Compendium of Abstracts

Presented at the

2005 New York City Watershed Science and Technical Conference

September 21 & 22, 2005

Advancing the Science of Watershed Protection

George E. Pataki
Governor

Randy A. Daniels
Secretary of State

2005 New York City Watershed Science and Technical Conference

Advancing the Science of Watershed Protection

Holiday Inn Route 9
Fishkill, New York 12524

September 21-22, 2005

Sponsored by:

State of New York Department of Health

NYS Department of Environmental Conservation

NYS Department of State

Watershed Protection and Partnership Council

Watershed Agricultural Council
www.nycwatershed.org

CWC
Investing in the Catskills' Future

New York City Department of Environmental Protection
www.nyc.gov/dep

NYWEA

New York Section
American Water Works Association

TABLE OF CONTENTS

Due to space and time limitations, the following abstracts were not able to be presented at the 2004 conference:

INTRODUCTION AND ACKNOWLEDGMENTS

Dear Conference Participants,

In 1997, the signatories to the historic New York City Watershed Agreement formed a vast partnership to protect and enhance the New York City Watershed and the scores of communities living within it. Integral to this complex and ambitious undertaking has been an unprecedented array of Watershed protection and water quality monitoring measures, coupled with unparalleled efforts and resources devoted to understanding the science of watershed protection.

The New York City Watershed Science and Technical Conference was created as an annual opportunity to bring scientists together with watershed stakeholders and the public, to technically inform, exchange ideas, and present information collected regarding the protection of the nation's largest unfiltered surface water supply. While presenting new research findings and data, we believe that the conference will also serve to enhance technology transfer and increase coordination among the array of entities working to advance watershed science.

Earlier this year, a Call for Abstracts was made to agencies and stakeholders in and beyond the NYC Watershed. The resulting overwhelming response, coupled with a conference constrained by space and time, necessitated a process of review and selection by the Watershed Protection and Partnership Council's Technical Advisory Committee. The abstracts chosen by the Committee for presentation are included in this compendium.

In addition to all who submitted their scientific endeavors, we wish to thank the many agencies, professional organizations, and individuals who contributed to the success of this conference. It is our hope that all who attend will be edified by the scientific data presented, and inspired by the dedication and hard work of those who, each day, advance our insight into the science of protecting the drinking water for 9 million New Yorkers.

Respectfully,

William C. Harding
Executive Director, WPPC

For The Conference Sponsors:
- The New York State Department of Environmental Conservation
- The New York State Department of State
- The New York State Department of Health
- The Watershed Protection and Partnership Council
- The Catskill Watershed Corporation
- The Watershed Agricultural Council
- The New York City Department of Environmental Protection
- The New York Water Environment Association
- The New York Section of the American Water Works Association

The Simultaneous Detection of Intrinsic *Giardia* and *Cryptosporidium* (oo)cysts with Matrix Spike Recovery – The Good, the Bad, and the Texas Red!

Kerri A. Alderisio, Lisa A. Blancero and Debra Schwarz

A technical study was conducted to determine comparability between spiking with ColorSeed™ C&G and live *Giardia* and *Cryptosporidium* for protozoan matrix spike analysis. Since ColorSeed has not yet been approved for use with USEPA Method 1623, the initial objective was to validate ColorSeed while comparing it to the routine live spiking procedure used by the New York City Department of Environmental Protection's Pathogen Laboratory. The tricky part was getting it to work in our matrices. ColorSeed C&G is a promising tool for performing quality control measurements of (oo)cysts within one field sample. The red fluorescent (oo)cysts are identified as ColorSeed spike material during microscopic examination and are used to determine the percent recovery of the spiked organisms from the matrix. The organisms that do not fluoresce red, but do fit the requirements outlined by USEPA Method 1623 for identifying *Giardia* and *Cryptosporidium*, are counted as intrinsic organisms that originated from the environment. Upon examination of the first samples, it was evident that the fluorescein isothiocyanate (FITC) fluorescence was fading from the *Cryptosporidium* oocysts much more quickly with the ColorSeed spiked samples compared to DEP's routine spiked samples. Also, generally, ColorSeed samples processed entirely through Method 1623 resulted in Giardia cysts that appeared damaged when compared to samples analyzed with the live spike material. Oddly, these same distorted organisms had some variety of brilliant fluorescent red color when observed under the Texas Red filter, confirming that they were ColorSeed organisms. Conversely, analysts also recorded some ColorSeed cysts that were identified as *Giardia* under FITC when spiked into deionized water, but when further examined under a Texas Red filter, appeared a very dull red. Once the procedural areas of concern were identified, and method changes were introduced, improvements were observed in all of the aspects noted during the preliminary testing. Changing the stain improved FITC fluorescence, changing the Method 1623 elution buffer stopped the damage occurring to the cyst morphology, and as a result, the Texas Red fluorescence improved greatly. The percent recovery of the *Giardia* cysts also improved and became much more comparable to the recoveries seen with the routine method. Adaptations discovered during this experimentation have allowed for the potential to eliminate the need for a second sample to be collected and analyzed with each field sample when matrix spike recovery is required on non-regulatory samples. The result is an overall time saving procedure that does not compromise the recovery of (oo)cysts in matrices seen in the New York City Watershed.

Kerri A. Alderisio
New York City Department of Environmental Protection
Division of Water Quality Control
465 Columbus Avenue
Valhalla, NY 10595
Phone: (914) 773-4423
Fax: (914) 773-0365
Email: kalderisio@dep.nyc.gov

Lisa Blancero
New York City Department of Environmental Protection
Route 28A
Shokan, NY 12481
Phone: (845) 657-6080
Fax: (845) 657-6067
Email: lblancero@dep.nyc.gov

Debra Schwarz
New York City Department of Environmental Protection
P.O. Box 370
Shokan, NY 12481
Phone: (845) 657-6068
Email: schwartz@dep.nyc.gov

Molecular Tracers of Soot and Sewage Contamination in Streams Supplying NY City Drinking Water

Anthony K. Aufdenkampe, David Arscott, Charles L. Dow and Laurel J. Standley

As part of an extensive six-year stream-monitoring project of source watersheds to NY City drinking water supplies (http://www.stroudcenter.org/research/nyproject/index.htm), a suite of organic molecules were analyzed to assess the extent and sources of pollution to 110 stream sites distributed across all source watersheds. These molecular tracers included: polycyclic aromatic hydrocarbons (PAH), which target petroleum and combustion products; caffeine and fragrances (HHCB & ANTN) found in domestic products, which indicate the presence of septic or waste water treatment plant (WWTP) effluent; and fecal steroids, which track animal (farm or wildlife) and human fecal contamination. PAH contamination was substantial at a number of sites and appears to enter streams primarily as soot deposition. Caffeine appears to be a conservative tracer of human sewage and can be used to calculate non-point source (septic) inputs. Ratios of fecal steroids also appear conservative, and can be used to distinguish human from animal sources of fecal material to streams.

The Stroud Water Research Center (www.stroudcenter.org) is an independent, non-profit institution devoted to basic and applied research on streams and rivers in North America and beyond.

Anthony K. Aufdenkampe
Stroud Water Research Center
970 Spencer Road
Avondale, PA 19311
Phone: (610) 268-2153
Fax: (610) 268-0490
Email: aufdenkampe@stroudcenter.org

David Arscott
Stroud Water Research Center
970 Spencer Road
Avondale, PA 19311
Phone: (610) 268-2153
Fax: (610) 268-0490
Email: darscott@stroudcenter.org

Charles L. Dow
Stroud Water Research Center
970 Spencer Road
Avondale, PA 19311
Phone: (610) 268-2153, Ext. 259
Fax: (610) 268-0490
Email: cdow@stroudcenter.org

Laurel J. Standley
Watershed Solutions, LLC.
14845 SW Murray Scholls Drive
Suite 110, #518
Beaverton, OR 97007
Phone: (503) 524-3042
Email: www.watershed-solutions.com

Response of Fish Populations to Natural-Channel-Design Restoration in Streams of the New York City Watershed, 1999-2005

Barry P. Baldigo, Dana R. Warren, Sarah J. Miller, Thomas Baudanza, Walter Keller and Doug DeKoskie

Fish populations in five Catskill Mountain streams were surveyed annually from 1999 to 2005, 1-2 years before and 1-4 years after natural-channel-design techniques were used to restore unstable project reaches. Population and community responses to the restorations were assessed through Before-After-Control-Impact (BACI) analyses, which standardize changes in community characteristics at the various treatment (restored) reaches to normal year-to-year changes observed at unaltered stable-control reaches. Population and community indexes responded to restoration differently among streams due to unique initial habitat conditions, yet BACI analyses showed that natural-channel-design restorations did not affect total community density, but significantly increased community richness by more than 2 species, total biomass by about 7 g/sq m, and equitability by almost 50% on average in treated stream reaches. Community biomass was consistently dominated by sculpin or dace and sculpin populations before restoration and by trout populations (combinations of brown, brook, and rainbow) following restoration. The number of trout species and life-stages as well as the total number and biomass of trout populations generally increased in all restored project reaches. These findings demonstrate that natural-channel-design restorations appreciably improve the ability at Catskill Mountain streams to support well-balanced trout populations and fish communities.

Barry P. Baldigo
U.S. Geological Survey
425 Jordan Road
Troy, NY 12180
Phone: (518) 285-5605
Fax: (518) 285-5601
Email: bbaldigo@usgs.gov

Dana R. Warren
Department of Natural Resources
Fernow Hall
Cornell University
Ithaca, NY 14853
Phone: (607) 339-7401
Email: drichardwarren75@yahoo.com

Sarah J. Miller
New York City Department of Environmental Protection
71 Smith Avenue
Kingston, NY 12401
Phone: (845) 340-7518
Email: smiller@dep.nyc.gov

Thomas Baudanza
New York City Department of Environmental Protection
71 Smith Avenue
Kingston, NY 12401
Phone: (845) 657-5744
Email: tbaudanza@dep.nyc.gov

Walter Keller
Department of Natural Resources
Fernow Hall
Cornell University
Ithaca, NY 14853
Phone: (607) 652-3143
Email: Walter.Keller@dhs.gov

Doug DeKoskie
Greene County Soil and Water Conservation District
907 County Office Building
Cairo, NY 12413
Phone: (518) 622-3620
Email: doug@gc.swcd.com

Characterization of New York City-Owned Watershed Forests through Analysis of Remotely Sensed Forest Type Data

Todd R. Baldwin and Seth Lapierre

Vertical color-infrared aerial photography 1:15840 (1"=1320) was obtained in early spring 2003 across the entire NYC watershed area. Photos were manually interpreted using a stereoscope, creating polygons for each stand greater than 5 acres in size which was consistent in crown closure, size, and species composition. Conversion to a controlled digital forest cover type map was accomplished through orthorectification from existing DEP orthophoto coverage, ultimately producing seamless ArcInfo. coverage for each basin.

Data provided in attribute tables includes general vegetation type, distinguishes evergreen from deciduous, natural or planted, classifies by crown closure percent and height class and distinguishes the primary, secondary and tertiary species. Analysis of attribute data has allowed characterization of overall City-owned watershed forestland by these various attributes as well as the ability to distinguish differences by basin, MOA lands verses pre-MOA lands and begin to identify potentially high-risk forest conditions.

This tool has served as a basis for further refinement of current watershed forest management strategies, improving planning and decision-making City land.

Todd R. Baldwin
Watershed Forester
New York City Department of Environmental Protection
Division of Watershed Lands & Community Planning Land Management
71 Smith Avenue
Kingston, NY 12401
Phone: (845) 340-7586
Fax: (845) 340-8494
Email: tbaldwin@dep.nyc.gov

Seth LaPierre
Watershed Forester
New York City Department of Environmental Protection
Division of Watershed Lands & Community Planning Land Management
71 Smith Avenue
Kingston, NY 12401
Phone: (845) 340-7624
Fax: (845) 340-8494
Email: slapierre@dep.nyc.gov

Pressure as a Potential Indicator of Interference in the Recovery of Cryptosporidium spp. oocysts in Surface Water Samples Using Method 1623

Lisa Blancero and Kerri A. Alderisio

During field filtration at several sites in the New York City watershed, an increase in pressure on the filters was noticed. Preliminary data analysis of field filter pressure and the frequency of detection of Cryptosporidium oocysts indicated a slight signal of decreased recovery at increased filter pressures. It is believed that the sediment at these sites may have had an impact on the recoveries as well as the pressure increase on the filters. This sediment, Catskill clay, is different from other matrices that the lab has seen such as the Tennessee River Sediment used in USEPA performance testing samples. As a follow up, a study was designed in the laboratory to focus on the pressure aspect of sample collection and the effects of Catskill clay. Approximately 9.5 grams of a local matrix of Catskill clay was added to deionized water in the laboratory so that a maximum filter pressure recommended by the filter manufacturer (60psi) could be attained. Three filtration units were designed to filter three different 50L carboys simultaneously, each as an independent unit. Using the Catskill clay, the laboratory created matrix samples with each having a turbidity of 240 nephelometric turbidity units. Each of these matrix samples were spiked with flow cytometer counted Cryptosporidium oocysts obtained from Wisconsin State Laboratory of Hygiene and subsequently filtered at three different pressures (10psi, 25psi and greater than 50psi). Each of the filters was processed according to USEPA Method 1623: Cryptosporidium and Giardia in Water by Filtration/IMS/FA. Initial trials showed a decrease in oocyst recoveries by an average of 13% as the pressure increased from 10 psi to 50 psi. In an effort to increase overall recoveries, 5% sodium hexametaphosphate was added to the elution step. Although overall oocyst recoveries did increase, a significant decrease in oocyst recovery still occurred as the pressure on the filters increased. It is believed that these data may indicate the importance of recording pressure while collecting samples for protozoan analysis, as well as the need to be very familiar with the matrix of a sample in order to appropriately qualify the data produced at each collection site.

Lisa Blancero
New York City Department of Environmental Protection
Division of Water Quality Control
Route 28A
Shokan, NY 12481
Phone: (845) 657-6080
Fax: (845) 657-6067
Email: lblancero@dep.nyc.gov

Kerri A. Alderisio
New York City Department of Environmental Protection
Bureau of Water Supply
465 Columbus Avenue
Valhalla, NY 10595-1336
Phone: (914) 773-4423
Fax: (914) 733-0365
Email: kalderisio@dep.nyc.gov

Primary Productivity and Algal Biomass in NYC Drinking Water Reservoirs and Influent Streams

Thomas L. Bott, J. Denis Newbold, David B. Arscott and Charles L. Dow

Primary productivity was measured in 12 reservoirs and ecosystem metabolism at 17 locations in influent rivers over a 5-year period. The light and dark bottle oxygen change procedure was used in reservoirs and the open system diel oxygen change method in streams, with reaeration determined by propane evasion. Gross primary productivity (GPP) normalized for photosynthetically active radiation (PAR) ranged from 0.025 to 0.18 g O_2/mol quanta. Activity was greatest in the Cannonsville, Titicus, and Amawalk reservoirs and lowest in the Schoharie and Neversink. Gradients of primary productivity and chlorophyll *a* were measured in the Cannonsville, Amawalk, Muscoot, Titicus, New Croton, and Cross reservoirs. GPP per area in influent rivers ranged from 0.22 to 4.2 g $O_2 \cdot m^{-2} \cdot d^{-1}$. Activity was greater in west of Hudson (WOH) streams (highest rates in Bushkill, West Br. Delaware, Esopus) than in those east of the Hudson (EOH, lowest rates in the Kisco and the Muscoot at Baldwin). Respiration rates ranged from 1.6 to 12.5 g $O_2 \cdot m^{-2} \cdot d^{-1}$ and ranked similarly and the P/R ratios ranged from 0.43 to 0.58 in most WOH rivers, and from 0.17 to 0.38 in EOH rivers. After normalizing river GPP rates for incident PAR, highest rates (GPP/PAR) occurred in the Titicus and Muscoot Rivers, and lowest rates in the Cross and Kisco. Uptake of NH_3, PO_4, glucose, and arabinose was measured simultaneously with stream metabolism measures. Ammonia uptake was correlated with respiration rates. GPP/PAR in five reservoirs for the years 2000 – 2003 was compared with GPP/PAR in influent streams. Data for the Neversink and Schoharie reservoirs averaged 0.025 and 0.035, respectively, while values for the New Croton and Cannonsville reservoirs averaged 0.118 and 0.125, respectively. GPP/PAR was lower in the Kisco River (0.100), influent to the New Croton, and Neversink River (0.150), compared to the West Br. Delaware River (0.200), influent to the Cannonsville, and the Schoharie River (0.285). Results suggest that during those years the Delaware - Cannonsville system was nutrient saturated, generating high productivity in both river and reservoir, while the opposite occured on the Neversink system. Shade restricted productivity in the Kisco River, perhaps allowing nutrients to support high productivity in the New Croton reservoir, while high productivity in Schoharie Creek may have reduced nutrients delivered to that reservoir, reducing productivity. The Rondout river-reservoir system aligned between the Schoharie and Cannonsville systems. Nutrient flux data and watershed characteristics generally support these conclusions.

Thomas L. Bott
Stroud Water Research Center
970 Spencer Road
Avondale, PA 19311
Phone: (610) 268-2153, Ext. 224
Email: tlbott@stroudcenter.org

J. Denis Newbold
Stroud Water Research Center
970 Spencer Road
Avondale, PA 19311
Phone: (610) 268-2153
Email: jdenis@stroudcenter.org

David B. Arscott
Stroud Water Research Center
970 Spencer Road
Avondale, PA 19311
Phone: (610) 268-2153
Email: darscott@stroudcenter.org

Charles L. Dow
Stroud Water Research Center
970 Spencer Road
Avondale, PA 19311
Phone: (610) 268-2153, Ext. 259
Email: cdow@stroudcenter.org

Evidence of Climate Change in the Catskill Region and Implications for the New York City Cat-Del Water Supply

Douglas Burns and Julian Klaus

Widespread evidence indicates that the global climate has warmed during the past 100 years; this warming is largely attributed to greenhouse gas emissions that originate from the burning of fossil fuels. Several recently published papers show that climate change is also evident in the northeastern U.S. Measurements generally indicate that the climate of the northeast has warmed by 1 – 2°F during the 20th century, and that this warming trend has accelerated during the past 30 years. Accompanying warming is a lengthening growing season, earlier snowmelt, and decreased winter snowfall/rainfall at many sites in the northeast. The objective of this study was to evaluate climate change in the Catskill region and to describe the implications of any changes observed for the New York City Cat-Del water supply, the majority of which is derived from the region. Historical trends were determined through Mann-Kendall tests of single station air temperature and precipitation data for sites within 100 km of the Catskill region, and with at least 40 years of record. Additionally, historical trends were determined in stream runoff from 8 gaged sites located within the region that have at least 40 years of data. The day each year by which half the Jan. 1 to May 31 flow volume was recorded (WSCV) was evaluated as a general indicator of winter rain and snowmelt. The date in which WSCV was recorded moved significantly ($p < 0.10$) earlier in the year by a mean of 10 days since the 1950s at 3 of 8 sites examined. Three additional sites showed a potentially emerging trend ($p \sim 0.2 – 0.3$) towards an earlier WSCV date indicating that earlier high flow is becoming a regional pattern. Data from most of the precipitation measurement sites in the region showed two significant trends since the mid-20th century: (1) decreasing February precipitation, and (2) increasing September precipitation. Surprisingly, monthly streamflow did not show trends consistent with these precipitation trends; neither a significant decrease in February streamflow nor a significant increase in September streamflow was noted at any of the gages. Since February precipitation is dominantly snow, decreasing values may be reflected in slightly less runoff during February through April. A weak, but not statistically significant negative trend in April streamflow was present in 6 of the 8 streamflow records examined. Ongoing work is evaluating temperature trends in and near the Catskills, including data available from the U.S. Historical Climatology Network. Slide Mountain, a high elevation station in the headwaters of the Ashokan, Neversink, and Rondout Reservoirs has shown a strong warming trend since record collection began in 1961. Mean annual temperature has increased significantly by about 2°F, which is driven largely by a 4°F significant increase in the minimum daily temperature. Following completion of the climate trend analyses, implications for the New York Cat-Del water supply will be evaluated through water budget methods.

Douglas Burns
U.S. Geological Survey
425 Jordan Road
Troy, NY 12180
Phone: (518) 285-5662
Fax: (518) 285-5601
Email: daburns@usgs.gov

Julian Klaus
Institute of Hydrology
University of Freiburg
Germany

Demonstrating Multi-Objective Stream Restoration and Monitoring as Part of the Esopus Creek Stream Management Plan

Dan Davis and Gary Capella

NYCDEP and Ulster County Soil and Water Conservation District (UCSWCD) with project partners, U. S. Army Corps of Engineers, USDA Natural Resource Conservation Service and FIScH Engineering, Inc., sponsored a stream restoration project in 2003 on the Esopus Creek near Phoenicia, New York. The primary goal of the project was to address erosion and failure of approximately 500 feet of the left descending stream bank that was threatening property, posing a recreation hazard and degrading water quality. Rapid retreat of the stream bank (up to 3 ft/yr laterally) exposed highly erodible clay-rich glacial deposits and was an episodic source of suspended sediment in the stream. The restoration effort comprised natural channel design (NCD) components, traditional and experimental bank stabilization techniques, and bioengineering to meet the project objectives of stabilizing the bank, returning the stream to its recent historic alignment and enhancing recreation potential. Following successful yet challenging construction conditions, NYCDEP and UCSWCD have designed a monitoring and maintenance protocol and implemented the first year of post-construction monitoring and maintenance following minor damage from several flood flows since construction. Project design, construction and ongoing monitoring will be used as a demonstration of multi-objective stream restoration to add to development of the Esopus Creek Stream Management Plan, to be completed in 2007.

Dan Davis
New York City Department of Environmental Protection
Bureau of Water Supply
71 Smith Avenue
Kingston, NY 12401
Phone: (845) 340-7535
Email: ddavis@dep.nyc.gov

Gary Capella
Ulster County Soil and Water Conservation District
652 Route 299, Suite 103
Highland, NY 12528
Phone: (845) 883-7162, Ext. 5
Fax: (845) 883-7184

Stream Geomorphic and Watershed Assessment of Esopus Creek above Ashokan Reservoir

Dan Davis and Susannah Erwin

Efficient and effective stream corridor management is enhanced by optimized characterization and assessment of stream valley geomorphic and riparian condition to inform prioritization of management actions. As a FAD deliverable, NYCDEP is sponsoring development of a stream corridor management plan for the upper Esopus Creek (above Ashokan Reservoir). The Plan will summarize the resources and issues in Esopus Creek, prioritize needed action and provide recommendations for long-term stewardship. NYCDEP and Cornell Cooperative Extension of Ulster County (CCE) initiated the necessary watershed assessment and stream geomorphic characterization by implementing Phase 1 of the Vermont Agency of Natural Resources multi-phased stream geomorphic assessment protocols. Phase 1 utilizes available remotely sensed data, other mapped data, previous study results, and limited field observations to establish geomorphic-defined reaches, provisional stream classification, predictions of channel condition, adjustment process, and reach sensitivity. This effort served two purposes – initiating the actual assessment process for Esopus Creek and evaluating the efficacy of a multi-phased approach to stream corridor assessment. A Phase 1 assessment was successfully completed on the mainstem of upper Esopus Creek (26 miles), producing a comprehensive database and set of GIS projects containing detailed information on geomorphic and watershed characteristics and condition. The Phase 1 findings were evaluated by implementing Phase 2 (collection of field-based data) for three reaches. It is clear from this exercise that a phased approach is necessary for the size of the upper Esopus Creek watershed (192 mi^2) and results will be used to optimize field assessment phases, increasing the efficiency in informing the management planning effort. While the protocols used still need further testing to determine their applicability to the goals and needs of the NYCDEP stream management planning process, they do offer a structure that can be adapted to project conditions.

Dan Davis
New York City Department of Environmental Protection
Bureau of Water Supply
71 Smith Avenue
Kingston, NY 12401
Phone: (845) 340-7535
Email: ddavis@dep.nyc.gov

Susannah Erwin
Cornell Cooperative Extension of Ulster County
10 West Brook Lane
Kingston, NY 12401-2928
Phone: (845) 340-3990
Fax: (845) 340-3993
Email: ulster@cornell.edu

Catskill Watershed Corporation Septic Monitoring Program – Phase I

Thomas De John, P.E. and James Hassett

The Catskill Watershed Corporation (CWC) is a not-for-profit corporation that implements and administers various environmental protection, economic development, and community improvement programs throughout the portion of the New York City (NYC) watershed located west of the Hudson River (WOH watershed). This watershed and its six reservoirs are the primary source of drinking water for NYC as well as numerous other municipalities that adjoin the NYC aqueducts.

The goal of this research project is to provide information about the effectiveness of alternative onsite wastewater treatment technologies under local conditions to help designers and regulators select appropriate, cost-effective systems in the WOH watershed. CWC staff works with many septic systems that are on lots insufficient for NYS Department of Health 75-A conventional onsite systems standards due to poor soils, small size, proximity to watercourses, high groundwater, or steep slopes. The CWC Septic Monitoring Program will help promote use of the best available technology for long term control of sewage from on-site systems. This research project is designed to provide information to help answer the following questions:

Can alternative technologies remediate substandard absorption areas to an acceptable level (i.e., to dispose of wastewater to the subsurface)?

What is the performance (i.e., carbon, nutrient and pathogen removal) of such systems in real world conditions?

What is the cost of installation, operation and maintenance of various technologies?

Can these systems be provided proper maintenance, through septic maintenance districts or other mechanisms?

The National Research Council confirmed the need for such research in a draft report released in 1999 entitled "Watershed Management for Potable Water Supply: Assessing New York City's Approach". The report recommended greater use in the watershed of aerobic systems. The report states that other alternative technology such as peat filters, re-circulating sand filters, constructed wetlands and waterless systems may be as effective as aerobic units, but research is needed to verify this. The report further states that performance monitoring of septic systems can be difficult and has not been done in the NYC watershed on a regular basis.

For this research project, CWC and their consultant Project Team will monitor alternative technologies to replace or repair existing septic systems in difficult sites typical to the WOH area. In Phase I of this project the CWC will oversee installation of several alternative technologies including aerobic treatment, peat filters, sand filters, raised systems as well as conventional 75-A systems at up to 38 sites. In Phase II the Project Team will sample subsurface soil water and pretreated effluent at twenty select sites over a one year period to observe the level of treatment provided. This presentation will report on Phase I of this project including aspects of equipment design and system installation as well as site selection criteria and preliminary sampling results (if available). The importance of this research lay not only in the system types and sites tested but also the significant number of systems of each type in a single coordinated research project.

Thomas De John, P.E.
Project Manager
Catskill Watershed Corporation
905 Main Street
P.O. Box 569
Margaretville, NY 12455
Phone: (845) 845-1400
Fax: (845) 845-1401
Email: tdejohn@cwconline.org

James M P. Hassett, Professor and Chair
Project Team Director
Faculty of Environmental Resources and Forest Engineering
Director, Division of Environmental Science
College of Environmental Science and Forestry
Syracuse, NY 13210
Phone: (315) 470-6637
Fax: (315) 470-6958
Email: jhassett@esf.edu

Applicability of Publ]ished Phosphorus Loading and Reduction Data to the Stormwater Regulatory Program in the New York City East of Hudson Watershed

John Drake and Mary Galasso

Sources such as the National Pollutant Reduction Program Database and the International Stormwater Best Management Practices (BMP) Database have been established to provide the stormwater industry with readily accessible information as to the efficiency of stormwater treatment practices. Review of these databases and additional stormwater literature indicate that reported studies span a wide range of variables such as project scale, sampling method, sampling frequency, stormwater practice design criteria, regional and seasonal considerations. The specific applicability of available literature to stormwater management practices commonly implemented in the New York City East of Hudson watershed is examined.

Stormwater pollution prevention plans prepared to meet the requirements of the New York City Regulations regarding the effects of stormwater discharge from regulated activities must currently demonstrate, among other things, that the quality of runoff after development is not substantially altered from pre-development site conditions. This is demonstrated by comparing pre and post development estimates of constituents modeled for a defined drainage area. Generally, pollutant reduction must be demonstrated prior to discharge into the waters of the State of New York. Although project size can vary greatly, resulting drainage areas are often small in scale.

While pollutant loading and reduction data are available for many identified pollutants, phosphorus is selected for review. The selection was based both on the propensity of data reported for the constituent and mandated phosphorus limitations within the East of Hudson watershed. Published data for phosphorus loading and reduction are reviewed based on information available as to drainage area size, sample method, location and frequency, and stormwater practice type. Where the information is provided, design criteria, age of practice, and regional and seasonal variations are evaluated.

Analysis of the published data could provide relevant information regarding the efficiency of stormwater management practices commonly implemented in the NYC watershed. The applicability of the findings of this literature review to stormwater management concerns in the East of Hudson watershed is discussed.

Mary P. Galasso
New York City Department of Environmental Protection
Bureau of Water Supply
465 Columbus Avenue
Valhalla, NY 10595
Phone: (914) 773-4440
Email: mgalasso@dep.nyc.gov

John Drake
New York City Department of Environmental Protection
Bureau of Water Supply
465 Columbus Avenue
Valhalla, NY 10595
Phone: (914) 742-2025
Email: jdrake@dep.nyc.gov

Aqueous Two-Phase Polymer Partitioning of Surrogate Particles and *Cryptosporidium* sp. Oocysts: Proof-of-Concept Studies

David M. Dziewulski and Erik Ruff

Aqueous two-phase partitioning, an old industrial separation method, has recently become a popular method for studying and separating biological particles and macromolecules. Partitioning using polyethylene glycol (PEG) has been very useful for separating proteins and nucleic acids from cell, and other, debris. The technique separates cells and biological materials based on surface characteristics including charge or hydrophobicity. The main objective in this work was to develop one or more aqueous two-phase systems (ATPS) capable of partitioning *Cryptosporidium* oocysts from natural surface waters into target polymer phases. This was initially done by testing different ATPS using polystyrene microspheres as surrogates of *Cryptosporidium* oocysts. After an extensive literature review, ATPS development was designed to take advantage of the surface charge or hydrophobic characteristic of the surrogates or *Cryptosporidium*, and partition them into small volume target polymer phases using an hydrophobic (PEG-phosphate salt system; PPS) or an hydrophilic (PEG and dextran; DxPS) polymer system. Polymers of different molecular weights and different concentrations of NaCl and phosphate salts were used during system development. Polystyrene (PS) particles and carboxylated PS, 4.5-micron diameter, respectively were used as hydrophobic and charged surrogates of *Cryptosporidium*. Stepwise testing was done using particle loadings ranging from $>10^6$ down to approximately 10^2 particles per 100 ml. It was found that the PPS system was more amenable to recovery of both types of particles while the dual polymer systems discriminated between hydrophobic and charged particles. In the PPS system, hydrophobic particles (PS) seeded with 127 to 162 particles, preferred the hydrophobic upper PEG target phase (77.7% " 17.8% recovery). Carboxylated particles also preferred the same phase because they were rejected by the highly negatively charged bottom phase that contained most of the salts (87.3% " 7.8% recovery). The dual polymer system showed less efficient, but very predictable, recovery even when the component concentrations were modified. Carboxylated particles were recovered in the hydrophilic bottom target phase containing dextran (range = 44.6 47.3%). Hydrophobic particles partitioned into the upper PEG phase (range = 51.1 58.3%). Formalinized oocysts were also tested and the majority favored the salt-rich bottom phase of the PPS system and the bottom target phase of the PEG-dextran ATPS. This indicated that the formalinized oocysts were either neutral or slightly charged. Microelectrophoresis confirmed that these oocysts had little mobility and, therefore, had near neutral charge. The PS particles, being hydrophobic, showed no mobility and the carboxylated PS had Zeta potentials of 4.4 " 2.9 mV. Additional testing was done using EasySeed oocysts (BTF Pty. Ltd.). Since these oocysts are gamma irradiated, they are claimed to mimic oocysts occurring in the environment. Preliminary studies using 100-ml ATPS showed that these oocysts partitioned into the hydrophilic dextran phase of the DxPS system (43.3 " 17.9%) and scale up to 500-ml resulted in 50.83 " 21.1% recoveries. This indicated that the oocysts of the EasySeed preparation were also neutral or slightly charged. The method shows promise for use in the recovery of oocysts from relatively small volumes of highly compromised water samples.

David M. Dziewulski
NYS Department of Health
Bureau of Water Supply Protection
547 River Street
Flanigan Square, Room 400
Troy, NY 12180
Phone: (518) 402-7711
Fax: (518) 402-7659
Email: dmd14@health.state.ny.us

Erik Ruff Environmental Associates, Ltd.
24 Oak Brook Drive
Ithaca, NY 14850
Phone: (607) 272-8902

* Material included in this abstract is from:

Ruff, Erik, Aqueous Two-Phase Polymer Separation of Cryptosporidium Oocysts and Surrogate Particles, Thesis, Master of Science, State University of New York at Albany School of Public Health, Department of Environmental Health and Toxicology, August 2004. Safe Drinking Water Act Grant, USEPA ID No.X-99273800.

Development, Testing and Application of Models to Address Temperature and Turbidity Issues in Schoharie Reservoir

Steven W. Effler, Rakesh K. Gelda, Emmet M. Owens, Susan M. O'Donnell, David M. O'Donnell, MaryGail Perkins, David G. Smith and Donald C. Pierson

Contemporary water quality issues for Schoharie Reservoir include the temperature (T, ºC) and turbidity (Tn, NTU) of water withdrawn that enters Esopus Creek. Several engineering alternatives are under consideration to avoid the discharge of warm or turbid water to the creek, including: (1) an in-reservoir baffle positioned to increase travel time from the primary tributary to the intake, and (2) replacement of the existing single depth intake with a multi-level facility. Credible mathematical models are required to evaluate these alternatives and guide design. The integrated program of monitoring, progress studies, and modeling that is being conducted to meet these needs is described. Key findings from the monitoring program, documentation of successful model testing, and preliminary results of model applications, are presented.

Modern monitoring techniques including the use of rapid profiling instrumentation, that supports two- and three-dimensional resolution of Tn patterns over short space and time intervals, and robotic monitoring units, that provide continuous measurements of key parameters for both the primary tributary and within the reservoir, were implemented. Conspicuous increases in reservoir Tn are reported following runoff events, associated with the entry of large quantities of terrigenous minerals form Schoharie Creek. These inputs are carried in plunging density currents, and are shown to impart distinct Tn patterns in time and space. The robotic network, that is capable of delivery data to off-site locations in near-real-time, is described and example resolved signatures of runoff event impacts are presented. This monitoring information supports modeling by specifying drivers and state variable patterns.

Documentation of successful testing of two-dimensional hydrothermal/hydrodynamic and three-dimensional hydrodynamic models for the reservoir is presented. The credibility of the two-dimensional model to simulate the seasonal thermal stratification regime and the T of withdrawn water is demonstrated for a 15 year period. Additionally, this model and the three dimensional model are demonstrated to successfully simulate the behavior of density currents in the reservoir. Finally, the successful testing of a two-dimensional Tn model for the reservoir is documented.

The tested models are being applied to evaluate the potential benefits of an in-reservoir baffle and a multi-level intake facility. The baffle alternative is being evaluated with the three-dimensional model because of the proposed configurations. The effects of three different baffle lengths on the transport of a conservative tracer from the mouth of Schoharie Creek to the intake are considered. Reduced peak concentrations and increased time of travel are predicted for the baffle configurations. A predictive framework, composed of the two-dimensional water quality (T and Tn) model linked to a heuristic optimization algorithm, is applied to identify multi-level configurations that avoid high T and minimize Tn in the reservoir withdrawal. Simulations of the effects of a multi-level intake facility on the reservoir's stratification regime are also presented.

Steve Effler
Upstate Freshwater Institute
P.O. Box 506
Syracuse, NY 13214
Phone: (315) 431-4962, Ext. 102
Fax: (315) 431-4969
Email: sweffler@upstatefreshwater.org

Rakesh K. Gelda
Upstate Freshwater Institute
P.O. Box 506
Syracuse, NY 13214
Phone: (315) 431-4962, Ext. 120
Fax: (315) 431-4969
Email: rkgelda@upstatefreshwater.org

Emmet M. Owens
Civil and Environmental Engineering Department
Syracuse University
Syracuse, NY 13244

Susan M. O'Donnel
Upstate Freshwater Institute
P.O. Box 506
Syracuse, NY 13214
Phone: (315) 431-4962, Ext. 121
Fax: (315) 431-4969
Email: susanod@upstatefreshwater.org

David M. O'Donnell
Upstate Freshwater Institute
P.O. Box 506
Syracuse, NY 13214
Phone: (315) 431-4962
Fax: (315) 431-4969

MaryGail Perkins
Upstate Freshwater Institute
P.O. Box 506
Syracuse, NY 13214
Phone: (315) 431-4962
Fax: (315) 431-4969

David G. Smith
New York City Department of Environmental Protection
465 Columbus Avenue
Valhalla, NY 10595
Phone: (914) 773-4437
Fax: (315) 431-4969
Email: smithD@dep.nyc.gov

Donald Pierson
New York City Department of Environmental Protection
918 Ulster Avenue
Kingston, NY 12401
Phone: (845) 340-3294
Email: DPierson@dep.nyc.gov

Using the Regulatory Process to Minimize the Potential for Erosion and Sedimentation During Construction – a Case Study

Mary P. Galasso

Stormwater pollution prevention plans prepared to meet the requirements of the New York City Watershed Regulations typically include construction sequencing and erosion and sediment control plans. The detail to which these elements are addressed in the regulatory process is relative to the complexity of the project. For a municipal complex in the East of Hudson watershed, extensive cut and fill balancing was necessary to convert the site from a hilly, forested site with local wetlands and watercourses to a level municipal campus. Through DEP's regulatory review process, the details of phasing the cut and fill balances, interim grading and associated erosion control practices were established as part of the construction sequence prior to approval of the project and ensuing construction. As with any project, modifications to the sequencing and erosion control measures were anticipated during construction.

No water quality violations were reported during construction. No work stoppages were attributed to water quality concerns. Successful implementation of the phasing, sequencing and associated erosion controls was the result of several key factors including good communication between the various stakeholders, (i.e., DEP, town officials, construction managers, contractors), adherence to the approved construction sequencing and erosion control plan, and flexibility of stakeholders in adjusting the plan as required by unforeseen circumstances. Construction is completed and all temporary measures have been removed.

Mary P. Galasso
New York City Department of Environmental Protection
Bureau of Water Supply
465 Columbus Avenue
Valhalla, NY 10595
Phone: (914) 773-4440
Email: mgalasso@dep.nyc.gov

Land Use and Nutrient Loading in the Cannonsville, Pepacton and Schoharie Watersheds

Myrna H. P. Hall, Charles A. S. Hall, and Maria Josefson

In our effort to understand the connections between land use change and water quality in the New York City West of Hudson watersheds we have examined the possible correlation between water quality measurements and land use types, road density, and soil factors in sub catchments of three of the six drainage basins. These include the Cannonsville, Pepacton, and Schoharie systems. Analyzing change in land use versus water quality *over time* should be straightforward. However, time series analysis of this data set is problematic, due to inconsistencies in the methods used for water quality data collection, timing of collection relative to events, continual changes in laboratory methods and analysis, extended time periods where no sampling was undertaken, and "noise" introduced by introduction of wastewater treatment facilities and their recent upgrades. Therefore, for this initial analysis, we have analyzed these relations for just one water year, 2001-2002. Specifically we regressed the average annual concentration of 8 constituents versus a variety of candidate causal factors lumped by sub-basins within each of the watersheds. Land use data for this period of time is derived from a 2001 ETM7 classified satellite image. Our findings to date in the Cannonsville indicate that percent "urbanized area" explains 63 % of the variation in TDP concentration in that catchment. Five factors combined – percent urbanized, percent agriculture, percent forest cover, road density and the average sub-basin soil permeability (K factor) yield an R^2 of 0.96 for the twelve sub-basins where we have available a complete 12-month data inventory. We calibrated a predictive model using 6 randomly selected sub-basins, stratified by size, and predicted TDP for the 6 other sub-basins. The model predicted the TDP of the second set of watersheds with an R^2 of 0.70. Results for additional nutrients and additional watersheds are underway, and will be reported in this presentation in September. An important preliminary conclusion appears to be that if we are going to be able to calibrate water quality models as a function of projected land use change, sampling should be concentrated over the duration of an event rather than distributed evenly over the year because the data reveals that nutrient concentrations tend to be much higher during spring flushing and other events as opposed to low background summer and fall levels.

Myrna H. P. Hall
Assistant Professor
Faculty of Environmental Studies
SUNY College of Environmental Science and Forestry
One Forestry Drive
Syracuse, NY 13210
Phone: (315) 470-4741
Email: mhhall@esf.edu

Charles A. S. Hall
Professor
Faculty of Environmental Forest Biology
SUNY College of Environmental Science and Forestry
One Forestry Drive
Syracuse, NY 13210
Phone: (315) 470-6870
Email: chall@esf.edu

Maria Josefson
Graduate Program in Environmental Studies
Faculty of Environmental Studies
SUNY College of Environmental Science and Forestry
One Forestry Drive
Syracuse, NY 13210
Email: mjosefso@syr.edu

Nitrogen Immobilization by Woodchip Application: Protecting Water Quality in a Northern Hardwood Forest

Peter M. Homyak, Dr. Douglas A. Burns, Dr. René H. Germain, Dr. Russell D. Briggs and Dr. Ruth D. Yanai

Forest harvesting can have negative effects on stream water quality. Vegetation removal has been shown to disrupt the nitrogen cycle, which can adversely affect stream water quality by increasing nitrate and ammonium concentrations. This can result in lowered pH, reduced ANC, and mobilization of aluminum and base cations from the forest floor. A practice that increases the immobilization of N after forest harvesting should reduce nitrification and thereby reduce nitrate flux to streams. Woodchips have a high C:N ratio, which promotes the immobilization of N as the chips decompose. We tested the potential of woodchips to reduce these adverse water quality changes after forest harvesting. We hypothesized that the addition of woodchips from the logging slash that is typically left behind after a harvest would be sufficient to prevent elevated nitrate concentrations and associated water quality changes in soil solution. Five 0.2 ha patches were clearcut in August 2004 in the Frost Valley YMCA Model Forest located in the Neversink Reservoir Watershed in Claryville, NY. Three treatments were implemented in triplicate in 9×9 m plots in the clearcut patches. In one treatment, woodchips were applied to the soil surface at a rate equivalent to the amount of slash smaller than eight inches in diameter (1x treatment). A second treatment doubled that amount, (2x treatment) and a third treatment received no chipped slash (0x treatment). Additionally, three unharvested reference plots were established in forested areas located between clearcut patches. Woodchips primarily consisted of sugar maple (*Acer saccharum*), American beech (*Fagus grandifolia*), and yellow birch (*Betula alleghaniensis*). Ion exchange resin bags (IONAC.NM-60H^+/OH^- form, Type I, Beads) were buried for seven-week periods over the growing season to monitor soil N dynamics at each of the plots. Seven weeks after harvesting, NO_3- concentrations in the clearcut patches were 4 times greater than in reference unharvested plots. The woodchip applications reduced NO_3- concentrations to about 70% of the 0× treatment, but not as low as those in the unharvested reference plots. Preliminary evidence indicates that N immobilization is likely occurring in the 1x and 2x wood chip treated plots; further monitoring of these plots in 2005 will provide evidence of whether the application of woodchips has potential as a management practice to protect water quality during forestry operations.

Peter M. Homyak
SUNY ESF
341 Illick Hall
One Forestry Drive
Syracuse, NY 13201
Phone: (315) 470-4850
Email: Petehomyak@aol.com

Dr. Douglas A. Burns
U.S. Geological Survey
425 Jordan Road
Troy, NY 12180
Phone: (518) 285-5662
Email: daburns@usgs.gov

Dr. René Germain
SUNY ESF
222 Marshall Hall
One Forestry Drive
Syracuse, NY 13201
Phone: (315) 470-6698
Email: rhgermai@esf.edu

Dr. Russell Briggs
SUNY ESF
358 Illick Hall
One Forestry Drive
Syracuse, NY 13201
Phone: (315) 470-6989
Email: rdbriggs@esf.edu

Dr. Ruth D. Yanai
SUNY ESF
346 Illick Hall
One Forestry Drive
Syracuse, NY 13201
Phone: (315) 470-6955
Email: rdyanai@mailbox.syr.edu

Characterization of Phosphorus Loading Source Areas in a Monitored Dairy Farm Landscape, Five Years After Implementation of Best Management Practices

W. Dean Hively

Two years of field data collection, along with ongoing site records, provided the basis for characterization of phosphorus (P) loading source areas throughout a 160-ha monitored dairy farm watershed located in the headwaters of Cannonsville Reservoir, a New York City (NYC) drinking water supply. Best management practices (BMPs) that were implemented on the farm using the NYC Watershed Agricultural Program's Whole Farm Planning process resulted in a 43% reduction in watershed TDP loading over a four-year monitoring period (1), but at the time of sampling it was evident that several P loading problem areas remained. A program of soil and water sampling was therefore employed to characterize P loading sources and processes throughout the landscape. Grabsamples (n=75) of surface runoff and stream flow were collected at various locations throughout the farm during baseflow, rainfall, and snowmelt. Observed runoff concentrations of total dissolved phosphorus (TDP) were elevated at near-barn locations, roadways, and tile drains; were moderate at intensively managed field locations; and were low at extensively managed and forested upper-watershed locations. Soil samples (n=78) were collected throughout the watershed at field and non-field locations. Soil test phosphorus (STP), which rainfall simulation had shown to correlate with TDP concentrations in surface runoff (2), generally increased with proximity to the barn and with frequency of manure application. Only near-barnyard soils exhibited excessive levels of STP. Stream sediment samples (n=41) exhibited low STP in upper stream reaches, with increasing P enrichment in the lower watershed and downstream from the barnyard. Sample results assisted in the development of P extraction coefficients for landscape types throughout the farm watershed that were used for hydrological modeling of TDP loading processes (3,4). Additionally, field observations were used to characterize the magnitude of P load contributions from ten specific source areas including roadways, barnyards, barnyard filter areas, stream crossings, wetlands, and forests. A second round of BMPs, implemented in 2002-2003, have since corrected many of the identified P loading problem areas.

Citations:

1. Bishop, P.L., W.D. Hively, J.R. Stedinger, J.A. Bloomfield, M.R. Rafferty, and J.L. Lojpersberger. 2005. Multivariate analysis of paired watershed event data to evaluate agricultural BMP effects on streamwater phosphorus. Journal of Environmental Quality 34(3).
2. Hively, W.D., R.B. Bryant, and T.J. Fahey. 2005. Phosphorus concentrations in runoff from diverse locations on a New York dairy farm. Journal of Environmental Quality 34(4).
3. Gérard-Marchant , P., W.D. Hively, and T. S. Steenhuis. Distributed hydrological modeling of an agricultural landscape. [Manuscript in review]
4. Hively, W.D., P. Gérard-Marchant, and T. S. Steenhuis. Distributed hydrological modeling of dissolved phosphorus transport in an agricultural landscape. [Manuscript in review]

W. Dean Hively
Research Associate (Soil Scientist)
USDA-ARS Environmental Quality Laboratory Building 007
Room 214
BARC-W 10300 Baltimore Avenue
Beltsville, MD 20705
Phone: (301) 504-9031
Email: HivelyD@ba.ars.usda.gov

Project Review of City Owned Facility Construction Projects for Compliance to Stormwater and Erosion and Sediment Control Standards

M. Penny Kelly

New York City Department of Environmental Protection has a program to upgrade city water supply facilities of the Bureau of Water Supply (BWS) that are handled through Bureau of Environmental Engineering (BEE). The DEP is in the unique position of being charged with regulating activities in the watershed as well as a facility operator entrusted to deliver high quality drinking water.

Because these projects are inherently proposed in and around water, erosion and sediment controls are imperative to avoid causing a contravention of the water quality. It is a goal of the agency that these upgrade projects are constructed in compliance with stormwater management and erosion and sediment control practices as required by the rest of the regulated community. These projects require the preparation and implementation of a stormwater pollution prevention plan, with the erosion and sediment control plan the most important component. BWS involvement in the contract process has enabled City projects to comply with New York state water quality regulations as well as our own regulations.

To achieve this goal, BWS has initiated a dialog with BEE during the contract design and into the review and approval process. Once the project is awarded, BWS maintains the dialog with the contract and observes the work, and provides input through project completion.

M. Penny Kelly
New York City Department of Environmental Protection
Bureau of Water Supply
465 Columbus Avenue
Valhalla, NY 10595
Phone: (914) 742-2090
Email: mpkelly@dep.nyc.gov

Phase II: Toxicity Identification Evaluation (TIE) of Seventeen Minor (<0.5 MGD) Wastewater Treatment Facilities (WWTFs) Located within the New York City Watershed (NYCWTS).

Edward J. Kuzia and Nicole D. Wright.

In 2000-2001, an aquatic toxicity testing program was implemented at thirty-nine minor treatment facilities consisting primarily of small rural municipalities, residential housing and office complexes, interstate rest areas and ski resorts located within the NYCWTS. Whole Effluent Toxicity (WET) testing was conducted at these small facilities according to Environmental Protection Agency (EPA) and New York State Department of Environmental Conservation (NYSDEC) guidelines, per the State Pollutant Discharge Elimination Systems (SPDES) permit strategy used for large facilities, in order to assess potential receiving water impacts. The results of Phase I investigations indicated that after four quarters of Tier II chronic toxicity testing, 74% of the minor NYCWTS facilities demonstrated unacceptable levels of toxicity in their effluent, as indicated by a final test failure rate of >50% (or >2 out of 4 failed quarterly tests). In most instances, the observed toxicity was not entirely attributable to common toxicity parameters such as ammonia. Elevated conductivity levels, as well as total suspended solids were also associated with effluent toxicity in some cases. Because the majority of facilities in this drainage have little or no available dilution, more stringent pass/fail criteria are required including no chronic toxicity in 100% effluent. However, much of the observed toxicity was extreme with No Observed Effect Concentrations (NOECs) of <6.25% effluent. Data analysis using the more typical average stream flows over the last ten years versus the more conservative 7Q10 flows, subsequently increased the dilution available, resulting in a 43% decrease in the number of facilities exhibiting unacceptable levels of effluent toxicity. However, this also indicated that for the remaining 31% of facilities, some significant aquatic toxicity issues persisted. As a result, using the WET testing results from Phase I, seventeen out of the original thirty-nine facilities were selected for additional investigation in 2004-2005 for Phase II TIE work, in order to identify the cause(s) of the previously observed effluent toxicity. Although the TIE work will not be completed until the end of the year, preliminary results indicate that effluent toxicity is still present at some of the facilities tested thus far, and in a few cases again appears severe. Two facilities have demonstrated extremely low final effluent pH values, while one facility contained elevated ammonia which is presumably responsible for the observed toxicity. Results and conclusions will be presented to date, as well as recommendations for follow-up work discussed.

Edward J. Kuzia
NYS Department of Environmental Conservation
Toxicity Testing Unit
Hale Creek Field Station
182 Steele Avenue Extension
Gloversville, NY 12078
Phone: (518) 773-7318, Ext. 3011
Email: exkuzia@gw.dec.state.ny.us

Nicole D. Wright
NEIWPCC-NYS Department of Environmental Conservation
Toxicity Testing Unit
Hale Creek Field Station
182 Steele Avenue Extension
Gloversville, NY 12078
Phone: (518)773-7318, Ext. 3011
Email: ndwright@gw.dec.state.ny.us

Experimental Manipulation of Nutrients in a Catskill Forest

G.B. Lawrence, A.S. Eallonardo, D.J. Leopold, S.W. Bailey, R. Minocha and D.A. Burns

Nitrogen has long been considered the growth-limiting nutrient of northern temperate forests. Decades of atmospheric deposition have increased inputs of nitrogen to these forests, however, particularly in areas of high deposition such as the Catskill Mountain region. By 1990, elevated concentrations of nitrate in Catskill streams, and elsewhere, led to concerns that nitrogen availability in forest soils had increased beyond that which the forest ecosystem could retain and utilize. During this time the Catskills have also received high levels of acid deposition that have leached calcium out of soils and decreased it's availability for trees. Like nitrogen, calcium is an essential nutrient. All trees utilize calcium for wood formation and other physiologic functions, although the demand for calcium varies among species. Sugar maple is among the species with the highest demand for calcium in the Catskill forest. Concentrations of calcium in Catskill soils have been found to be similar to those in western Pennsylvania, where unusually high levels of sugar maple mortality have been found. Sites with the lowest amounts of calcium in the soil tended to be most susceptible to defoliating insects, the primary cause of mortality. Fertilization with calcium and magnesium were shown to increase resistance to defoliating insects and reverse dieback on these sites. Preliminary analysis indicates that poor growth rates and canopy condition of sugar maple can be found in ridgetop stands in the Neversink River Valley, and defoliation during the summer of 2004 was common throughout much of the Catskills.

To evaluate the possible relationship between an imbalance in the availability of nitrogen and calcium (and possibly magnesium), and tree growth and health, a long-term study was initiated in the fall of 2003, in which forest plots in the Neversink River valley were fertilized with dolomite (limestone that contains both calcium and magnesium) and/or nitrogen. This experiment is a component of the USGS Nutrient Controls Study that is evaluating the effects of forest harvest intensity on water quality. Effects on soil and soil water chemistry are being monitored in conjunction with the response of canopy trees and understory to the fertilization. The goal of this experiment is to determine the degree to which soil conditions are controlling tree growth and health. This information on nutrient status will enable forest managers to develop management strategies that will promote healthy regrowth and avoid impairment of water quality.

Preliminary results indicate a measurable effect of dolomite addition on concentrations of exchangeable calcium and magnesium in the upper 10 cm of soil. Effects of treatments on soil water chemistry, however, were limited to elevated nitrate concentrations for approximately one to two months after addition. Abundance of sugar maple seedlings was also found to be much higher in plots that received dolomite than in plots that did not in the growing season following the treatment. Additional data will be available following sample collection during the growing season of 2005.

G.B. Lawrence
U.S. Geological Survey
425 Jordan Road
Troy, NY 12180
Phone: (518) 285-5664
Fax: (518) 285-5601
Email: glawrenc@usgs.gov

A.S. Eallonardo
SUNY Environmental Science and Foresty
One Forestry Drive
Syracuse, NY, 13210
Email: aseallon@mailbox.syr.edu

D.J. Leopold
SUNY Environmental Science and Foresty
One Forestry Drive
Syracuse, NY, 13210
Email: djleopold@esf.edu

S.W. Bailey
USDA Forest Service
Hubbard Brook Experimental Forest
Campton, NH 03223
Email: Scott.Bailey@unh.edu

R. Minocha
USDA Forest Service
Northeastern Forest Experiment Station
P.O. Box 640
Durham, NH 03824
Email: rminocha@hopper.unh.edu

D.A. Burns
U.S. Geological Survey
425 Jordan Road
Troy, NY 12180
Phone: (518) 285-5662
Fax: (518) 285-5601
Email: daburns@usga.gov

Deer Impact Management Strategy for the NYC Water Supply

Paul Lenz

City-owned water supply land in the New York City (NYC) watershed currently exceeds 85,000 terrestrial acres. Forest inventory data gathered in the last several years indicates that most City-owned water supply lands are negatively impacted by white-tailed deer (*Odocoileus virginianus*). Impact by deer on these lands has been documented through evidence of over-browsing, limited forest regeneration, and exclusion of species. Continuous elimination of forest regeneration by deer is considered a significant threat to the goal of a diverse, resistant and resilient forest ecosystem.

Forests have long been recognized as important sources of clean and abundant water. Concern over impacts from deer to forest regeneration and health, watershed recreation, ecosystem integrity, and water quality has prompted the development of Deer Impact Management Strategy (DIMS). This document provides background information on deer dynamics, studies involving deer and forest resources, current deer management activities, and a discussion of a strategy for dealing with the impacts of deer on City-owned land. The document also reviews current literature, studies and management programs, identifies land management goals for DEP that relate to water quality, forestry, recreation, and provides detailed recommendations to help meet the land management goals of the Bureau of Water Supply. This presentation is a synopsis of the document, the strategy, management activities completed thus far, and details on short and long term goals.

Paul Lenz
New York City Department of Environmental Protection
Bureau of Water Supply
Watershed Lands and Community Planning
71 Smith Avenue
Kingston, NY 12401
Phone: (845) 340-7545
Fax: (845) 340-8494
Email: plenz@dep.nyc.gov

DEP Wetland Functional Assessment Mapping

Laurie Machung

DEP's Wetland Functional Assessment Program combines a GIS-based classification and assessment system with a monitoring program to determine baseline characteristics and water quality functions of wetlands among various hydrogeomorphic settings. The GIS portion of the work was completed in 2004 through a contract with the United States Fish and Wildlife Service (USFWS). The USFWS completed a Watershed-based Wetland Characterization and Preliminary Assessment of Wetland Functions (W-PAWF) for the Croton, Catskill, and Delaware Watersheds. For the W-PAWF, hydrogeomorphic modifiers were attached to each wetland polygon in the NWI database to support preliminary, basin-wide assessments of eight wetland functions: surface water detention, streamflow maintenance, nutrient transformation, sediment retention, shoreline stabilization, provision of fish habitat, provision of waterfowl and waterbird habitat, and provision of other wildlife habitat. A series of 13 maps was prepared for each reservoir basin to highlight wetland types that may perform these functions at significant levels. Because the W-PAWF is a preliminary evaluation based on wetland characteristics interpreted through remote sensing and best professional judgment, DEP completed an extensive field review of the wetland classifications and has implemented a monitoring program at a subset of reference wetlands located throughout the Croton, Catskill, and Delaware Watersheds. DEP's field review has resulted in a number of methodological improvements for the W-PAWF, particularly in the identification of isolated wetlands. A pilot monitoring program has been completed in the West Branch and Boyd Corner reservoir basins and is currently underway in the Catskill and Delaware Watersheds. Reference wetland monitoring data are being analyzed to assess the findings of the W-PAWF and to investigate relationships among chemistries of soil and water, plant communities and hydrogeomorphic classes.

Results of this program will enable DEP to determine baseline conditions and water quality functions of a number of wetland types and will benefit the development of both regulatory and non-regulatory wetland protection and non-point source programs.

Laurie Machung
New York City Department of Environmental Protection
Bureau of Water Supply
Wetland Program
71 Smith Street
Kingston, NY 12401
Phone: (845) 340-7594
Email: lmachung@dep.nyc.gov

Factors Controlling Aluminum Release after a Clear-Cut in the Neversink Watershed

Michael R. McHale, Peter S. Murdoch, Douglas A. Burns and Gregory B. Lawrence

The Dry Creek watershed in the Catskill Mountains of New York State USA was clear-cut during the winter of 1996-97. We examined changes in nitrate (NO_3-), aluminum (Al), and calcium (Ca^{2+}) concentrations and *p*H in stream water, soil water, groundwater, and soil in response to the harvest to examine how interactions between these constituents and biogeochemical cycling controlled Al release after the clear-cut. Biomass in the clear-cut area was reduced by 97%, though slash was left on the watershed to minimize soil disturbance and conserve nutrients and base cations within the watershed. The Catskill Mountains have received some of the highest acid deposition rates in the United States for several decades. Prior to the clear-cut, forest soils were characterized by low base saturation, high exchangeable Al and low exchangeable base cations. Mean stream water NO_3- concentrations were about 35 mmol l^{-1} and were not strongly related to inorganic monomeric Al (Al_{im}) concentrations because a large fraction of total monomeric Al (Al_{mono}) was organically complexed and Al dissolution was minimal at stream typical *p*H values of 5.8-6.0.

During the first summer after the clear-cut NO_3- concentrations were elevated throughout the watershed and peaked at 1309 mmol l^{-1} at the watershed outlet. Nitrate export increased 22.7 and Al_{im} export increased 2.0 kg ha^{-1} yr^{-1} during 1998, the first water year after the harvest. Al_{im} mobilization is of particular concern because it is toxic to some fish species and can inhibit the uptake of Ca^{2+} by tree roots. In the O-horizon organic complexation helped to control Al release after the clear-cut, however Al^{3+} concentration still increased dramatically. In the B-horizon there was little organic matter available so there was a large release of Al_{im} from the soil exchange complex.. The amount of Al_{im} in B-horizon soil water was strongly correlated to NO_3- concentration ($r^2 = 0.92$) especially at NO_3- concentrations greater than 100 mmol l^{-1}. Groundwater springs contributed high base cation low NO_3- water to the stream which, to some extent, ameliorated the effect of soil water on the stream. Stream water Al concentrations from the clear-cut were diluted by runoff from an adjacent watershed which resulted in no discernable increase in Al_{im} concentration in the stream just 0.25 km downstream of the clear-cut. Therefore, the extent to which the clear-cut affected the ecosystem and the dominant control on Al release changed with the scale at which measurements were taken. Within the clear-cut watershed there was an increase in soil exchangeable Al and a decrease in exchangeable base cations that caused a decrease in the soil Ca:Al ratio. Clear-cutting resulted in a release of NO_3-and an associated mobilization of Al_{im} from the soil exchange complex that was released to streams as well as a decrease in soil base saturation.

Michael R. McHale
U.S. Geological Survey
Water Resources Division
425 Jordan Road
Troy, NY 12180
Phone: (518) 285-5675
Fax: (518) 285-5601
Email: mmchale@usgs.gov

Peter S. Murdoch
U.S. Geological Survey
425 Jordan Road
Troy, NY 12180
Phone: (518) 285-5663
Fax: (518) 285-5601
Email: pmurdoch@usgs.gov

Douglas A. Burns
U.S. Geological Survey
425 Jordan Road
Troy, NY 12180
Phone: (518) 285-5662
Fax: (518) 285-5601
Email: daburns@usgs.gov

Gregory B. Lawrence
U.S. Geological Survey
425 Jordan Road
Troy, NY 12180
Phone: (518) 285-5664
Fax: (518) 285-5601
Email: glawrence@usgs.gov

Fluvial Process Research and Database Development Efforts of the NYCDEP Stream Management Program in Support of Regional Stream Restoration and Management

Sarah Miller

The concept of natural channel design (NCD) for stream restoration projects is based on the premise that morphological variables used to design dimension, pattern and profile can be developed from empirical models and reference stream reaches in similar valley settings. Efforts to design and evaluate restoration projects using this approach for streams of New York State have been hampered by insufficient documentation of natural variability in stream morphology, fluvial process and biology. This project sought to develop and implement a set of repeatable protocols and experimental designs to assess stability of reference sites in the Catskill Mountains, and to develop a database of associated hydraulic, geomorphic, and biologic characteristics to support regional NCD efforts. Specifically, researchers developed methods to investigate the efficacy of relations currently used in stream assessment, design, and monitoring, including defining bed-mobilizing discharge, channel geometry, bed-sediment size distribution, water velocity, relative roughness, shear stress, Shields parameter, size distribution of lateral depositional bar sediments, tracer bedload particle transport, and scour and fill depths. These findings should also provide a benchmark for aquatic habitat conditions and fish and macroinvertebrate communities in reference streams.

Sarah Miller
New York City Department of Environmental Protection
Bureau of Water Supply
71 Smith Avenue
Kingston, NY 12401
Phone: (845) 340-7518
Email: smiller@dep.nyc.gov

Regional Assessment of Factors Influencing Forest Health and Surface Water Quality in the Headwaters of the New York City Water Supply

Peter S. Murdoch, D. Burns, M. McHale and G. Lawrence

Long-term sustainability of water quality in the Catskill watersheds of the NYC water supply will require a healthy forest and land-use practices that do not lead to forest degradation. The depletion of forest soil nutrients as a result of acidic deposition, forest decline resulting from invasive pests or diseases, and land-uses that decrease water infiltration or forest productivity can affect (1) water quality in the New York City drinking water supply reservoirs (2) habitat degradation for fish in Catskill streams, and (3) rates of forest regrowth following harvesting in some watersheds of the Catskill Mountains. The US Geological Survey, in cooperation with the New York City Department of Environmental Protection (NYCDEP), New York Department of Environmental Conservation (NYDEC), and the USDA Forest Service (USFS), has begun a multi-year assessment of factors controlling forest health, including mapping of indicators of forest sustainability for the Catskill Mountain region. This assessment builds on existing data from long-term research of processes controlling stream and soil chemistry that the USGS-NYCDEP partnership has developed since the early 1980s. This talk provides the most recent data on regional soil and stream water-quality being collected for regional map development, an update on forest responses to fertilizer additions in experimental plots within the Neversink River basin, and the initial response of soil-water and stream-water quality to partial forest harvests in the Frost Valley Model Forest. Plans to assess the effects of invasive pests, including the hemlock wooly adelgid, have been developed and sampling was initiated in spring, 2005. A sharp increase in sugar maple seedlings is evident within forest plots where calcium fertilizer was added. Partial-harvest of trees at the Frost Valley Model Forest plots began in winter, 2005. Regional surveys of soil and stream chemistry indicate zones of low calcium and pH in the headwaters of the Neversink, Rondout, Ashokan, and Schoharie reservoir watersheds. A combination of intensive and extensive data collection, and the integration of forest-, soil-, and water-sampling programs of the NYCDEP, USGS, and USFS is providing a strong regional picture of the extent of soil calcium depletion and pest infestation in the Catskill reservoir watersheds. Ongoing research on the effects of harvesting on nutrient export to rivers and the role of calcium and nitrogen in forest growth is being combined with regional surveys of soil and stream chemistry to generate detailed data at the importance of soil chemistry and pest invasion to forest health, water quality, and resource management in the Catskill region.

Peter S. Murdoch
US Geological Survey
425 Jordan Road
Troy, NY, 12180
Phone: (518) 285-5663
Fax: (518) 285-5601
Email: pmurdoch@usgs.gov

Douglas A. Burns
U.S. Geological Survey
425 Jordan Road
Troy, NY 12180
Phone: (518) 285-5662
Fax: (518) 285-5601
Email: daburns@usgs.gov

M. McHale
U.S. Geological Survey
425 Jordan Road
Troy, NY 12180
Phone: (518) 285-5675
Fax: (518) 285-5601
Email: mmchale@usgs.gov

G. Lawrence
U.S. Geological Survey
425 Jordan Road
Troy, NY 12180
Phone: (518) 285-5664
Fax: (518) 285-5601
Email: glawrenc@usgs.gov

Drainage Basin Comparisons of Giardia spp. and Cryptosporidium spp. Occurrence within the East of Hudson District of the New York City Watershed

Patrick J. O'Brien

The East of Hudson District of the New York City Watershed is comprised of 15 separate drainage basins. Since the sources of Giardia cysts and Cryptosporidium oocysts can be from humans, domestic animals, and wildlife, the distribution of (oo)cysts throughout the district is not expected to be uniform across all of basins. Additionally, between-basin differences in physical parameters such as impervious surface area, land use, waste water handling, and wildlife assemblages could affect (oo)cyst occurrence. A between basin comparison of Giardia and Cryptosporidium (oo)cyst occurrence was conducted to determine which basins of the watershed present with higher occurrences. Filtered water samples were collected from streams within each of the basins, and enumerated for occurrence, by the NYCDEP DWQC Pathogen Program as part of various research and monitoring objectives. All samples were collected and processed using USEPA Method 1623 between June 2003 and June 2005. For ease of analysis, the occurrence raw data was converted to (oo)cysts/Liter and was analyzed in that form as sample volume was not always equal. The sampling frequency at each site was not uniform; as samples were collected both monthly and quarterly for at least one year; therefore the n for each site varied between 4 and 24. The sites were pooled by basin and the mean occurrence of Giardia cysts and Cryptosporidium oocysts was calculated. A between-basin ANOVA was conducted to determine if any differences in (oo)cyst occurrence were present. Additionally, instances of high occurrence, defined as >45 Giardia cysts and > 3 Cryptosporidium oocysts in a 50-L sample were used to rank the basins by frequency of elevated counts. The results of this project will allow the NYC DEP to investigate the basin characteristics where higher occurrence was detected. Research such as this is essential to the determination of pathogen sources as well as to the establishment of effective watershed protection controls.

Patrick J. O'Brien
New York City Department of Environmental Protection
Bureau of Water Supply
465 Columbus Avenue
Valhalla, NY 10595-1336
Phone: (914) 773-4414
Email: pobrien@dep.nyc.gov

The Watershed Agricultural Council's Integrated Approach to Watershed Protection on the Working Landscape

Tom O'Brien

Over 75% of the land in the 2000 square mile New York City water supply watershed is in private ownership. The billions of gallons of clean water required daily by millions of downstream consumers flows through and from these lands. Stewardship of this precious water resource is an interest of many parties, from municipalities and government agencies to the residents who make their living in a land-based rural economy.

The Watershed Agricultural Council (WAC) programmatic premise and approach is that farm and forestland that is properly utilized provides vital protection of this water resource and is the preferred alternative to the developed landscape or land use options limited through regulation. Keeping the working landscape economically viable as well as protective of the water supply is the mission of the WAC.

Water quality protection goals are achieved through engagement of private landowners in an incentive-based effort to establish and uphold a strong stewardship ethic. Stewardship tools include environmental assessment, planning and implementation of best management practices and other conservation tools.

Enhancing food, fiber, and wood markets is also integral to meeting the goals of retaining a working landscape. Across the nation and in Europe, as consumers are becoming more concerned about a sustainable and safe food supply, marketing opportunities for value-added local products grows.

The long-term requirements of effective land stewardship are ongoing planning, landowner education, proper operation and maintenance of structural best management practices, upgrading existing practices, and periodic conservation plan revisions to account for technological and land ownership changes. Lastly, permanent conservation tools are employed through easements that provide invaluable water quality protection as well as the retention of farmland soils for the population's future food security and supply.

Tom O’Brien
Executive Director
Watershed Agriculture Council
33195 State Highway 10
Walton, NY 13856
Phone: (607) 865-7790
Email: tobrien8@nycwatershed.org

Concentrations of Organic Compounds in Wastewater at Five Sites in New York State, 2003

P.J. Phillips, B. Stinson, S.D. Zaugg, E.T. Furlong and J. Anderson

Fifty-six samples of raw and treated sewage (25 and 31 samples, respectively) were collected at five wastewater-treatment plants (WWTPs), and 48 samples were collected from above and below five WWTP outfalls (21 and 27 samples, respectively) from May through December 2003 in New York State. Analyses for more than 60 organic compounds in all samples indicate that concentrations of organic compounds in WWTP effluents and receiving streams vary in response to three main factors - size of the receiving stream, technology and operation of the WWTP, and chemical characteristics of raw (influent) sewage. More than 30 of these compounds were detected in at least 40 percent of the raw and treated sewage samples, and 23 compounds were detected at concentrations greater than 1 mg/L in at least one raw or treated sewage sample. Concentrations of these compounds were higher in stream-water samples collected within a few miles downstream from WWTPs than in the samples collected upstream, and were highest in small streams in which WWTP effluent represented a large proportion of streamflow.

The 30 most frequently detected compounds can be grouped according to percent difference between WWTP effluent and influent concentrations. Concentrations of some chlorinated phosphate flame retardants and musk fragrances in effluents were 30 to 60 percent lower than the concentrations in influents, and concentrations of detergent degradates, caffeine, and triclosan in effluents were at least 98 percent below those in influents in most, but not all WWTPs. The greatest concentrations decreases were at the WWTPs that use activated sludge; the plant that used a trickling filter provided lesser removal or transformation of these compounds. Effluent samples from two WWTPs commonly contained several drugs in concentrations greater than 10 mg/L; these concentrations are attributed to manufacturing plants that discharge large volumes of wastewater to these WWTPs.

P. Phillips
U.S. Geological Survey
425 Jordan Road
Troy, NY 12180
Email: pjphilli@usgs.gov

S.D. Zaugg
U.S. Geological Survey
MS 407
Denver, CO 80225

E.T. Furlong
U.S. Geological Survey
MS 407
Denver, CO 80225

B. Stinson
Metcalf and Eddy
Lincoln Building
60 East 42nd Street
New York, NY 10165

J. Anderson
Metcalf and Eddy
Lincoln Building
60 East 42nd Street
New York, NY 10165

Relative Importance of Turbidity Sources to the Ashokan Reservoir

D.C. Pierson, E. Schneiderman and M. Zion

Turbidity levels in the Ashokan reservoir can at times reach relatively high levels (> 15 NTU), which will limit the use of the reservoir as a drinking water source. Turbidity in this reservoir is largely associated with two sources: Schoharie Reservoir releases that enter the Esopus Creek as a point source via the Shandaken Tunnel and non point source turbidity generated within the Esopus Creek watershed. Presently NYC DEP is examining ways to reduce Shandaken tunnel turbidity releases, by improving Schoharie Reservoir infrastructure, and/or by modifying reservoir release criteria. In this paper, using model simulations, we investigate the relative importance of Shandaken Tunnel turbidity and Esopus Creek non point source turbidity in influencing the Ashokan Reservoir.

A series of simulations were run from the beginning of 1993 to the end of 1999, and these were driven by measured variations in weather and reservoir operations. Watershed turbidity loads were estimated for all major tributaries to the Schoharie and Ashokan reservoirs using the GWLF model. These were then used to drive linked Schoharie - Ashokan two dimensional (CE-QUAL-W2) reservoir simulations, which predict the vertical and longitudinal distribution of turbidity in the two reservoirs. Data, saved at a daily frequency, allowed us to examine the relative importance of the two turbidity sources, over monthly to yearly time scales. How variations in weather and reservoir operations affect the relative importance of the turbidity sources, the overall level of turbidity loading, and the transport of turbidity through the west basin of Ashokan is discussed.

Dr. Don Pierson
Director of Reservoir Modeling
New York City Department of Environmental Protection
Bureau of Water Supply
71 Smith Avenue
Kingston, NY 12401
Phone: (845) 340-3294
Fax: (845) 340-7575
Email: dpierson@dep.nyc.gov

E. Schneiderman
New York City Department of Environmental Protection
71 Smith Avenue
Kingston, NY 12401
Phone: (845) 340-7571
Fax: (845) 340-7575
Email: eschneiderman@dep.nyc.gov

M. Zion
New York City Department of Environmental Protection
71 Smith Avenue
Kingston, NY 12401
Phone: (845) 340-7505
Fax: (845) 340-7575
Email: mzion@dep.nyc.gov

Management of New York City's Water Supply Lands and Conservation Easements: An Integrated Approach

John R. Potter

The New York City Bureau of Water Supply takes an integrated approach towards management of its water supply lands and conservation easements. This holding now exceed 125,000 acres and includes nineteen reservoirs, 250 miles of streams, 2,000 acres of wetlands, and 7,350 acres of riparian buffers. Updated statistics on this holding are quantified and presented. The protection of these critical water supply resources on fee lands is done within the context of an overall Land Management Plan that sets goals in support of the Bureau's mandate of ensuring delivery of a sufficient quantity of high quality drinking water to consumers. These goals are presented, and examples are given in situations where there is overlap and the need for integration. Progress towards meeting the Bureau's land management goals is summarized in terms of land use planning, resource management, property management, and recreational use. An overview is given on progress with conservation easement stewardship. Upcoming challenges in all areas of City land management are outlined.

John Potter
New York City Department of Environmental Protection
71 Smith Avenue
Kingston, NY 12401
Phone: (845) 340-7541
Fax: (845) 340-7575
Email: jpotter@dep.nyc.gov

Hydrogeology of the Pepacton Reservoir Watershed in Southeastern New York

Richard J. Reynolds

The hydrogeology of the 372-square-mile Pepacton Reservoir watershed in the southwestern Catskill Mountain Region of southeastern New York was investigated from 2000-2002 by the U.S. Geological Survey in cooperation with the New York State Department of Environmental Conservation. The primary objectives of the study were to: (1) map the distribution of surficial geologic units within the basin, (2) define the location and extent of significant valley-fill aquifers within the basin, and (3) estimate mean annual baseflow and recharge for each of eight subbasins within the watershed.

A GIS-analysis of surficial geologic data indicates that the most widespread geologic unit within the basin is till, which occurs as masses of ablation till in major stream valleys and as thick deposits of lodgment till that fill upland basins. Till covers about 91.5 percent of the Pepacton Reservoir watershed, while stratified drift (alluvium, outwash, and ice-contact deposits) accounts for 6.3 percent. The Pepacton Reservoir itself occupies about 2.3 percent of the basin area. Large outwash and ice-contact deposits occupy the valleys of the upper East Branch Delaware River, the Tremper Kill, the Platte Kill, the Bush Kill, and Dry Brook. These deposits form valley-fill aquifers that range in thickness from 90 feet in parts of the upper East Branch Delaware River valley to less than 30 feet in the Dry Brook valley, and average about 50 feet in the main East Branch Delaware River valley near Margaretville.

An analysis of daily mean stream discharge for the six eastern subbasins for 1998-2001, and for two western subbasins for 1945-52, was performed using three computer programs to obtain estimates of mean annual baseflow and mean annual ground-water recharge for the eight subbasins. Mean annual baseflow ranged from 15.3 inches per year for the Tremper Kill subbasin to 22.3 inches per year for the Mill Brook subbasin; the latter reflects the highest mean annual precipitation (50 inches per year) of all the subbasins studied. Estimated mean annual ground-water recharge ranged from 24.3 inches per year for Mill Brook to 15.8 inches per year for the Tremper Kill. The baseflow index, which is the mean annual baseflow expressed as a percentage of mean annual streamflow, ranged from 69.1 percent for Coles Clove Kill to 75.6 percent for the upper East Branch Delaware River; most subbasin indices were greater than 70 percent. These high baseflow indices suggest that, because stratified drift covers only a small percentage of subbasin areas (generally 5 to 7 percent), most of the baseflow is derived from the fractured sandstone bedrock that underlies the basin.

Richard J. Reynolds
US Geological Survey
425 Jordan Road
Troy, NY 12180
Phone: (518) 285-5677
Email: rjreynol@usgs.gov

Adequacy of an Industry Standard BASINS-Based Watershed Loading Model (SWAT) for Evaluation of Water Quality Impacts for a Small Catchment in the New York City Watershed

Kyle E. Thomas, James M. Hassett and Theodore A. Endreny

Simulation models are used extensively in water quality planning and pollution control (USEPA 1997). Distributed models allow for deterministic simulations of loading based on spatial heterogeneity. Previous research has demonstrated that existing, widely used distributed models exhibit little to no sensitivity to variation in spatial arrangement of the landscape input to the models (Fisher et al. 1997). Based on this work and work performed by others, it was expected that existing watershed loading models would not be sensitive to small-scale perturbations occurring within an urbanizing watershed. This hypothesis is being tested by applying the BASINS-based Soil and Water Assessment Tool (SWAT) model to evaluate subtle changes in landscape in a catchment within the Croton reservoir system for New York City.

Data utilized for the modeling effort were obtained from the Croton Terrestrial Processes Project initiated in 2000 to identify sources of N and P in the Croton reservoir system and to partition these sources among land use, land cover, topography and other geographic variables. In support of the project, three catchments - representing a fully-developed catchment, a semi-developed catchment, and a forested catchment - were intensively monitored from 2000 to 2001 using one streamflow gaging station, one meterological monitoring station, six groundwater wells, six lysimeters, and six throughfall collectors in each. The dataset generated for the project also contains spatial data including 2-m grid digital elevation model (DEM) files, 2-m topographic indeces of wetness files, and meteorological data from three meteorological stations installed and operated in the Croton watershed during the project, one in each studied catchment. Land cover maps for the catchments were generated from high spatial resolution aerial photography using supervised classification.

The SWAT model was calibrated using data described above collected from August 2001 to August 2002 in the fully-developed catchment B28. Model simulations are currently being performed to evaluate response to hypothetical small-scale perturbations in land cover, such as conversion of subdivisions to low-impact types of cluster development. This paper will present the hypothetical land use perturbations simulated by the SWAT model and the results of the simulations. It is expected that the results will further support the need for a grid cell scale, process-based, distributed watershed loading model capable of quantifying pollutant loads to a receiving water associated with upland practices occurring at a catchment scale on a long term (i.e. seasonal or yearly) basis. The development of such a model will be the subject of future research by the authors.

Kyle E. Thomas, P.E.
SUNY-ESF
One Forestry Drive
Syracuse, NY 13210
Email: kethomas@syr.edu

James M. Hassett, Ph.D.
SUNY-ESF
One Forestry Drive
Syracuse, NY 13210
Email: jhassett@esf.edu

Theodore A. Endreny, Ph.D., P.E., P.H.
SUNY-ESF
One Forestry Drive
Syracuse, NY 13210
Email: te@esf.edu

Due to space and time limitations, the following abstracts were not able to be presented at the 2005 conference, but are instead printed on the following pages with the gracious permission of the authors:

Monitoring of Pesticides and Other Toxic Compounds in NYC Watersheds

David Van Valkenburg, Charles Cutietta-Olson and Tracy Lawrence

Sampling of NYC's water supply waterbodies for pesticides and other toxic compounds has been ongoing since 1994. This program was enhanced in 2000 with $120,000 over two years for additional laboratory analysis of samples. A sampling strategy targeting potential source areas was implemented throughout the East-of-Hudson and West-of-Hudson watersheds. While data before 1999 are limited, a review of data collected in the 1994-2004 period suggests that pesticides and other toxic compounds do not occur in water at concentrations that are a major concern for the water supply at this time. The most frequently detected compounds are the herbicide 2,4-D and the class of compounds known as polycyclic aromatic hydrocarbons (PAHs). The reservoir watersheds with the most frequent occurrence of detections are Muscoot, New Croton, and Kensico. Future monitoring will attempt to characterize ambient pesticide and toxic compounds concentrations in water and sediment on a statistical basis (i.e., a specified level of confidence of estimates of mean and 90th percentile concentrations) in order to more quantitatively identify source areas and assess the environmental and water supply risk posed by these compounds.

David Van Valkenburg
New York City Department of Environmental Protection
Bureau of Water Supply
71 Smith Avenue
Kingston, NY 12401
Phone: (845) 340-7587
Fax: (845) 340-7504
Email: dvanvalkenberg@dep.nyc.gov

Charles Cutietta-Olson
New York City Department of Environmental Protection
71 Smith Avenue
Kingston, NY 12401
Phone: (914) 773-4475
Fax: (845) 340-7504
Email: olsonc@dep.nyc.gov

Tracy Lawrence
New York City Department of Environmental Protection
Bureau of Water Supply
71 Smith Avenue
Kingston, NY 12401
Phone: (845) 340-7522
Fax: (845) 340-7504
Email: tlawrenc@dep.nyc.gov

Natural and Anthropogenic Influences on Dissolved Organic Carbon Concentrations in Baseflow of Streams Draining the NYC Source Water Area

Dave B. Arscott, Louis A. Kaplan, J. Denis Newbold, Charles L. Dow

Water chemistry was sampled from 110 stream sites draining the New York City source water area between 2000-2004. Streams were visited annually during summer baseflow for 2 (n = 50), 3 (n = 48), or 5 (n = 12) years. Major ions, nutrients, a suite of molecular tracers (e.g., fecal steroids, polycyclic aromatic hydrocarbons, caffeine, and fragrances), particles, and dissolved organic carbon (DOC) concentrations in transport were measured in each sample. Land use/cover was quantified for the catchment upstream of each sample site using NYCDEPs 2001 GIS Land Cover/Use data layer (10 m resolution). Additionally, population density, road density, and permitted discharges normalized for catchment area (SPDES; annual average flows) upstream of each site were quantified. Dissolved organic carbon in water samples was measured before and after incubation in the dark for 28 days at room temperature to quantify DOC metabolized by bacteria (biodegradable dissolved organic carbon (BDOC)).

Inter-annual variation in baseflow DOC concentrations at West of Hudson (WOH) stream sites (n = 8) with 5 years of measurements could be explained by significant and positive relationships with baseflow discharge among years (R^2 ranged from 0.46 – 0.95). At East of Hudson (EOH) study sites, differences in baseflow DOC concentrations among years varied significantly with baseflow discharge at 2 of 4 sites. In contrast to DOC, baseflow specific conductance and alkalinity had significant negative relationships with baseflow discharge in both East and West of Hudson regions. These inter-annual patterns of baseflow DOC coupled with specific conductance and alkalinity suggest that elevated water tables during wet years tend to deliver soil water with shorter soil contact time (and subsequently lower concentrations of dissolved minerals) but water that has been in more recent contact with shallower soil layers rich in organic material, consequently delivering higher concentrations of DOC to streams compared to dry years.

Spatial variation in baseflow DOC concentrations within any given year was related to different factors in WOH compared to EOH stream sites. Baseflow DOC concentrations at EOH sites were on average >2x higher than at WOH sites (3.50 ± 1.75 [SD] versus 1.53 ± 0.49 mg/L, respectively). Biodegradable DOC followed a similar pattern (0.43 ± 0.52 mg/L EOH; 0.29 ± 0.13 mg/L WOH). In EOH catchments, annual average flows from permitted discharges and % wetlands were significant and positive predictors of baseflow DOC and BDOC. In WOH catchments, factors related to DOC and BDOC concentrations were more complex and related to differences in population density, % agriculture, and % wetlands. WOH baseflow DOC and BDOC also varied significantly and positively with stream standing stock of benthic algae and BDOC varied with fecal steroid concentrations in transport. These factors suggest possible pathways and factors influencing both DOC and BDOC concentrations in streams. However, understanding the relative contributions of DOC and BDOC from autochthonous sources such as algal exudates compared to allochthonous inputs of both non-point sources and point sources is not presently known.

David B. Arscott, Ph.D.
Stroud Water Research Center
970 Spencer Road
Avondale, PA 19311
Phone: (610) 268-2153, Ext. 272
Email: darscott@stroudcenter.org

Louis A. Kaplan
Stroud Water Research Center
970 Spencer Road
Avondale, PA 19311
Phone: (610) 268-2153
Email: lkaplan@stroudcenter.org

J. Denis Newbold
Stroud Water Research Center
970 Spencer Road
Avondale, PA 19311
Phone: (610) 268-2153
Email: jdenis@stroudcenter.org

Charles L. Dow
Stroud Water Research Center
970 Spencer Road
Avondale, PA 19311
Phone: (610) 268-2153, Ext. 259
Email: cdow@stroudcenter.org

Variation in Total Phosphorus Export Coefficients for Small Catchments Based on Routine and Storm Event Monitoring

Dale L. Borchert and James D. Mayfield

From 2000 to 2004, the NYCDEP conducted an intensive monitoring program on three study catchments located within the New Croton Reservoir watershed in Westchester County, NY. The data collected were used to estimate annual total phosphorus export coefficients from the three study catchments. The export coefficients generated from this project were then compared to literature values, and discussed in terms of annual rainfall and annual runoff coefficient differences. The data affirmed the difficulty in developing a single export coefficient for a particular land use or catchment. The data also re-enforced the need to apply a range of acceptable export coefficients when modeling land use changes.

Dale L. Borchert
New York City Department of Environmental Protection
Bureau of Water Supply
465 Columbus Avenue
Valhalla, NY 10595-1336
Phone: (914) 773-4457
Email: dborchert@dep.nyc.gov

James D. Mayfield
New York City Department of Environmental Protection
Bureau of Water Supply
Route 28A
Shokan, NY 12481
Phone: (845) 657-5779
Fax: (845) 657-6067
Email: jmayfield@dep.nyc.gov

Boat Management on NYC Water Supply Reservoirs

Jennifer Cairo

Fishing by boat, a popular recreational activity on New York City Water Supply Lands for over a century, engages an estimated 9,000 anglers and nearly 11,000 rowboats on 21 water supply reservoirs each fishing season. Rowboats used for fishing are steam-cleaned, registered and stored on Water Supply Lands to reduce the likelihood of zebra mussel introduction. On-site boat storage, the location of storage areas directly on water body shores, and intensive recreation use in these areas pose significant challenges to the management of water supply lands as well as to public recreation opportunities and, potentially, protection of water quality. Examples of specific concerns will be presented.

In early 2004 DEP Land Management staff began development and implementation of a long-term boat management strategy to address these challenges. This strategy is aimed at meeting City land management goals for protection of public health and ecosystem integrity, providing high quality recreation benefits, advancing understanding and knowledge of recreation opportunities and water supply protection, and promoting effective City land ownership. Management options being incorporated under this strategy will be discussed including:

Consistent removal of abandoned boats from Water Supply Lands;

Consolidation of boat administration and extended registration duration;

Revision of recreational rules and regulations to improve boat management and fishing access;

Improving public access to the Water Supply's outstanding deep water fishing opportunities;

Integrating boat permit and natural resource information;

Evaluating and improving boat storage area designation and management, and public access to storage areas;

Incorporating angler use patterns, distribution, and satisfaction into public access management;

Expanding public involvement in stewardship of boat storage areas and reservoir shores;

Increasing communication with boat owners

Identifying relationships between fishing by boat and water quality.

Jennifer Cairo
Land Manager
New York City Department of Environmental Protection
71 Smith Avenue
Kingston, NY 12401
Phone: (845) 340-7517
Fax: (845) 340-8494
Email: jcairo@dep.nyc.gov

Storm Flow Sampling in Three NYC Drinking-water Supply Watersheds as Part of a Large-Scale Baseflow-Focused Monitoring Effort

Charles L. Dow, Anthony K. Aufdenkampe, J. Denis Newbold, David B. Arscott and Louis A. Kaplan

Storm flow chemistry was monitored at three sites in the New York City drinking water-supply watersheds to augment an extensive baseflow monitoring program in the region conducted by the Stroud Water Research Center. The three sites represent major land uses found across the watershed: forests – Neversink River near Claryville; agriculture – W. Br. Delaware at Hawleys; and urban/suburban – Kisco River near Stanwood. Storm sampling began in 2001 and to date, samples have been collected from five storms each at the Neversink and Kisco Rivers and six storms at the W. Br. Delaware River. Two samples from each storm were analyzed for inorganic chemistry (major ions, nutrients), molecular tracers (caffeine, fragrances, fecal steroids, polycyclic aromatic hydrocarbons), dissolved organic carbon, and suspended solids. The two samples per storm were selected to represent peak turbidity concentrations and peak flow, based upon the storm hydrograph. All storm samples were collected in April, May, June, or September. Baseflow sampling for all monitoring project sampling sites generally took place between June and October with a few baseflow samples taken in April and May at the storm sampling sites to coincide with storm event sampling.

Instantaneous analyte fluxes, the product of analyte concentration and instantaneous stream discharge (or daily mean discharge for baseflow samples) normalized for watershed area, showed that comparable loads of nutrients (N and P), suspended solids, and organic material were transported during storms from all watersheds, regardless of the major land use. However, ion fluxes, especially chloride, were greater for the urbanized watershed relative to the other two sites. It should be noted that the observed ion fluxes were likely influenced by differences in geology between the East of Hudson (Kisco) site relative to the two West of Hudson sites in addition to differences in land use/cover. Molecular tracer concentrations, notably the sum of fecal steroids, were generally in the same range for the forested watershed as for the agricultural and urban/suburban watersheds, suggesting that even primarily forested watersheds are a significant source of fecal contamination during storms. However, total fecal steroids do not distinguish between human versus non-human sources, whereas ratios of certain fecal steroids can be used to distinguish sources. Using literature values for one particular ratio (coprostanal:cholestanol ratio) does provide evidence that non-human sources of fecal contamination dominated in the forested watershed, while human sources were dominant in the agricultural and urban/suburban watersheds.

Charles L. Dow
Stroud Water Research Center
970 Spencer Road
Avondale, PA 19311
Phone: (610) 268-2153, Ext. 259
Fax: (610) 268-0490
Email: cdow@stroudcenter.org

Anthony K. Aufdenkampe
Stroud Water Research Center
970 Spencer Road
Avondale, PA 19311
Phone: (610) 268-2153
Fax: (610) 268-0490
Email: aufdenkampe@stroudcenter.org

J. Denis Newbold
Stroud Water Research Center
970 Spencer Road
Avondale, PA 19311
Phone: (610) 268-2153
Fax: (610) 268-0490
Email: jdenis@stroudcenter.org

David B. Arscott
Stroud Water Research Center
970 Spencer Road
Avondale, PA 19311
Phone: (610) 268-2153
Fax: (610) 268-0490
Email: darscott@stroudcenter.org

Louis A. Kaplan
Stroud Water Research Center
970 Spencer Road
Avondale, PA 19311
Phone: (610) 268-2153
Fax: (610) 268-0490
Email: lkaplan@stroudcenter.org

Two-Dimensional Modeling of Solids in Kensico Reservoir to Assess Processes Affecting the Transport and Dilution of Turbidity and Pathogens

Todd S. Echelman

Kensico Reservoir, located in southern Westchester County of New York state, is an important component of the New York City water supply, with about 90% of the City's potable water flowing through it. With a storage capacity of about 30 billion gallons and outflows of about a billion gallons a day, the reservoir has a retention time of about one month. Transport and dilution of waters within the Reservoir are affected by the storage of the reservoir, the aqueduct flows, and meteorological conditions. Clearly, these processes affect constituents suspended in the Kensico Reservoir water column, such as solids, turbidity and pathogens. The characteristics of the suspended solids themselves also greatly affect the turbidity levels entering the New York City water supply, and recent studies show that suspended solids and turbidity levels also affect pathogen sedimentation and detection rates.

Turbidity and pathogen levels have been monitored in Kensico Reservoir for at least two decades, and in the last decade New York City began a modeling program to guide management decision-making regarding constituents of concern. This study uses a two-dimensional model (CE-QUAL-W2) to quantitatively evaluate the transport and dilution of suspended solids, under existing conditions throughout an eight-year period, from 1992 to 1999. Monthly two-day "spikes" (100 mg/l) of suspended solids are simulated from different sources (Catskill Aqueduct, Delaware Aqueduct, etc.), to assess the potential transport of turbidity and pathogen-like particles, under a variety of conditions.

Similar to initial studies (Echelman, 2004), this more systematic analysis compares transport and dilution of particles derived from different sources under both isothermal and thermally stratified conditions. Quantitatively assessments of the unit response of outlet concentrations relative to reservoir loading are performed through linear regression. Results show that Catskill Aqueduct loads, under thermally stratified conditions, produce relatively high effluent responses (EPC = 0.06 IL – 0.95), while Delaware Aqueduct loads, under isothermal conditions, produce relatively low effluent responses (EPC = 0.02 IL – 0.21), where EPC represents effluent peak concentrations, in mg/l, and IL represents influent loads, in Kg. These differences are largely derived from both the physical (bathymetric) and seasonal (thermal) conditions that characterize Kensico Reservoir. This work is intended to assist New York City water supply managers in understanding the transport of turbidity and pathogen-like particles in Kensico Reservoir.

Todd S. Echelman
New York City Department of Environmental Protection
Bureau of Water Supply
465 Columbus Avenue
Valhalla, NY 10595
Phone: (914) 742-4434
Email: techelman@dep.nyc.gov

NYC Watershed DEP Conservation Easement Program

Paul Lenz

The City has purchased 35 Conservation Easements (CE's) from willing sellers totaling 5100 acres in the NYC watershed since the since the signing of the 1997 Memorandum of Agreement (MOA) in 1997. Add to this an additional 2200 acres in DEP CE's expected to close by the end of 2005, and an additional 35 properties totaling almost 7000 acres held in farm easements by the Watershed Agricultural Council, and there are over 14, 000 acres protected.

When NYC purchases a CE, they are buying a "bundle of rights." In the case of NYC, these rights are primarily the development rights associated with a piece of property and the landowner has agreed not to conduct certain activities on the property encumbered by the CE. This may include subdivision, land disturbance, certain types of vegetation disturbance, and certain construction activities. However, the CE also allows certain other activities to occur and these may include hunting, fishing, farming, keeping livestock, building ponds, and forestry. The CE is designed to insure long-term water quality protection while also allowing the landowner flexibility to realize economic benefits as well as obtain their property management goals.

As part of the MOA and FAD, NYC is required to regularly inspect existing CE's. Currently, the Land Management Program within NYC Department of Environmental Protection (DEP) is responsible for this program and inspects all CE's at least twice per year. During these on-site inspections, landowners are invited to accompany CE Stewards and discuss property management issues. This provides an opportunity for the landowner and CE Steward to interact and build a positive working relationship. The DEP Stewardship Program is becoming increasingly proactive in assisting landowners in protecting water quality while allowing landowners to perform various activities on their land. The Stewardship Program has published a comprehensive "Water Quality Recommendations for Conducting Activities on Lands Protected by a NYCDEP Conservation Easement," sent a CE newsletter to CE landowners, and designated DEP staff as Conservation Easement Stewards to work with landowners. As part of the CE acquisition phase, Land Management staff collects significant amounts of baseline documentation. This consists of on the ground photographs with GPS locations, a baseline documentation map showing natural resource and property features, an aerial photograph, and a survey. These items are checked during each inspection.

The focus of this presentation is to inform participants about the types of natural resources that have been protected by CE's, describe the DEP Stewardship Program, explain how lands are inspected and monitored, discuss how activities are approved, and highlight the Watershed Land Information System (WaLIS) that is used to track NYC DEP CE's.

Paul Lenz
New York City Department of Environmental Protection
Bureau of Water Supply
Watershed Lands and Community Planning
71 Smith Avenue
Kingston, NY 12401
Phone: (845) 340-7545
Fax: (845) 340-8494
Email: plenz@dep.nyc.gov

From the Food Web to the Worldwide Web: Using Leaf Pack to Educate Students and Build a Valuable Watershed Database

Christina Medved and Aaron Bennett

Over the past four years, the Stroud Water Research Center and Hudson Basin River Watch have trained teachers and citizen volunteers in the New York City watershed to use leaf packs to study the life in – and assess the health of – their local streams. In the course of this program, participants have investigated local issues, gathered relevant ecological data, compared their data with those of other communities and learned how to use the new information to address local problems. All the data can be posted on the Leaf Pack Network® web site, which is emerging as a rich web-based resource that provides, in addition to the data, information on macroinvertebrates, watershed research, riparian ecology and water resources.

The session will cover use of the Leaf Pack experiment as a research tool for non-scientists and the valuable opportunities for interdisciplinary watershed education available with the project framework. A case study from a school that compared native versus exotic leaves will be presented as will the use and application of the Leaf Pack Network® as a mechanism to facilitate student learning and start the conversation of dealing with local watershed issues.

Christina Medved
Stroud Water Research Center
970 Spencer Road
Avondale, PA 19311
Phone: (610) 268-2153, Ext. 258
Email: cmedved@stroudcenter.org

Aaron Bennett
The Catskill Center for Conservation and Development
P.O. Box 504, Route 28
Arkville, NY 12406
Phone: (845) 586-2611
Fax: (845) 586-3044
Email: cccd@Catskill.org

Developing New Relationships for Rainfall Intensity-Duration-Frequency (IDF) in the Mujib Basin in Jordan

Dr. Nidal A. Hadadin

Variables needed for hydrologic design of hydraulic structures include the rainfall intensities, critical storm duration (concentration times for determination of peak discharges) for the catchments area, and the selected frequencies (return period). These variables together constitute the design storm. In order to determine the anticipated peak discharges for each selected catchments area; it was necessary to analyze topographic maps, watersheds characteristics and Rainfall records

In this study, the relationship between the rainfall amount, duration and frequency were studied for Mujib basin in Jordan. Intensities –duration –frequency (IDF) equations were developed for each of the 8 rainfall recording station in the basin. The 8 IDF equations obtained were compared with the curves obtained by Gumbel method and Water Authority of Jordan (WAJ) (1986); the results predicted by the writer are closer to the measured values. There are some differences in the results between this study and the studies of other investigators; these differences are due to:

a) Differences in the record length used by this study and WAJ study (1986)

b) Extrapolation of WAJ curves to include the 5 minutes duration

c) Some of the relative error was due to small values of reading.

Peak discharges were calculating for different location in the basin; it was found that the peak discharge which gotten from Manning's equation is closed to the peak discharge that gotten from rational method at recurrence interval equal to 25 years.

The Objectives of this research are:

to develop information for hydrologic design in the Mujib basin, Intensity-Duration-Frequency curves (IDF), and these curves will be prepared and presented in a form suitable for practical application for each of the 8 rainfall recording stations in the basin. The results will be of assistance to protect the hydraulic structures from considerable damage due to the flooding problems. Building to withstand natural and environmental disasters due to flood problem is one of the most important issues to be addressed in this research to provide guidance for the improving professional practice of disaster reduction in Jordan.

the results were compared with those gathered from Water Authority of Jordan (WAJ) for rainfall stations that have adequate records.

The peak discharges will be calculated for difference wadis in the Mujib basin by using the rational method; these results will be compared with the values of peak discharges that will be obtained by using Manning's equation.

Dr. Nidal A. Hadadin
Department of Civil Engineering
The Hashemite University
P.O. Box 150459
Zarqa 13115, Jordan
Email: nhadadin@hu.edu.jo

Relation Between Channel Cross-Section Shape and Sediment Transport

Dr. Nidal A. Hadadin

Much research has been conducted to predict sediment transport, and many empirical and semi-empirical equations have been developed, none gives us a complete detail about the effect of cross section geometry on sediment transport.

The effect of many variables on sediment transport has been understood; however, the influence of other variables still required additional research. The objective of this research is to study the effect of the cross section shape on the sediment transport.

The uncertainties associated with the variation of the physical characteristic of natural rivers, limited sample data, and inherent measurement errors will cause uncertainty in the parameters that describe the channel. To deal with those uncertainties that relate to the cross section the statistical characterization of channel cross-section geometry were used in this study. One way to describe irregular cross section geometry is by modeling flow depth as power function of the channel geometry proprieties (top width, flow area and hydraulic radius). Another way to deal with irregular cross section is by modeling the cross section as a function of effective width and effective width then width/depth ratio was found.

In this study, the effect of cross section geometry on sediment transport was demonstrated theoretically by inserting the shape factor in sediment continuity equation and analytically by utilizing the field data sets (natural channel) for Yalobusha River, Mississippi. Geometry of the river is represented by cross sections that are specified by coordinate points (stations and elevations) and the distances between cross sections. Twenty cross sections for Yalobusha River were used in the HEC-RAS model, flow data and boundary conditions were also entered to perform the calculations.

When the hydraulic parameters for every cross section are obtained, the sediment transport was computed by using selected sediment transport equations. The possible relationship between shape factor and sediment transport can then be assessed.

The shape factor is inserted in the sediment continuity equation the result show that the shape factor and scale factor for successive cross sections can be used to predict the sediment concentration. This can be achieved by knowing the sediment concentration at the first cross section in addition to other hydraulic parameters that appear in derived equation.

There is strong relationship between sediment transport and the ratio between effective width to effective depth. It was found as a width depth ratio increases the sediment transport decreases.

Key words: sediment transport, channel, cross section geometry, shape factor, width depth ratio.

Dr. Nidal A. Hadadin
Department of Civil Engineering
The Hashemite University
P.O. Box 150459
Zarqa 13115, Jordan
Email: nhadadin@hu.edu.jo

Application of Pathogen Field Monitoring Data: Preliminary Modeling to Assess Transport Processes in Ashokan Reservoir

Gerry Pratt and Todd Echelman

Recent advances in computer modeling of reservoir systems have contributed to the understanding of the transport of water and suspended particles such as pathogens. Sedimentation is identified in several studies as an important process affecting pathogen detection rates in lakes and reservoirs. This exercise applies field data and theory to the modeled processes and evaluates sedimentation as predicted by computer simulations and real world situations. A two-dimensional model provides a preliminary assessment of transport of Giardia-like particles, under existing 2004 conditions in Ashokan Reservoir.

Gerry Pratt
New York City Department of Environmental Protection
Bureau of Water Supply
71 Smith Avenue
Kingston, NY 12401
Phone: (845) 340-7615
Fax: (845) 340-7575
Email: gpratt@dep.nyc.gov

Todd S. Echelman
New York City Department of Environmental Protection
Bureau of Water Supply
465 Columbus Avenue
Valhalla, NY 10595-1336
Phone: (914) 773-4434
Fax: (914) 773-0365
Email: techelman@dep.nyc.gov

NYSDEC Map Amendments in the New York City Watershed Status and Methodology

Norbert Quenzer and Peter Feinberg

The NYSDEC has undertaken an intensive effort to update the Freshwater wetland regulatory maps in the New York City watershed. This effort was initiated to help protect the NYC drinking water supply that serves approximately nine million people in the metropolitan NY area. The protection of wetlands in the watershed is an important component of the over-all watershed protection efforts. This work is being funded by the Safe Drinking Water Act from EPA and is administered through the NYSDEC Division of Water.

The map amendment process entails a number of steps from the initial identification of potential wetland changes to field verification/documentation, public notice and public hearing to final map adoption.

Bagdon Environmental, under contract to the NYSDEC, began revising the wetland maps in the New York City watershed west of the Hudson River in 1999. This re-mapping effort entailed parts of Ulster, Greene, Delaware, Schoharie and Sullivan Counties. Final maps for these revisions were filed in November 2001.

The map revisions on the west side of the Hudson River were directed at adding new wetlands meeting the 12.4-acre minimum threshold for mapping. The preliminary selection of wetlands was conducted using a GIS query based on wetland polygon size from the National Wetland Inventory Mapping. The query did not take into account potential linear connections between small wetland polygons and resulted in relatively few new potential wetlands. In addition, the NWI mapping used as a reference for determining potential new state wetlands was not field verified. This was discovered when Bagdon Environmental reviewed remote sensing resources and field-checked potential wetland sites. As a result of this initial re-mapping effort, fifteen new wetlands were added totaling 1,318 new acres of wetland under state jurisdiction.

The re-mapping effort in the New York City watershed east of the Hudson River (encompassing portions of Westchester, Putman and Dutchess Counties) began in October 2001. In addition, staff from NYSDEC Region 3 concurrently conducted map revisions outside of the watershed on lands located within the same 7.5 minute quadrangles.

The map amendments on the east side of the Hudson were conducted using a different approach and included reviewing both potential new wetlands and wetland boundary changes of existing mapped wetlands. Numerous inaccuracies were noted in the remote sensing information for the area west of the Hudson, specifically the NWI maps, that necessitated changing the methods for querying potential new areas for mapping. In addition, the original mapping was out-dated and needed updating to accurately reflect the wetland boundaries, as required under Article 24 (Freshwater Wetland Act). The methodology used to determine potential wetland boundary changes and identification of new wetlands encompassed the use of remote sensing data and Geographical Information System (GIS) analysis. Field surveys were conducted to verify potential wetland boundary changes based on the results of the preliminary GIS findings.

The re-mapping effort for Westchester County has been completed with the final maps filed in July 2004. This effort resulted in 5,754 additional acres of wetland under state jurisdiction within the county. The re-mapping effort is in the process of being completed for Putnam County and Dutchess County with finalization of maps scheduled for December 2005.

Norbert Quenzer
Vice President/Senior Ecologist
Bagdon Environmental
Three Normanskill Boulevard
Delmar, NY 12054
Phone: (518) 439-8588
Fax: (518) 439-8592
Email: NQuenzer@BagdonEnvironmental.com

Peter Feinberg
Ecologist
Bagdon Environmental
Three Normanskill Boulevard
Delmar, NY 12054
Phone: (518) 439-8588
Fax: (518) 439-8592
Email: PFeinberg@BagdonEnvironmental.com

Patricia Riexinger
Division of Fish, Wildlife and Marine Resources
Bureau of Habitat
Landscape Conservation Section
NYS Department of Environmental Conservation
625 Broadway
Albany, NY 12233-4756
Phone: (518) 402-8848
Fax:(518) 402-8925
Email: pxriexin@gw.dec.state.ny.us

A Three Tiered, Nested Approach to Stream Barrier Inventory: a Better Way Characterize Barriers for Restoration Discussions in Tributaries of the Hudson River Estuary

Jesse Sayles

Even though holistic and adaptive are among many "buzz" words used in the repertoire of today's academics, politicians, and managers, they are very important concepts for environmental analysis and management, and should be sought after. Holism can be approached as ecosystem health and context. Barrier (dams, culverts and buried-streams) characterization for stream restoration or rehabilitation should extend beyond the physical barrier to include the riparian zone and catchment basin. Ecologically, addressing issues such as storm-water runoff in the associated catchment, or riparian buffer quality, should occur before, or alongside, possible barrier mitigation or removal considerations. I propose a three tiered nested approach when characterizing barriers. Tier one is an on-sight documentation of the barrier itself. This includes geographic location, dimensions, and qualitative description of stream ecology and geomorphology above and below the barrier. Adaptability captures the variability found in a specific system. So, in Tier two, the barrier is put in the context of the riparian zone, documenting size (laterally) and nature (composition). Tier three adds a specific character of the surrounding catchment basin by looking at the percent impervious surface. The data from theses three tiers are presented using GIS technology as a nested set of a single site.

This approach was applied in tributaries of the Hudson River Estuary during spring and summer, 2005 to provide data for citizen groups developing action plans for local streams. Data gathering tools used were GIS, citizen participatory action research, and qualitative and quantitative field methods. Application was designed to be rapid, balancing quality and quantity of data with quantity of sites visited. Collaborative efforts with New York State Department of Environmental Conservation Bureau of Marine Resources, and US Fish & Wildlife facilitated continuity between other programs engaged in stream barrier assessments in the area. Field parameters queried are not novel, and should be substituted or adapted based on specific contexts. However, the nested three tiered concept is, and it takes barrier inventory to a level advocated by the academic, scientific and political communities; holistic and adaptive.

Jesse Sayles
Hudson River Estuary Program
Department of Environmental Conservation
21 South Putt Corners Road
New Paltz, NY 12561-1696
Phone: (845) 256-3145
Email: jssayles@gw.dec.state.ny.us

GIS Overview of the Current State of Riparian Buffers in the NYC Watershed

Terry Spies and Ira Stern

DEP's GIS system was used to inventory streams in the Catskill/Delaware portion of the New York City Watershed, categorizing stream length in terms of public or private ownership and related protection status. GIS was then used to quantitatively assess the current state of riparian buffers surrounding those streams, focusing on land ownership, protection status, regulations, and land-cover/land-use. Results for both publicly- and privately-owned lands indicate that an overall healthy riparian buffer profile exists for the Catskill/Delaware watersheds, if the current predominant land cover of forest can be maintained into the future. Recommendations on how to continue to protect and maintain riparian zones in the NYC Watershed will be presented and include significant coordination with stakeholders, outreach and incentives to private landowners, continued acquisition of easements, and further implementation of stream management plans.

Terry Spies
New York City Department of Environmental Protection
Bureau of Water Supply
71 Smith Avenue
Kingston, NY 12401
Phone: (845) 340-7527
Fax: (845) 340-7514
Email: tspies@dep.nyc.gov

Ira Stern
New York City Department of Environmental Protection
Bureau of Water Supply
71 Smith Avenue
Kingston, NY 12401
Phone: (845) 340-7520
Fax: (845) 340-7514
Email: istern@dep.nyc.gov

Modeling Seasonal and Inter-Annual Variability of Dissolved Phosphorus Concentrations in Direct Runoff

Mark S. Zion and Elliot M. Schneiderman

The major pathway for dissolved phosphorus to enter streams and reservoirs is via direct runoff. Rain or snowmelt washing over the ground surface carries dissolved phosphorus from the soil and transports these constituents downstream. The concentration of dissolved phosphorus in direct runoff is dependent mainly on the phosphorus concentration in the soil which, in turn, is dependent on multiple factors including the land cover and agricultural management practices such as spreading of fertilizer or manure, tillage alternatives, grazing and crop rotations.

Two separate modeling strategies can be used to simulate dissolved phosphorus concentrations for direct runoff. One approach is to assign a concentration value to the direct runoff associated with land cover, land use and management practices based on observed concentrations obtained from field studies. This approach, used in the Generalized Watershed Loading Functions (GWLF) model offers simplicity, ease of use, flexibility, and the ability to directly incorporate observations into the model. As new data and studies reveal previously undetected effects of watershed processes, these effects can be readily incorporated into the model via appropriate changes in concentrations associated with direct runoff.

A second approach is to calculate phosphorus concentrations based on phosphorus soil mass balance, accounting specifically for phosphorus additions due to manure and fertilizer spreading, plant uptake, mixing due to tillage and internal soil phosphorus transformations. This approach is used in the Soil and Water Assessment Tool (SWAT) model, developed by the U.S. Department of Agriculture. The advantage of this approach is the realistic representation of the conceptual processes that control watershed chemistry, thus providing opportunities to study how manipulation of individual processes and management practices can impact watershed phosphorus loads in direct runoff.

The purpose of this study is to improve concentration values used in the GWLF model by utilizing the sensitivity of dissolved phosphorus concentrations in direct runoff due to land management options and climatic variability as they are calculated by the SWAT model. Dissolved phosphorus concentrations in direct runoff for various land management options are predicted by SWAT based on the underlying integrated theory. This permits the investigation of seasonal patterns and inter-annual variability on runoff phosphorus concentrations. The resulting intra- and inter-annual variability in phosphorus concentration is then added to the GWLF watershed model, thus improving predictive capability for watershed management scenarios.

Mark S. Zion
New York City Department of Environmental Protection
Bureau of Water Supply
71 Smith Avenue
Kingston, NY 12401
Phone: (845) 340-7505
Fax: (845) 340-7575
Email: mzion@dep.nyc.gov

Elliott M. Schneiderman
New York City Department of Environmental Protection
Bureau of Water Supply
71 Smith Avenue
Kingston, NY 12401
Phone: (845) 340-7571
Fax: (845) 340-7575
Email: eschneiderman@dep.nyc.gov