge. When dramatic differences are observed, we will send e mail notifications to the emergency managers to notify them of a potential flood. Additionally, the National Weather Service will harvest this high frequency data to provide forecasts and life-saving flood warnings.

Benefits to Baseline Monitoring

High frequency monitoring at the HRECOS Mohawk station will help to improve existing models including weather models produced by the National Weather Service for the Eastern Mohawk valley. Most significantly, this data will establish a robust environmental baseline from which we can detect change including the impacts of climate and land use changes.

Benefits to Education

Remote monitoring has the unique advantage of providing students with a hands on experience from the classroom. As one enthusiastic supporter stated, "Giving students the experience with real data gives them the confidence to look into science careers more seriously. 'If I understand this and this is real then science is real.'"

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WATERSHED MANAGEMENT: CONSIDERING GROUNDWATER AND DEPENDENT ECOSYSTEMS

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New York's watersheds are under threat from pollution, aging infrastructure, habitat loss and fragmentation, as well as loss of agricultural and forestry land. To address these issues the New York Department of State (Department) provides hands-on professional assistance and, through Title 11 of the Environmental Protection Fund, matching grants for the preparation and implementation of watershed management plans. The Department's guidebook, Watershed Plans: Protecting and Restoring Water Quality, sets forth a framework for the characterization of the physical attributes of a watershed, identification and assessment of impairments and threats, analysis of gaps, and opportunities for improvement in local laws and practices to control nonpoint pollution and to protect water resources. Following this approach, with the Department's oversight, 37 intermunicipal watershed management plans have been completed or are underway throughout the state, covering 11,500 square miles, 21% of the state's land area, and involving 53 counties and over 458 communities. Led by municipalities, with the participation of other local and state agencies, and the increased involvement of Soil and Water Conservation Districts, the development of watershed plans continues to seek public input. The process benefits from the place-base knowledge of dedicated local residents, business owners, and non-governmental organizations, while considering state goals for water quality and availability.

Watershed characterization can go beyond the relationship between overland flow and surface water quality to arrive at a fuller representation of hydrology, reflecting the movement of water under the surface of the land, as well as over it. Many opportunities exist to further explore the connections between land cover, groundwater discharge, and dependent ecosystems including springs, groundwater-fed streams, certain wetlands, lakes, and nearshore coastal waters. As such, better knowledge of groundwater hydrology through watershed characterization can contribute to the protection of biodiversity. The watershed planning framework can also be used to prioritize adaptive responses to prepare for changes in the frequency and intensity of precipitation, including identification of forested areas providing flood attenuation functions.

Watershed analyses can draw upon many sources of data, including remote sensing, modeling, agency records, and the knowledge of local residents. Analysis of soils, land use, land cover and underlying geology, have been used to identify areas that are potentially vulnerable to groundwater contamination. These can be used to help refine management practices to be more protective and to help guide future activities into the most suitable locations.

In the Mohawk River Watershed, the preparation of a watershed management plan, led by the Mohawk Watershed Coalition of Conservation Districts, will use GIS technology combined with the expertise of project partners to perform suitability analyses to identify opportunities to reduce nonpoint pollution, encourage groundwater recharge and protection, promote habitat restoration, advance green infrastructure, and guide growth.

New sources of data are being integrated into the planning process as they are made available. As data are increasingly gathered regarding major water withdrawals, under Title 33 of ECL Article 15, New York will gain a greater understanding of groundwater resources, which can be applied to decision-making at the regional scale to meet the demands for drinking water, industry, and ecosystems.

Increasingly, watershed management plans across the state will need to address not only water quality but also water availability for both humans and ecosystems. The Department of State will continue to support the intermunicipal watershed management planning approach that is illustrated by the Mohawk River example. This effort has a strong component of public participation, builds upon the existing knowledge base and, where necessary, involves the collection and assessment of new data critical to forming successful adaptive management strategies.

SCHENECTADY COUNTY ENVIRONMENTAL ADVISORY COUNCIL

Mary Werner, Laura MacManus-Spencer, and Kathy Rowland

Board Members, Schenectady County Environmental Advisory Council

The Schenectady County Environmental Advisory Council (SCEAC) 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

Ongoing SCEAC activities related to these actions will be presented, including copies of the State of the Environment Report (2010 update) and 2010 Annual Report.