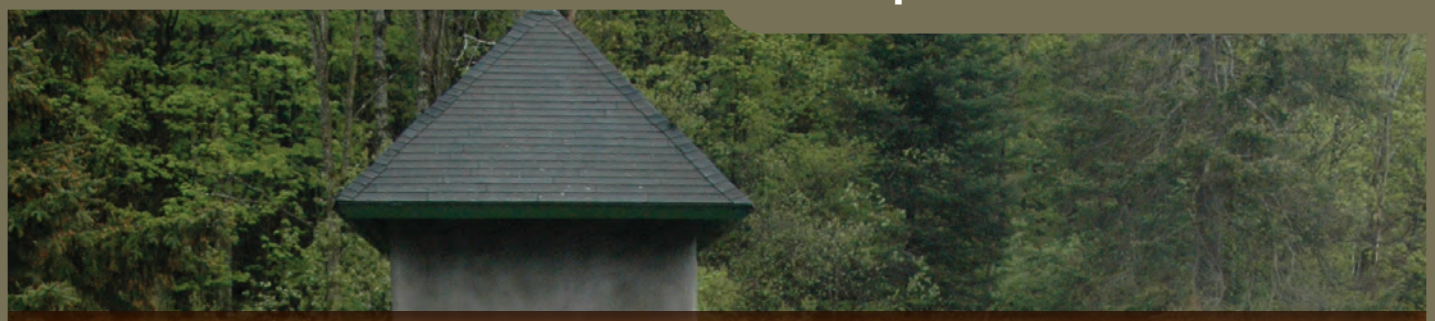
Compendium of Abstracts



NYC Watershed Science and Technical Conference

September 10, 2014 Thayer Hotel, West Point

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INTRODUCTION AND ACKNOWLEDGMENTS

Dear Conference Participants,

In 1997, the signatories to the historic New York City Watershed Agreement formed an enduring partnership to protect and enhance the City's Watershed and the scores of communities living within it. Underlying this complex social and political undertaking has been an unprecedented technical initiative among scores of local, State and federal agencies with one common goal: to advance the science of watershed protection.

The Watershed Science and Technical Conference was created more than a decade ago as an annual opportunity to bring scientists, professionals, and other experts together with watershed stakeholders and the public, to technically inform, exchange ideas, and unveil new information regarding the protection of the nation's largest unfiltered surface water supply.

Thinking back, as few as 5 years ago, those of us associated with clean water didn't think very much about flooding and its potential effects in drinking water supplies. Sure, localized flooding every few years in places like the Catskill area of the NYC Watershed reminded us that we needed to pay more attention to the matter, if only to deal with the associated turbidity and nutrient spikes and, most importantly, to help those mountain communities recover from the damage and heartbreak. We approached localized flooding in a localized way because widespread disaster from hurricanes and tropical storms was just not that high on the list of probables.

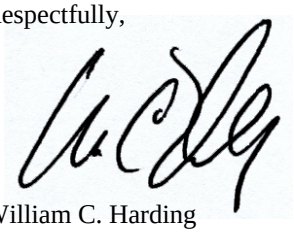
The came Irene, Lee, and Sandy.

Three storms that completely changed the way we think about flooding, communities, water supply, recovery and resilience. Since that time, flooding has been a thread woven throughout the presentations at our conference, and this year is no exception. Taking a look at the conference program, we see an emphasis on stormwater control, turbidity, nutrients, bacteria, flood studies, and community planning for a more flood-safe future.

We have learned much since the flood waters rose. Coordinated recovery, mitigation and prevention efforts continue to bring communities back, but some will never be the same. Through it all, the highest levels of scientific and technical analysis, coupled with community planning efforts and engineering expertise have contributed to an ever expanding knowledge base regarding why, where and how flooding happens. The 2014 conference will showcase some of the data and information developed on this most important scientific front.

In addition to our esteemed presenters and all those 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,



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The New York State Environmental Facilities Corporation

Evaluation of the Effects of Climate Change on a North Carolina Interbasin Transfer

Klaus Albertin, Jaime Robenson and William Kreutzberger, CH2M HILL; Clarissa Lipscomb, Kerr Lake Regional Water System

The Kerr Lake Regional Water System (KLRWS) is in the process of requesting a certificate for an increase in interbasin transfer (IBT) from the Roanoke River. In order to meet the regulatory requirements related to surface transfers, an environmental impact statement (EIS) must be prepared. Evaluation of the IBT requires an analysis of potential water supply and demand under future conditions within a 50-year planning window, including potential impacts from climate change.

The Roanoke River Basin Hydrologic Model (RRBHM) was used to evaluate the potential impacts to water resources in North Carolina and Virginia. As part of this evaluation, estimates of climate change impacts to rainfall and temperature within the planning window were developed using the SimCLIM tool. This effort indicated that the use of SimCLIM and the RRBHM are an effective method for evaluating changes in water supply and reservoir operation as a result of climate change impacts and increased demand for water supply.

The purpose of the modeling was to evaluate the effects of an increased surface water withdrawal from John H. Kerr Reservoir (Kerr Lake) within the Roanoke River basin on key social, environmental, and economic indicators for the system. Evaluation of the IBT required an analysis of potential water supply and demand under future conditions within a 50-year planning window.

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Incorporating Climate Change into TMDL Implementation and Water Quality Management: Are There Good Modeling Tools That Can Help?

Klaus Albertin, Harry Zhang, CH2M HILL

Climate change can have numerous and diverse impacts, including those on ambient water quality. In 'National Water Program Strategy: Response to Climate Change', the U.S. Environmental Protection Agency expects that the number of water bodies recognized as impaired is likely to increase, even if pollution levels remain stable, as a result of climate change. In the long term (*i.e.*, 50 years), warmer water and changing flows may result in the significant deterioration of aquatic ecosystem health in some areas. However, there are few studies which specifically focus on climate change impacts with regards to Total Maximum Daily Load (TMDL) implementation and water quality management. The objective of this paper is to review available modeling tools that can help incorporate climate change consideration into TMDL implementation and water quality management. The TMDL and National Pollutant Discharge Elimination Systems (NPDES) programs may need to adapt by considering the long-range implications for waterbody impairment associated with climate change and make needed revisions to TMDL guidance and water quality-based effluent limitations. Site-specific TMDL implementation plans may need to be updated to reflect more sensitive environmental conditions and focus on providing better assurance that reflect necessary levels of protection in a changing climate. A scenario planning approach for climate risk assessment can be employed, where climate change is just one consideration among potentially many variables that should be considered in planning for climate resilience. We evaluated the use of this process and appropriate tools, including SimCLIM (a climate scenario visualization and analysis tool), to develop scientifically defensible and implementable adaptation options to enhance climate resilience. In summary, available tools can support the assessment of TMDL implementation plans under projected climate change scenarios as well as under different management actions in response to climate.

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An Assessment of the Potential to Determine the Infectivity of Cryptosporidium Oocysts in NYC Water Matrix Using Cell Culture Immunofluorescence Assay

Kerri Alderisio, NYC Department of Environmental Protection

Not all Cryptosporidium oocysts are created equal. While current water quality regulations are based on total counts of oocysts, not all oocysts are capable of causing disease in humans. Some oocysts may be countable but not viable, others may be viable but not able to initiate infection, and lastly, some may be viable and capable of initiating an infection, but not a species or genotype that would make a person sick.

Previous Cryptosporidium testing performed by NYCDEP has included the counting of oocysts by conventional microscopy (USEPA Method 1623) and the Polymerase Chain Reaction (PCR) genotyping of oocysts (small-subunit rRNA-based nested-PCR); however, neither of these methods provides information on infectivity. Prior to beginning a study to determine the infectivity of naturally

occurring oocysts, the ability to recover known quantities of viable and infective human-pathogenic oocysts from NYC finished water matrix needed to be determined. Three sampling events were coordinated in April 2014 to include the collection of 90 filtered liters of water along with 10 liters of bulk water (x3 per event) for spiking. In short, the 10L aliquots were spiked with a known quantity of infectious C. parvum oocysts and then filtered through the 90 liter filters. Samples were processed using a modified version of Standard Method 9711D, which determines oocyst infectivity by utilizing a Cell Culture Immunofluorescence Assay (CC-IFA). Recovery of infectious oocysts was determined by comparing the numbers of infection foci for seeded samples and the number of foci for infectivity controls. Initial results indicate good mean recovery of infectious oocysts in reagent grade water (79%) and in NYC water matrix (52%). Additional testing involving low dose spike material in cell culture is planned for later in the year.

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The Schoharie Seiche: Daily Turbidity Variation within NYC's Schoharie Reservoir

Andrew Bader, Lori Emery, NYC Department of Environmental Protection

Large daily oscillations in turbidity (up to 100 NTU) were observed in the waters exiting NYC's Shandaken Tunnel Outlet between July and September in 2013. After a thorough field investigation, DEP determined that the oscillations in turbidity were the direct result of seiche activity within the Schoharie Reservoir. Seiches (internal waves) are caused by winds piling up surface waters on one side of the reservoir. This causes a depression of the thermal structure and initiates a rocking back and forth motion of waters below the surface (this is most noticeable near the reservoir's thermocline). Turbidity originating from Schoharie watershed streams during storm events (e.g., June) had entered the reservoir as an interflow and was located in the proximity of the thermocline. It is likely that turbidity particles, generated from the resuspension of sediments at the bottom-water interface, were transported to the depth of the intake at the Schoharie Intake Chamber during these daily seiches, as well. The internal seiche, a natural phenomenon in lakes, has been observed in Schoharie Reservoir in previous years.

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Building Momentum through Stakeholder Involvement: Watershed Planning for the Quassaick Creek, New York

Kelly Dobbins, Chad Wade, Orange County Department of Planning: Laura McLean, Michael Principe, HDR

The Quassaick Creek Watershed might be small by some standards, encompassing roughly 50 square miles, but it boasts popular recreational assets, important biological communities, and three reservoirs that together generate nearly 10 million gallons of drinking water per day to communities in the mid-Hudson Valley. Despite these assets, the Quassaick Creek is on New York State's Priority Waterbodies List due to water quality impairments and the Watershed contains a large lake on the State's 303(d) list of Impaired Waterbodies. In 2012, after receiving a grant from the New York State Department of State, the Orange County Planning Department led the formation of a committee with representatives from multiple agencies and community stakeholders to develop the Quassaick Creek Watershed Management Plan (May 2014). The project was supported by HDR, Inc.

Two differentiators for success during the watershed planning process have been the committee's ability to obtain funding for key initiatives and their commitment to sustainable development. Key initiatives included securing funding for green infrastructure projects and a fitness trail that enhances an underutilized lake and advancing plans for a riverside trail with historic and scenic features. Regular stream clean-ups, tree-plantings, and other public events organized by the Quassaick Creek Watershed Alliance has kept the Creek in the public eye throughout the planning process. The plan has is meant to: educate decision-makers, the public, and other stakeholders about watershed functions and values; provide guidance to make local plans and regulations compatible with a healthy watershed, and recommend measures for watershed protection and enhancement. The planning process coordinated a wide variety of existing programs and enhancement activities, spawned new partnerships, new projects and a renewed focus. As development continues throughout the Watershed, the plan recommends land management and development techniques that are respectful of these waterways – the most vital of which is clean drinking water.

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Stormwater Management Trends in the New York City Water Supply System East of Hudson Watershed in Response to the Watershed Regulations

John Drake, NYC Department of Environmental Protection

Following the signing of the historic 1997 Watershed Memorandum of Agreement and promulgation of the Rules and Regulations for the Protection from Contamination, Degradation and Pollution of the New York City Water Supply and its Sources (Watershed Regulations) many land development activities occurring within the New York City water supply watershed require review and approval of a Stormwater Pollution Prevention Plan (SWPPP) by the New York City Department of Environmental Protection (DEP).

DEP Stormwater Programs has been conducting technical reviews of SWPPPs throughout the water supply watershed since 1997. In the East of Hudson Watershed, Stormwater Programs EOH is the engineering interface between the City of New York's source water protection efforts and the land development needs of a regulated community spread over 20 towns. This presentation will showcase some of DEP's observations and experiences with respect to land development and stormwater management trends over this 17 year span by utilizing data compiled from its record of actual SWPPP applications.
The presentation will focus on two distinct periods: from 1997 to March 2010, when development activities were governed by the May 1997 Watershed Regulations ("1997 Regulations"); and from April 2010 to the present ("2010 Amendment"), when the technical standards in the Regulations changed from reliance on "end of pipe" stormwater management practices (SMPs) to newer "source control", volume-based concepts.

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Developing a Tool to Assess Key Factors Influencing Stormwater Management Design in the New York City Watershed

Mary Galasso, NYC Department of Environmental Protection, Bureau of Water Supply

Bureau of Water Supply, Stormwater Programs section has been reviewing Stormwater Pollution Prevention Plans (SWPPP) prepared for land development projects in the New York City watershed since 1997. The criteria used to determine approval/denial of a SWPPP are varied; however, each SWPPP undergoes a thorough individual review to determine whether or not the project can be constructed in accordance with regulatory requirements and established technical standards for stormwater management. Stormwater Programs has approved over 360 SWPPPs for land development projects in 17 years.

In 2011, Stormwater Programs initiated a project to categorize relevant components of approved SWPPPs in order to conduct a reasonable, objective assessment of the key factors influencing stormwater management design so that the review and approval process may be enhanced moving forward. The project includes systematic review of approved SWPPPs for components such as soil type, topography, land use, project size, disturbance limits, imperviousness, watercourse/wetland disturbance, drainage area characteristics, proposed stormwater management measures, maintenance criteria, etc., and establishment of a user-friendly catalogue of this information. The catalogue will enable staff to select relevant information from multiple approved SWPPPs by single or multiple metrics. Queries can be used to substantiate perceived commonality or differences and, potentially, to determine which characteristics best predict effectiveness of stormwater management design.

The presentation will focus on accomplishments to date. These include establishment of a method for information collection and querying, and early efforts to glean relevant information from approved SWPPPs, and preliminary attempts at establishing common or different key components influencing stormwater management design.

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Flood Hazard Mitigation Initiatives in the NYC Watershed

Jeff Graf, Elizabeth Reichheld, David Tobias, NYC Department of Environmental Protection; Timothy Cox, Catskill Watershed Corporation

In recent years, multiple flood events in the Catskill Region have spawned a range of new initiatives which taken together will address flood hazards in the NYC West of Hudson Watershed, especially important in a changing climate. New resources available for stream and floodplain management to mitigate flood hazards and improve community resiliency have been developed, including (1) a science-based Local Flood Analysis program run by the City's Stream Management Program to objectively assess flood hazard threats and to identify priority projects that can be advanced by communities to reduce flood risks, (2) a Local Flood Hazard Mitigation Implementation Program to be run by the Catskill Watershed Corporation to assist communities in implementing projects identified, and (3) a City-funded flood buy-out program which is designed to substantially supplement FEMA's flood buy-out program.

DEP and CWC will describe these programs and their current status.

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Building Information Modeling for Waste Water Treatment Plant Renovation Projects

Hamid Hajian, Susan Baya, Ashkan Rowshanrad, Andrew Bates, EnTech Engineering

Aging infrastructure in metropolitan areas present unique challenges to both goverment agencies and the Architecture, Engineering, Construction (AEC) industry. Keeping the underground utilities, waste water treatment plants, and pumping stations at standard operational level is of great importance to the local government agencies as they are vital components of the urban infrastructure system. It requires conducting frequent preventive maintenance and often performing renovation or upgrade projects. Keeping the facility functional with minimal disruption to the routine operation and reducing the project duration necessitate utilization of advanced technologies, such as Building Information Modeling (BIM). EnTech Engineering (EnTech) has extensive experience in BIM implementation in various projects throughout New York City metropolitan area. EnTech pioneers utilization of new technologies in major infrastructure projects and has worked with different government agencies, including NYCDEP, NYCDDC, and NYCT. This presentation outlines EnTech's major projects with local government, where BIM was successfully implemented. It shows how the technology helped the project team save time and reduce cost throughout the project lifecycle, from design to construction to operation.

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Trophic Response of Catskill and Delaware Reservoirs compared to OECD Regressions

Lorraine Janus, Ph.D., James Mayfield, Karen Moore, Ph.D., Richard VanDreason, NYC Department of Environmental Protection

The trophic response of NYC reservoirs under changing environmental conditions and increasing watershed protection and remediation over the past 25 years is examined. The standard regressions developed by the Organization for Economic Cooperation and Development (OECD) Cooperative Program on Eutrophication (conducted in the 1960s and 70s) set the context. This Program focused on defining the causes of eutrophication based on lake data from four regions: Alpine, Nordic, Shallow Lakes and Reservoirs, and the North American Project. Collectively, these projects led to the development of OECD Standard Regression Lines from over 100 northern temperate zone lakes. The Canadian Contribution test case (1980s), examined 7 lake regions across Canada to test the standard regressions. DEP reservoirs provide a second independent test case.

NYC reservoirs vary in their trophic responses to nutrients according to different meteorological, physical, and chemical factors. Given the wide variety of responses possible at a given nutrient level, it is essential to understand the causes of such variation to predict the effects of environmental changes on water quality. We plotted reservoir data on the standard OECD regression lines (that represent a large population of northern temperate lakes) and then examined the residuals to determine what factors can cause departures from the standard relationships. This analysis places our data in context and reveals important differences in reservoir responses that will be useful in water quality management. The diagnostic use of standard regression lines (and analysis of residuals) also highlights factors that need to be considered in future modeling to reduce prediction uncertainty.

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A Tool for Cross-Program Integration in the NYCW: the Lidar-derived NHDPlus Framework

Ricardo Lopez-Torrijos, CasaAlba Consulting; Tim Bondeli, Lucinda McKay, Horizon Systems

The NYC BWS has built comprehensive 1 and 3-meter lidar-based DEMs for all of the NYCW. The 3-meter DEM was used to develop a high resolution National Hydrography Dataset Plus (NHDPlus) system that provides a framework for a comprehensive BWS Enterprise Architecture. This paper will focus on how the BWS NHDPlus system can: (1) provide a robust framework for modeling, and (2) how the modeling inputs and results will link to the other BWS Programs. NHDPlus provides unique identifiers for each stream segment and the DEM-derived catchments associated with these segments. These catchments transform the 1-dimensional stream network to a true 3-dimensional representation of the watershed. NHDPlus provides Value Added Attributes (VAAs) that form the foundation for powerful and efficient stream network navigation, analysis and modeling. Models that have been built using NHDPlus include the USGS

SPARROW model and the USEPA BASINS system that includes the GWLF, SWAT, and HSPF models. The Enhanced Runoff Model (EROM) is a key extension of NHDPlus that uses the power of the catchments and VAAs to provide mean annual and mean monthly flow and velocity estimates for all the USA streams represented in NHDPlus Version 2. An emergency-response system named ICWATER uses NHDPlus as its fundamental framework. We will show how and why NHDPlus provides what can be called an "ideal" modeling framework.

In addition, NHDPlus can form the basis of an Enterprise Architecture System by linking any GIS data layers and analyses to the unique stream and catchment identifiers. Data such as land use/land cover, stream buffers, monitoring sites, and septic sites developed in one BWS Program can be readily incorporated into hydrologic and water quality models. In turn, the modeling results can be used by other BWS Programs through the stream and catchment identifiers.

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Dissolved Organic Carbon and Streamflow Relationships in the NYC West of Hudson Watershed

James Mayfield, Ricahrd VanDreason, NYC Department of Environmental Protection

The New York City Department of Environmental Protection (DEP) has begun the initial work required to try to develop dissolved organic carbon (DOC)/disinfection by-product (DBP) models that will allow DEP to simulate reservoir DOC and DBP production and help inform the operation of the water supply in meeting water quality standards. The development of these models will be quite complex and require a significant data analysis effort to provide realistic drivers and mechanisms for the model development. Toward that end, existing data will be mined to help support this effort. For example, it has been noted that developing relationships between dissolved organic carbon concentrations and streamflow may provide important information for this work. Water quality data that were collected by the United States Geological Survey (USGS) for DEP from fourteen sites in the West of Hudson watershed will be used to develop DOC concentration and flow relationships. These data were collected for a period of about ten years, and include fixed frequency samples and storm event samples. The sites include small forested headwater basins and medium sized mixed-use (*e.g.* agricultural, hamlets, etc.) basins. DOC-streamflow relationships will be developed and differences among the sites will be examined. This information will be ultimately used to support the development of the water quality models and support the operation of NYC's water supply.

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Applying a Novel Approach to Trend Analysis of Long-Term Water Quality Data

Karen Moore, Ph.D., James Mayfield, NYC Department of Environmental Protection

Years of investment in vigilance in watershed water quality monitoring have given New York City Environmental Protection scientists insights into potential issues and solutions in water resources management over time. With 25+ years of routine monitoring of the upstate reservoirs, streams, and wastewater treatment plants, careful assessments of data have informed policy and planning efforts.

We took advantage of the wealth of accumulated streamflow and water quality data for the West Branch of the Delaware River and other long-term monitoring sites to apply the "Weighted Regressions on Discharge, Time, and Season" approach described by Hirsch et al. (2010) to gain insights into the long-term record and look for new revelations in the data. We applied this approach to gain better recognition and understanding of the nature and magnitude of changes in water quality over time. We think there is great value in re-examining the long-term record as the record builds, and this particular approach is intended to help us further evaluate patterns in inputs of nutrients and other constituents of interest to water supply reservoirs.

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Update on Philadelphia's Green City, Clean Waters Program

Dwayne Myers, CDM Smith; Marc Cammarata, Philadelphia Water Department

The Green City, Clean Waters program is in the third year of its implementation period. With some modifications, the program laid out in the Long Term Control Plan Update was authorized for implementation through a Consent Order and Agreement between the Pennsylvania Department of Environmental Protection and the Philadelphia Water Department in 2011. The COA defines Water Quality Based Effluent Limits including CSO volume reduction, pollutant load reduction, and an innovative metric called Greened Acres.

The Greened Acre metric is an innovative way of tracking the traditional combined sewer overflow control compliance technique of source controls or surface runoff management. It captures elements of site-level discharge volume and pollutant load reduction performance that can be expected from the system - the "Clean Waters" goal of the program – and the area served by green stormwater infrastructure - the "Green City" goal of the program. In this way, the program is designed to invest rate payer dollars for maximum benefit both to the water environment and to the human beings who live and work in the City.

As the largest Green Stormwater Infrastructure program for CSO volume reduction, implementation requires innovation and adaptability to meet regulatory, technical, funding, policy, and organizational challenges. The program includes a pilot, research and innovation unit designed to accelerate the pace of innovation in green stormwater infrastructure and to accelerate successful implementation of Greened Acres. The process that has been designed to accelerate innovation involves a scientific approach to test hypotheses about what planning, design, and implementation choices lead to cost-effective outcomes. Data from experimental implementation approaches is being analyzed, along with data from implementation of standard approaches. Based on the results of these analyses, recommendations will be made to implementing units about how to remove implementation roadblocks, avoid mistakes, improve performance, and decrease cost of implementation.

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Findings & Results of the Monitoring of Stormwater Management Practices (SMPs) in the New York City Watershed

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The New York City Department of Environmental Protection retained HDR to monitor and assess the effectiveness of a discrete sample of stormwater management practices (SMPs), specifically stormwater ponds and wetlands, located in the New York City Watershed. The objectives of the project were to compare physical and vegetative characteristics of the approved designs to the as-built conditions, to assess post-construction function and maintenance, and to make recommendations for future installations. The SMPs selected for the study were stormwater ponds or wetlands designed to capture and treat runoff volumes specified in the Rules and Regulations for the Protection From Contamination, Degradation and Pollution of the New York City Water Supply and Its Sources (Watershed Regulations), were installed by spring 2008 to allow two full growing seasons of operations, and have tributary drainage areas that are at least 10% impervious. Permission of property owners for practices to be included in the study was required for SMPs on private property. 32 SMPs on 13 sites were included in the study. Tributary land uses included commercial, institutional and residential. As-built dimensions and elevations were assessed using GPS and a monitoring program was developed and implemented.

This presentation will briefly discuss the methodology used to screen the SMPs and obtain owner permission. It will describe the monitoring program developed for the study, and focus on the results and findings.

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The Third Unregulated Contaminant Monitoring Rule Watershed Survey

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The Environmental Protection Agency (EPA) required utilities to begin sampling for the Third Unregulated Contaminant Monitoring Rule (UCMR3) in 2013. The sampling of Public Water Supplies' (PWS) distribution water throughout the United States will be concluded by 2015. As part of the UCMR3, the New York City Department of Environmental Protection (DEP) is currently required to monitor for 28 chemicals in its distribution water system. The data collected will help EPA decide whether any of the 28 chemicals detected occur at concentrations and frequencies justifying regulation. DEP's distribution data along with the distribution data from approximately 6,000 other PWSs in the US are being compiled for review by the EPA in the National Contaminant Occurrence Database (NCOD).

Some or all of the UCMR3 constituents may be regulated in the future. Consistent with DEP's goal of providing the highest quality water to our customers, and in accordance with Filtration Avoidance Determination (FAD) objectives to monitor, model and understand the physical and chemical processes that potentially impact water quality, DEP is expanding our knowledge of the possible presence of some of the trace constituents within the watershed, which will enable us to plan for the future. Holistic strategies for managing the issue may become more important in the future as regulations are put forward. Therefore, DEP increased UCMR3 monitoring beyond that required in the distribution system to the watershed.

Watershed sampling began in March 2014. The results of the watershed monitoring will be analyzed at the conclusion

of the sampling which is scheduled to ending late May 2014. Sampling sites include stream samples upstream of watershed wastewater treatment plants' (WWTP) effluents, the WWTP effluents, reservoirs' primary tributaries, and keypoints throughout the watershed network. DEP is sampling for the 28 chemicals in the UCMR3, which include seven (7) volatile organic compounds, one (1) synthetic organic compound, six (6) metals, chlorate, six (6) perfluorinated compounds, and seven (7) hormones. Aside from the metals and hormones most of these chemicals have industrial purposes and are only expected to be in areas where they are used; and therefore, are unlikely to occur in the protected watershed. Many of the hormones have pharmaceutical uses so they may be detected in WWTP effluents. The comprehensive testing of the UCMR3 watershed study, and the low detection limits (low parts per trillion range) of the laboratory methods, enable DEP to determine the presence of these chemicals at extremely low concentrations.

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Assessment of the Occurrence of Cryptosporidium Oocysts and Genotypes in Wildlife Scat Samples

Christian Pace, NYC Department. of Environmental Protection

Cryptosporidium oocysts occur infrequently in the New York City Watershed, representing many different genotypes, and not all genotypes are infectious to humans. In 2013, DEP began testing wildlife feces collected within the Hillview Reservoir watershed to assess the prevalence of Cryptosporidium in local wildlife feces, and if detected, determine whether the types recovered were potentially infectious to humans. Hillview Reservoir has no tributaries, and there is only a small strip of surrounding land (mean 30 feet wide) that drains into the reservoir and is contained within an inner fence on the property. Wildlife scat samples were collected from animals discovered free or trapped inside the inner fence as those samples had the potential to be transported into the reservoir.

While the NYC Department of Environmental Protection (DEP) has reduced and controlled wildlife in the Hillview area since 1993 with a combination of physical deterrents, waterfowl harassment, and removals to minimize wildlife occurrence, some animals can get into the small watershed. Scat samples are routinely collected and disposed of, or sent for Cryptosporidium analysis at the Center for Disease Control and Prevention (CDC) laboratory in Atlanta. When scat samples test positive for Cryptosporidium, additional testing is performed to determine the genotype, which can be linked back to a specific animal source and potentially determine risk to human health.

From April to December 2013, 67 fecal samples from three major wildlife types (mammals, waterfowl, and perching birds) were collected in the watershed. Most samples (87%) were negative for Cryptosporidium; however, those that were positive were tested for genotype. This presentation will summarize the collection effort and prevalence of Cryptosporidium in scat samples through July 2014 and give an overview of the major genotypes and wildlife species represented.

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Developing a Long-Term Strategy to Simulate Dissolved Organic Carbon and Disinfection By-Products in NYC Water Supply Reservoirs

Donald Pierson, Ph.D., NYC Department of Environmental Protection; David Smith, Ph.D.,CUNY Hunter College Institute for Sustainable Cities

The New York City Department of Environmental Protection is planning to undertake a long-term effort to develop, test and apply a series of models that can be used to simulate the quantity and composition of DOC exported to our drinking water reservoirs; DOC produced or transformed within the reservoirs; and the potential formation of disinfection by-products (DBPs) from DOC. The need to develop a DOC/DBP modeling effort has been given greater prominence by adoption of the stage II standard for distribution system DBP monitoring, evidence that extreme storm events can result in large rates of DOC loading to reservoirs, and the concern that DOC/DBP levels should be included in future scenarios produced as part of DEP's Climate Change Integrated Modeling Project. As a first step in this effort DEP convened a two day workshop involving invited experts in watershed hydrology and biogeochemistry, limnology, and water treatment and disinfection by-product formation. In this presentation we outline the challenges identified by the workshop, the long-term vision of a DBP modeling program and DEP's plan for the first year of program development.

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Snowpack Monitoring in the New York City Water Supply Region: Past, Present, and Future

James H. Porter, Ph.D., NYC Department of Environmental Protection

The New York City Department of Environmental Protection (NYCDEP) operates the City's water supply system, providing more than one billion gallons of high quality water each day to more than nine million residents in the City and in several outside communities. The water is delivered via aqueducts from a 2,000 square mile watershed that extends more than 125 miles from the city. The system is comprised of 19 reservoirs and three controlled lakes with a total capacity of over 580 billion gallons. Managing such a complex system in an increasingly stringent regulatory environment and under a changing climate requires cutting-edge scientific tools. To meet this need, NYC worked with a team of consultants and expanded on its existing partnership with the National Weather Service (NWS) to build a decision support system known as the Operations Support Tool (OST). One of the keys to OST is runoff forecasts derived from the NWS Hydrologic Ensemble Forecast Service (HEFS). HEFS is new system which ingests meteorological forecasts and current snowpack data to produce a set (called an "ensemble") of runoff forecasts. These runoff forecasts are input to OST to predict reservoir conditions in the future, allowing water supply managers to model potential operations a priori and assess the probability of resulting outcomes. OST has been in development for several years and has been used with statistical forecasts that did not include the meteorological drivers or snowpack data present in HEFS forecasts. OST including HEFS forecasts was implemented in late 2013. This talk will present some of ways OST with HEFS has been used to help manage the water supply system, including during the winter of 2013-14 when a large snowpack presented challenging operational conditions.

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Management and Mitigation of Invasive Vegetation on Two New York City Reservoir Dams

David Quentin, Mr. Francisco Barquet, P.E., NYC Department of Environmental Protection

Dam faces represent a substrate by which invasive plant species can find an avenue to germinate and proliferate. Flora can exploit this environment even under the harsh conditions of exposure and no soil, and can grow as long as there is ample sunlight, water, a substrate to adhere to, and an existence of nutrients. Plant roots can damage the dam face by rupturing the dam caulking caused by excessive root growth.

DEP staff investigated the Kensico dam face and noted the pace at which plants grew out of the dam. A survey was performed to identify and note the proliferation of the plant species growing on the dam. The means by which the plant material could be safely and effectively removed without causing damage to the dam face were discussed. An Integrated Pest Management Plan (IPM) was proposed as a means of mitigating the issue and ensuring plant growth would be suppressed for the foreseeable future. A contractor was requested to employ IPM using non-chemical and chemical methods as means to clean the Kensico Reservoir dam face. Part of the work entailed the contractor rappelling down the dam face hand pulling plants and using a contact herbicide (a glyphosate based product). A post treatment survey was conducted to evaluate the success of the process.

Examples of plant genera in the initial botanical survey included: Populus, Solidago, Bidens, Robinia and Celastrus. The outcome of the work proved to be effective in eradicating the majority of plant growth from the dam face. This work represents a successful case study for future invasive plant management on New York City dams. IPM of invasive plants species on the Boyd Corners dam face will also be discussed.

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The 2013 Rim Fire and the Economic Impact on Natural Lands

Tim Ramirez, San Francisco Public Utilities Commission

The 2013 Rim Fire was the third largest wildfire in California history, and was unprecedented in scale and effect on the Stanislaus National Forest, Yosemite National Park, and the San Francisco Public Utilities Commission (SFPUC). This presentation will briefly describe the initial response to the fire, assessment and recovery efforts, and planning for monitoring and long-term management - particularly from the SFPUC perspective. Two early assessment reports will also be described: "The Economic Impact of the 2013 Rim Fire on Natural Lands" - which was developed by Earth Economics and funded by the SFPUC; and the Hetch Hetchy Watershed Effects Report - which summarizes the field work and analysis done by SFPUC staff to follow up on the efforts of the Burn Area Emergency

Response (BAER) team to describe the potential risk to SFPUC drinking water quality.

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The New York City Department of Environmental Protection's Stream Biomonitoring Program: A 20-Year Perspective

Martin Rosenfeld, NYC Department of Environmental Protection

Since 1994, NYCDEP has been assessing the health of streams in its watershed by sampling benthic macroinvertebrate communities, using protocols established by the New York State Stream Biomonitoring Unit. An overview of the program's accomplishments will be presented, focusing on what DEP has learned about the nature of these benthic communities; notable changes that have occurred to them over the past 20 years and their possible relationship to water quality; observed trends; and significant accomplishments, including the most recent data respecting the improved benthic community downstream of the upgraded Yorktown Heights Wastewater Treatment plant. The presentation will conclude with a look at possible future directions for the program.

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The O'Shaughnessy Dam Instream Flow Management Plan: An Innovative Approach to River Ecosystem Management

William Sears, San Francisco Public Utilities Commission

O'Shaughnessy Dam, located on the Tuolumne River within Yosemite National Park, regulates stream flow and affects the downstream river ecosystem. Existing required instream flow releases from O'Shaughnessy Dam have focused on providing ideal conditions for two species of trout, but have not considered the needs of the broader river ecosystem, including riverine wetland habitats, sediment transport, and other native species. Recent collaborative efforts have yielded new information about the river ecosystem, supporting development of an innovative instream flow management plan that aims to better address broader Tuolumne River ecosystem function.

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Modeling Headwater Wetlands in the East Branch Croton River Basin, NYCW Using a 2D Integrated Surface Water/Groundwater Model

Peter Singhofen, Gordon L. McClung, Streamline Technologies, Inc.; Ricardo Lopez-Torrijos, Casa Akba Consulting

Headwater wetland systems protect and enhance downstream water quality through natural filtering mechanisms and provide valuable flood storage and attenuation benefits. Although direct physical alterations to wetland systems can clearly disrupt natural flow patterns and adversely impact a wetland, land use changes in upland areas can indirectly impact wetlands by increasing runoff volumes and altering drainage routes to the wetlands. Existing hydrologic and hydrodynamic behavior of those wetlands must be understood in order to assess and quantify potential wetland impacts.

The purpose of this presentation is to describe a modeling approach that identifies flow patterns and quantifies hydro-periods and flood storage in a complex headwater wetland system located in the East Branch Croton River Basin in the New York City Watershed (NYCW). In particular, a 2D integrated surface water – groundwater model (ICPR) based on a flexible triangular computational mesh is applied to the study area. The model utilizes recent lidar-derived NHDPlus data including a 1-meter Digital Elevation Model (DEM) and NEXRAD rainfall data. Continuous simulations of the study area (including but not limited to Hurricane Irene) provide baseline water budgets, flow and velocity vector fields in the wetlands, flooded area–depth–duration relationships and flood storage assessments. A "what if" scenario that removes a significant amount of storage from the headwater wetlands is evaluated in terms of its potential impacts on the East Branch Croton River Basin.

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Effective Water Quality Monitoring of New York City's Reservoirs: An Overview of the RoboMon Project

Micael Spada, Joseph Miller, NYC Department of Environmental Protection

Water quality monitoring information is critical to guide effective management and protection of water supplies. However, event-based water quality problems, such as the elevated turbidity levels that are experienced in certain NYC reservoirs in response to runoff events, represent special challenges for effective monitoring. Effective monitoring of runoff events to support related management needs has two basic requirements: (1) representative measurements in time and space of forcing, or driving, conditions and in-reservoir patterns, and (2) timely communication of measurements to managers. The Robotic Water Quality Monitoring Network (RoboMon) fulfills these requirements. These units are robotic in that their monitoring functions (frequency and depths) are controlled remotely by commands delivered by a base station computer via phone and radio to computers within the units; collected data are transmitted back to the base station in near real time.

The network currently consists of four profiling buoys, three of which are deployed on the Ashokan Reservoir, with the fourth deployed on the Kensico Reservoir. Additionally, one buoy on each of the two reservoirs is outfitted with a meteorological station. The network also has two stream monitoring sites; one in the Catskill Watershed and one in the Delaware Watershed. These stations provide continuous monitoring of temperature, specific conductivity, and turbidity. Lastly, the network has two fixed depth buoys on Kensico reservoir which have three transmissometers suspended at five, ten, and fifteen meters depths to provide near real-time estimates of turbidity. Additional profiling buoys are scheduled for deployment at the Rondout, Neversink, Schoharie and Kensico Reservoirs. In addition, WWQO will be deploying buoys specifically designed to monitor water quality during ice-over conditions at the Ashokan Reservoir. Finally, a new RoboHut is planned for the Neversink River to monitor turbidity impacts related to storms. This presentation gives a general overview of the RoboMon project in the NYC watershed.

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Designing Low-Impact Development for Challenging Campus Landscapes: The StormWater Management Plan for the U.S. Army Garrison at West Point

Julie Stein, HDR; Matt Talaber, Katherine Ogut, Rumanda Young, Ph.D., US Militarty Academy at West Point

West Point is a federal military installation located in Orange County, New York. Most notably, West Point is home to the US Military Academy (USMA), a four-year co-educational federal service academy that emphasizes the development of cadets into leaders and a career of professional service to the Army. The USAG Department of Public Works (DPW) at West Point, along with Engineering Research Development Center - Construction Engineering Research Laboratory (ERDC-CERL) and The U.S. Army Corps of Engineers (USACE) initiated the development of a 20-year SWMP to address a variety of stormwater related challenges onsite. The goals of the SWMP are to develop a comprehensive approach and utilize Low Impact Development (LID) for stormwater management and to address known issues related to the existing infrastructure and drainage system. Development of the SWMP at West Point is strongly based on a landscaped approach—rather than an engineered or modeled approach. Attention was taken to identify cost-effective LID technologies fitting of the campus' historic resources and programming, and in accordance with all applicable federal and state regulations. Concept design plans were developed for a series of sites fitting the above criteria. The concept design plans demonstrate the feasibility and benefits of green infrastructure systems. One plan, ranked highest based on specific criteria, will be brought to full design. As a result, the development of the SWMP incorporates a landscaped approach into campus-wide stormwater management and reduction of runoff into aging infrastructure along the Hudson River. Special focus was given to the cadet experience and campus enhancements and integrating stormwater management with the West Point Real Property Master Plan, Long Range Component. The SWMP development approach successfully engaged those who live, work and study at West Point and, as such, is a process that can be replicated at other federally owned or operated properties.

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The Occurrence of Dissolved Organic Carbon (DOC) in New York City's Catskill Mountain Watersheds

Richard Van Dreason, NYC Department of Environmental Protection; Rajith Mukundan, City University of New York

An empirical model was recently developed by Mukudan and Van Dreason (2014) that indicated that organic carbon concentration was the most important factor explaining Trihalomethane (THM) formation within the NYC distribution system. THMs and other Disinfection by-products (DBPs) occur in drinking water as a result of a reaction between organic matter naturally occurring in the water and the disinfectant (e.g. chlorine) added to control

microbial contaminants. THMs and other DBPs are a major concern to water suppliers because of their suspected carcinogenic properties.

Because of its important role in regulating DBP formation, in this presentation we will describe the occurrence of DOC within the Catskill Mountain portion of NYC's water supply system. Regional and seasonal patterns will be compared using data collected from the Catskill reservoirs and from storm events collected on the major streams of the region. We also examine the patterns in DOC concentrations over time, since increases in the reservoirs could have important ramifications on future DBP formation in the distribution system.

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Implementing a Watershed Management Program

Rahul Verma, East of Hudson Watershed Corporation

The East of Hudson (EOH) watershed is approximately 375 square miles, and includes 10 reservoirs and three lakes that supply approximately 1.3 billion GPD of drinking water to NYC. A TMDL requirement has been promulgated for phosphorus in the EOH watershed, requiring a phosphorus reduction of 919kg/yr over a 10 year period, through the implementation of stormwater retrofits. To facilitate implementation of this program, the East of Hudson Watershed Corporation (EOHWC) was established by 19 EOH Coalition communities as a regional stormwater entity. The NYSDEC provides regulatory oversight under the MS4 permit, and stormwater retrofits are designed in accordance with the NYSDEC Stormwater Management Design Manual.

The operating environment for EOHWC is challenging and requires balancing regulatory criteria, sound engineering, constructability, modifying and updating existing stormwater retrofit plans, fiscal organization and accounting, acknowledging community needs, and project management to keep approximately 100 projects moving through scoping, design, construction, and closeout on parallel timelines over approximately three years.

The retrofit program was implemented in series of steps, and continues to evolve. Implementation required establishing the regulatory and legal framework, which includes Inter-Municipal Agreements between all 19 members, and a Funding Agreement with the NYCDEP, developing policies and procedures, installation agreements, and maintenance agreements. Technical implementation included developing design and construction contracts, identifying and classifying projects, permitting, and performing engineering and compliance reviews. Approximately 81 stormwater retrofit projects have been completed at the end of 2013, resulting in a phosphorus reduction of approximately 116 kg/yr. Approximately 100 projects are in progress to complete the remaining phosphorus reduction of 343kg/yr. Approximately $35 million will be spent on administration, engineering design, and construction.

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Source Water Protection - When is Enough, Enough?

Jennifer Warner, Water Research Foundation

It's been nearly twenty years since USEPA released the Safe Drinking Water Act Amendments of 1996 which, among other things, emphasized preventing contamination of source water areas through watershed controls and source water protection plans. The Amendments required states to delineate source water areas of public water systems, assess those areas to risk of contamination, and work with water systems to develop programs that protect source waters from current and future contamination threats. States were afforded considerable flexibility to perform the assessments and work with water systems. Some states worked very closely with water systems and others less so. Nearly two decades later, water systems and regulators wrestle with common questions and concerns regarding source water protection. Such questions and concerns can be even trickier and more difficult to definitely answer for unfiltered water supplies and their regulating authorities, for example:

- When is a source water protection plan sufficiently protective against current (known) and future (unknown) risks of contamination?
- What are the key elements of a successful source water protection program?
- How can a long-term planning horizon be built into a program, taking into consideration land development, extreme weather events, and other uncertainties?
- How is subjective regulatory criteria defined and applied in a source water protection program?

To share perspectives on these questions and begin to build a framework to evaluate source water protection programs, Water Research Foundation welcomed 24 representatives from six utilities (nearly all unfiltered) and five water regulators (four states and USEPA) from across the U.S. to a workshop in West Harrison, New York. The Cadmus Group, Inc. and Consensus Building Institute led the two-day effort that will ultimately result in the evaluation framework. This paper will present the framework and how

water systems and regulators can use it to assess and evaluate source water protection plans.

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Source Water Protection and Detection of Chemical Contaminants

Ben Wright, Ben Stanford Ph.D., Allison Reinert, Hazen and Sawyer

As the energy boom in the US expands, storage and transport of liquid hydrocarbons and associated chemicals is increasing. The industrial landscape is changing rapidly due to the availability of hydrocarbons for fuel and chemical feedstocks. Crude oil transported by rail has expanded the area of potential spill risks to areas that have no local oil production. Inexpensive natural gas has reinvigorated industrial chemical manufacturing in the US. Hydraulic fracturing continues to spread throughout many states in the mid-Atlantic and northeast. This increased level of activity also raises the concern for accidental releases to surface water supplies.

So far in 2014 there has been a tanker accident on the Mississippi, train derailments in Virginia and Colorado, and the mining chemical spill in West Virginia. In each of these instances public drinking water supplies were impacted. Fortunately in all but the West Virginia example, advanced notification enabled utilities to temporarily shut down intakes to avoid the contaminants. Given these rapid changes, can utilities afford to rely on other organizations for advanced notification of spills? Do current source water assessments accurately reflect potential chemical contaminants in the watershed? Do emergency response plans provide response measures for a wide range of potential contamination scenarios?

This presentation is designed to assist drinking water utilities in improving their preparedness for chemical and hydrocarbon spills, and will include a review of available data for identifying sources of contamination in a watershed, summarize technology for advance detection of synthetic organic contaminants, and provide an overview of mitigation response measures in the event of a spill.

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Potential Impacts of Climate Change on Turbidity in New York City Water Supply Catskill System

Mark Zion, Donald C. Pierson, Ph.D., NYC Department of Environmental; Nihar Samal, Rajith Mukundan, City University of New York, Institute for Sustainable Cities

New York City Department of Environmental Protection (DEP) has developed an integrated modeling system to gain understanding of the implications of potential future climate change on the quantity and quality of the New York City (NYC) Water Supply. The modeling utilizes climate change projections as input to an integrated suite of models including watershed hydrology and water quality models, a water system operations model, and reservoir hydrothermal and water quality models. This presentation focuses on turbidity levels in the Catskill System including Schoharie and Ashokan Reservoirs that are simulated to occur under future climate conditions. The integrated modeling system is used to gain insight on how future changes to the amount and timing of reservoir inputs of water and suspended sediment from the watershed are impacted by changes in watershed precipitation and evapotranspiration. In addition, changes in temperature, surface solar radiation and wind speed affect the hydrodynamics of the reservoir including timing and intensity of thermal stratification and potential depth of vertical mixing. These issues affect the transport and vertical distribution of water quality constituents including turbidity-causing particles. The results presented here are used to further understand the potential impacts of future climate change on the water supply water quality.

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