COMPENDIUM OF ABSTRACTS

September 13–14

2012

Watershed Science and Technical Conference

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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.

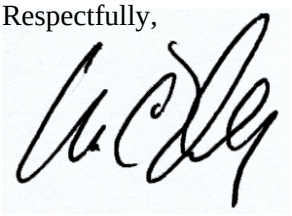
The Watershed Science and Technical Conference was created as an annual opportunity to bring scientists, professionals, and other experts together with watershed stakeholders and the public, to technically inform, exchange ideas, and unveil new information regarding the protection of the nation's largest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

For 2012, along with the usual presentation of the most current scientific trends and data regarding the New York City Watershed and other water supplies across the country, the conference will highlight some of the recovery efforts and technical analyses that took place in the aftermath of Hurricane Irene and Tropical Storm Lee.

We have learned much since the flood waters rose in the New York City Watershed. Coordinated recovery, mitigation, and prevention efforts continue to bring communities back, but some will never be the same. Since then, 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 2012 conference will showcase some of the data and information developed concerning the magnitude of this disaster, its associated recovery efforts, and readiness for future flood events.

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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For the Conference Organizers and Sponsors:

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The United States Geological Survey
The New York State Environmental Facilities Corporation

Comparison of Two Field Filters for the Collection of Viruses from Surface Water in the New York City Watershed

Kerri Alderisio, Kurt Gabel, Christian Pace, NYC Department of Environmental Protection

Viruses known to cause gastrointestinal illness in humans, also known as human enteric viruses (HEV), include enteroviruses, rotoaviruses, adenoviruses, reoviruses and many others. In fact, there are well over 100 different enteric viruses that are known to infect and replicate in the human intestinal tract and result in gastroenteritis, fever, respiratory distress and numerous other conditions. As required by the Information Collection Rule (ICR), the NYC Department of Environmental Protection (DEP) has used a 1MDS electropositive filter for the collection of enteric viruses from water since the beginning of its virus monitoring program in 1992 (10" Virosorb, Cuno). More recently, in 2009, the U.S. Environmental Protection Agency (EPA) presented findings using an alternate, and less costly, 5" electropositive filter (NanoCeram, Argonide). DEP performed a comparison of these two filters using surface water samples from the NYC watershed.

Thirteen, simultaneously collected samples were compared using three different matrices in the watershed. The three matrices represented the Catskill and Delaware aqueducts prior to Kensico Reservoir, and one stream located in the New Croton Watershed. Sample volumes were approximately 240 liters and samples were analyzed using the ICR Method. Matrix spike and quality control samples were also analyzed. Results indicated that the two filters were comparable in the matrices tested; however, it was noted that the NanoCeram filter yielded a higher filter pressure during collection. DEP switched to the NanoCeram 5" filter in November 2011. Since this time, on occasion, the need to lower the flow rate to meet the 30psi pressure requirement of the method, has as much as doubled the staff time needed in the field to collect a sample. DEP is currently investigating the use of the NanoCeram 10" filters, to determine if the increased surface area will minimize the need for lowering the flow rate.

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Tropical Storms Irene and Lee - Historical Precipitation and Microbiological Response in the Kensico Watershed

Kerri Alderisio, NYC Department of Environmental Protection

The year 2011 was historic for the New York City Water Supply. Tropical Storms Irene and Lee caused devastation throughout the watershed causing flooding, physical alterations to the watershed, and also changes to water quality. Preparations were made prior to the events, and response was swift, but these storms still demanded the attention of all Divisions of the Bureau of Water Supply in order to continue to deliver high quality water and meet all requirements of the Surface Water Treatment Rule (SWTR).

The Kensico watershed, home to the SWTR sampling sites, is roughly 13 square miles and the reservoir holds approximately 30 billion gallons of water. In addition to the Catskill and Delaware aqueduct inflows, there are eight perennial tributaries, numerous ephemeral streams, and overland flow to consider as input during storm events. Tropical Storm Irene pushed through the watershed August 27-28, and Lee came shortly after on September 5-8, dumping approximately 6.60 and 6.80 inches of rain, respectively, in the Kensico area. While a fecal coliform (FC) violation of the SWTR did not occur, the number of times the FC exceeded 20 CFU per 100ml at the source water was the highest recorded. The SWTR specifies that no more than 10% of samples may be over 20CFU/100ml in a running 6-month period, and the Catskill and Delaware systems reached 6.6% and 8.7%, respectively. This presentation will show how the precipitation and microbial response compares to historical events. Since the reservoir was being seeded with higher than normal FC from the aqueduct inflows, much higher than normal FC from streams, and an unknown, yet expectedly high, FC from unprecedented overland sheet flow, perhaps the result is no surprise. Protozoan counts were not similarly affected by the events, and this will also be discussed.

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Tanners Pond Environmental Center - Nassau County Stormwater Basin 232

Robert Alvey, Garden City Bird Sanctuary

Nassau County originally constructed Stormwater Basin 232 during the early 1950's in western Garden City as a means of draining precipitation from roads. In 1995, a private nonprofit organization, The Garden City Bird Sanctuary, Inc. obtained a Use and Occupany permit to manage a 9 acre portion of the site under an innovative “Dual Use” program for community use of the site. Extensive public education and outreach efforts have resulted in the development of the area as re-landscaped nature preserve and publically accessible park. The work has been accomplished in collaboration with both Nassau County and the Village of Garden City which has a separate Use and Occupancy permit for a portion of the site for a soccer field adjacent to the Village Nassau Haven Playground.

Over 8,000 visitors and volunteers have been at the Garden City Bird Sanctuary. There has been a consistent reliance on the use of volunteer community services for the work at the site. Over 20 Boy Scout Eagle projects have been completed in addition to 3 Girl Scout Gold Award projects. Grants to support development have been obtained from the New York State Parks Department, New York State Department of Environmental Conservation and a $50,000 grant under the 2006 Nassau County Environmental Bond for the installation

of a wet meadow. Additional funds have been received through donations and membership dues for the Garden City Bird Sanctuary.

The outreach efforts have lead to the designation of a portion of the site as the Alvey Arboretum, a landscaped tree lined trail, and the restoration of a remnant of the historic Hempstead Plains, a grassed prairie that once covered over 50,000 acres in central Nassau County. With an increased emphasis on the concerns of sustainability of wildlife and ecosystems associated with the increasingly dense suburban area, the site has been renamed as the Tanners Pond Environmental Center, incorporating the bird sanctuary, arboretum, wet meadows, and Hempstead Plains areas. Collaboration with Adelphi University has enabled the site to be open daily for both 2011 and 2012.

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Water Supply Operations and Monitoring in Response to Tropical Storms Irene and Lee

Charles Cutietta-Olson, NYC Department of Environmental Protection

One of the Filtration Avoidance requirements for the NYC water supply is that raw water fecal coliform concentrations must be less than 20 per 100 mL in 90% of the samples collected in a 6-month period.

Since 1993, Kensico Reservoir has easily complied with the fecal coliform criterion. However, in May 2011 the Kensico Reservoir watershed received over 5 inches of rainfall over five days, and six samples exceeded the 20 cfu/100mL threshold over the succeeding five days. Then later tropical storms Irene and Lee passed through the area in late August and early September, 2011, resulting in 21 additional fecal coliform samples exceeding the 20cfu/100mL threshold, and lowering the Delaware System's compliance with the raw water fecal coliform standard to 91.8%. The Bureau of Water Supply responded with a series of unusual operations including chlorination/dechlorination of a ~900 MGD water transfer to Kensico Reservoir and planned shutdowns of the Catskill Aqueduct leaving Kensico Reservoir. The Bureau of Water Supply's Water Quality staff conducted more detailed sampling and analysis of Kensico Reservoir and its watershed for fecal coliform sources.

Analysis of fecal coliform loading from the August-September storm events conducted by HDR-Gannett Fleming (2012) found that "[T]he fecal coliform loadings to Kensico Reservoir were due to localized events", in other words, not due to aqueduct inputs. This presentation will include a brief discussion of storm water monitoring conducted since the tropical storms and other considerations such as the likely extent of storm water input areas causing fecal coliform to be entrained in the Reservoir's flow paths and whether or not scheduled changes in the Reservoir withdrawal configuration are likely to affect entrainment.

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Assessing Changes in the Catskills and Delaware Watersheds Water Quality as a Function of Changing Land Cover: A Post 9/11 Perspective

Ari Engelberg, Myrna Hall, Philippe Vidon, Ph.D., Lianjun Zhang, Ph.D., SUNY College of Environmental Science and Forestry

Determining the relationship between in stream nutrient concentrations and land use is fundamental to effectively managing nutrient loading to streams and reservoirs. Developed and agricultural land uses often increase nutrient and sediment fluxes to streams, resulting in greater turbidity and eutrophication. New York City may be particularly vulnerable to these effects as parcelization and developed land uses have been and are projected to increase in its primary drinking water sources; the Catskills and Delaware Watersheds. This study analyzes changes in the relationship between water quality and land use for two three year periods centered on 2002 and 2006 to determine if there are trends in either, and whether changes in land use correspond to changes in water quality. We hypothesize that increases in development may offset water quality improvements derived from decreasing agricultural use. The analysis uses land use data as independent parameters in regression analysis to predict solute concentrations collected by NYCDEP for the 2002 and 2006 periods. Independent parameters including elevation range, soil erodibility, mean elevation, mean impervious surface cover, and percent agricultural land use are used to predict total nitrogen (TN), total phosphorous (TP), total dissolved phosphorous (TDP), nitrite and nitrate-N (No2No3-N), soluble reactive phosphorous (SRP), ammonia (NH3), and total suspended solids (TSS) concentrations. The analysis is still in progress; however in this presentation the preliminary results are examined and analyzed for significance.

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Stormwater Utility District

Robert H. Feller, Bond, Schoeneck & King, PLLC

The utility concept is routinely applied to the management of wastewater and potable water. Despite the increased focus on

stormwater management nationally, New York, unlike many other states, does not have a legal framework for approaching stormwater management in the same way. This talk will review the problem and discuss why the utility concept is one that should be an alternative for New York municipalities.

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Westchester's MS4 Communities on the LIS Upgrade Stormwater Infrastructure to Comply with the CWA & SDWA

Robert Ferri, Jerry Ciotola, US EPA Region 2

Since 2007 EPA initiated, working with NYSDEC and Westchester County DOH MS4 field assessments of every municipality in Westchester County discharging stormwater to the Long Island Sound. EPA's CWA and SDWA inspectors conducted administrative reviews of each municipality's MS4 Permit, inspected all municipal facilities, visited all outfalls, including a good number of catch basins and issued enforcement actions for compliance scheduling. Suspect outfalls were sampled, and EPA established a baseline for significant reduction in pathogens at suspected discharge points.

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Effect of Flooding from Tropical Storm Irene on Fish and Macroinvertebrate Assemblages in the Upper Esopus Creek Basin

Scott George, Barry Baldigo, US Geological Survey; A.J. Smith, NYS Department of Environmental Conservation

The Upper Esopus Creek, in the eastern Catskill Mountains of New York, was subjected to extreme flooding from Tropical Storm Irene on August 28, 2011. Peak storm flows at several USGS stream gages in the basin had a less than one percent chance of occurrence in any given year (>100 year flood). Although such flooding has been known to severely reduce species abundances and disrupt entire ecosystems, the actual impacts on resident biota in the Esopus remain unknown or simply speculative. A better understanding of the effects that extreme hydrologic events have on fish and macroinvertebrate assemblages in this basin is needed to help protect and sustain important natural resources under changing climatic conditions. Data from a limited number of surveys conducted between September 2011 and August 2012 were compared with data from annual fish and macroinvertebrate surveys conducted prior to Tropical Storm Irene (2009-2011) for 20 sites across the Upper Esopus Creek basin to describe impacts and potential recovery. Preliminary analysis of fish data from Fox Hollow Creek, an Upper Esopus tributary, suggested a profound decrease in both density and biomass of trout and sculpin following Tropical Storm Irene. Surveys of macroinvertebrate communities at five sites showed drastic reduction in species richness and density, with almost complete loss of many taxa in September 2011, and partial recovery by November 2011. Additional pre- and post-Irene metrics will be compared to fully quantify the degree of disturbance that can be attributed directly to the flooding. These findings have implications for long-term prospects for recovery, impacts of in-stream remediation efforts, and understanding of practices that may lessen or prevent ecosystem damage from future floods.

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The Ecological Evaluation of the Voghchi and Meghriget Rivers by the Hydrochemical and Hydrobiological Parameters

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The careless and intensive use of water resources, the incomplete mechanisms of their management, monitoring and quality evaluation led to ecological imbalance between nature and society. All of this is observed in the catchment areas of the Voghchi and Meghriget rivers. The Voghchi and Meghriget rivers are situated in the south of the Republic of Armenia. The catchment areas of the Voghchi and Meghriget rivers, the largest economic regions of Armenia, are under intense anthropogenic and technogenic influences. The ecological situation of the Voghchi and Meghriget rivers was studied by the hydrochemical and hydrobiological parameters. The water samples collected from the different sites of the rivers were analyzed during 2008-2009. As a determination index of organic matter content in the water samples the values of permanganate oxidation index were used. The results of the study shown that the pH values and the dissolved oxygen concentrations of the water of the Voghchi and Meghriget rivers varied within the ranges which were favorable for the growth of most hydrobionts. The content of organic matters increased in the Voghchi river after Kapan and Qajaran towns which resulted in the increase of the total number of bacteria, and the content of organic matters decreased in the Meghriget river after Meghri town which resulted in the decrease of the total number of bacteria. The results of the study revealed that the pollution level of the water of the Meghriget and Voghchi rivers ranged from very pure to dirty according to the values of permanganate oxidation index and the total number of bacteria. The

evaluation of the situaton of ecosystems, according to the ecological modification scale (according to the bakterioplankton growth index), revealed that the hydroecosystems were in the background situation which means the ecosystems were capable of self-recovery without significant changes in species compositions.

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Data Streams of Interest to the NYC Water Supply

Ray Homolac, NYC Department of Environmental Protection

DEP performs extensive analysis of water quality; however, there are outside agencies that also gather data about the watershed and some of this information is made available to DEP for analysis. Examples include on-site monitoring at United States Geological Survey (USGS) gauges and UFI Limnology buoys. The National Weather Service and The National Oceanic & Atmospheric Administration (NOAA) are also reliable sources of beneficial data to DEP. These are used for predicting storm events and tracking the watershed response to storms after they come through the area (flood stages, etc…) Aerial photography and Light Detection and Ranging (LIDAR), also known as laser radar, have been used. Tapping into additional data streams not currently used by DEP would be of great benefit for NYC as well. Some of the remote monitoring includes satellite data both visible and multispectral remote sensing, e.g., Landsat satellites. A recent development is deployment of the newest NASA satellite, Suomi NPP, an Earth observing satellite with unprecedented resolution. These and other data sources will be examined for potential use in water supply analysis.

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Green Infrastructure in New York City: Monitoring Stormwater Source Controls to Guide Implementation

Matthew Jones, Hazen and Sawyer; John McLaughlin, Julie Stein, NYC Department of Environmental Protection; William Leo, HDR-HydroQual

As part of the Mayor's PlaNYC 2030 initiatives, the New York City Department of Environmental Protection (DEP) is piloting green infrastructure source control retrofits to better manage stormwater runoff and address CSO and sewer capacity issues throughout the City. The purpose of this pilot program is to examine the functionality of these systems and the suitability of expanding their use throughout combined sewer areas. A comprehensive monitoring program serves as a key element of this pilot effort, providing valuable information on the challenges these systems present, and benefits they can provide within the ultra-urban environment of NYC. The monitoring program was developed to examine issues related to runoff quantity management, influent and effluent water quality, maintenance concerns, and general system functionality. This program encompasses more than 20 source control retrofits distributed throughout the City, including bioretention, bioswales, enhanced tree pits, street-side infiltration swales, constructed wetlands, blue roofs, green roofs, permeable pavement, and subsurface detention and infiltration systems. These retrofits were constructed within parks, medians, street-side sidewalks, public housing facilities, parking lots, and on rooftops. Remote monitoring equipment is utilized to collect data regarding quantitative performance of these source controls across a wide array of storm events. For some stormwater pilots, variable design elements, such as adjustable outlet configurations, were implemented in order to evaluate the effect of these elements on system performance. Qualitative assessments conducted during routine site visits evaluate elements such as the frequency and nature of maintenance activities, system aesthetics, and community perception. In addition to monitoring individual source controls, green infrastructure controls are being implemented throughout neighborhood demonstration areas, with sewer flow monitoring providing information on large scale benefits. Results of this monitoring program are expected to better inform future green infrastructure designs within the City and provide valuable information for future modeling and planning efforts.

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Computational Methods for Green Infrastructure in NYC Watershed

Shohreh Karimipour, NYS Department of Environmental Conservation

Traditionally, the NY State and City's standards for stormwater management have relied on event based design storms for evaluation of hydrology and sizing of stormwater management practices. While the State standards continue the use of simple method and spreadsheet tools, it does acknowledge the need for assessment of the long term effects of development and better understanding the hydrologic processes, and the necessity of continuous simulation modeling as an effective tool for analysis and evaluation of water quality and quantity design, flow-duration, and downstream impact.

As runoff reduction (total volume of 90% storm in NY) and application of green infrastructure approach are integrated into the design of stormwater controls, development of appropriate

modeling tools and computational methods become more essential. Green infrastructure design involves a number of natural hydrologic processes that must be correctly integrated in a modeling application. Practices such as green roof, porous pavement, street planters, bio-retention, vegetative buffers and even tree planting involve several hydrologic features in urban development. Computational methods that were traditionally set up for calculating runoff generated from impervious cover based on curve numbers and coefficients are not necessarily calibrated to characterize a site with green infrastructure practices. Variables such as storage, infiltration, evaporation and evapotranspiration, soil moisture accounting, subsurface flow, and eventually runoff formation and overflow control the design.

The NYC WRRs call for utilizing Stormwater Management Practices according to the NYS stormwater standards, while sizing of the design is based on the runoff generated by the 1-year, 24-hour storm or the 90% storm, whichever is greater. Although peak rate attenuation objectives are consistent in both sets of requirements, variables such as rainfall values, detention time, runoff reduction, treatment train, and acceptable modeling tools and assumptions are among the measures that could benefit from establishing a seamless process and unified calculation method.

Different approaches have been examined for adjustment of conventional tools to better model the green infrastructure scenarios. While modification of conventional variables is subject to debate and further verification, the design community's need for establishing acceptable methods with streamlined and accurate design of effective of green techniques is acknowledged.

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UV as a Disinfection Barrier and as a Barrier Against Emerging Contaminants

Jennifer Kintzer, Jon McClean, Patrick Bollman, P.E., Engineered Treatment Systems, LLC

Treatment facility operators face an increasing number of challenges in their facilities as new contaminants are emerging at the same time that existing microorganisms are becoming increasingly resistant to the traditional method of disinfection through the use of chlorine. The use of chlorine has also been determined to cause the formation of disinfection byproducts in the water distribution system, which must be controlled as well.

UV has been found to be an effective disinfection method against chlorine resistant organisms such as cryptosporidium and giardia while not forming harmful disinfection byproducts in the distribution system. UV has also been found to have the added benefit of removing total organic carbon (TOC), taste and odor causing bacteria and ozone from the water.

Research and field testing have also shown that through Advanced Oxidation Processes, UV can also effectively remove emerging contaminants such as pesticides and pharmaceutical and personal care products (PPCP) with the addition of oxidants such as hydrogen peroxide.

This presentation will focus on the following:

- Disinfection with UV
- Emerging contaminants (what they are, where they are, etc.)
- Advanced oxidation with UV

UV will continue to play an active role as a disinfection barrier against chlorine resistant organisms. However, since conventional wastewater treatment facilities were not designed as a barrier to emerging contaminants, many have been found to be unable to effectively remove these contaminants. As available water supplies dwindle and we are pushed toward the reuse of water, the removal of these contaminants will become a more pressing issue. The use of UV light and oxidants is shown to be an effective method of removing these emerging contaminants from the water.

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Long Island Sound Environmental Benefit Projects in Westchester County

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Manursing Lake Restoration, Edith G. Read Natural Park and Wildlife Sanctuary, Rye City: The lake and sanctuary are designated by New York Department of State as a Significant Coastal Fish and Wildlife Habitat and included in the U.S. EPA-Long Island Sound Study's Stewardship Inititiative.

This tidal lake, wetland, creek and buffer restoration project was completed in two phases. The first phase, completed in October 2009, focused on replacing a manually operated tide gate with a new, automatically operated gate. The new gate improves tidal flow through the lake, better connecting it to Long Island Sound. The improved connection enhanced the lake's ecology and allowed the creation of a wider intertidal zone, thereby enabling the establishment of tidal wetlands along the lake edge.

The wider intertidal zone was exploited in the second phase. This phase, completed in October 2010, focused on the creation of a “low” salt marsh dominated by smooth cordgrass in the intertidal zone. Above the “low” marsh are other restored coastal habitats, including “high” marsh, meadows and woodlands. A small tidal creek was excavated and flanked with wetlands. Shoreline bank stabilization also was part of the project's second phase.

Mamaroneck River Restoration at Saxon Woods Park, Mamaroneck Town and Harrison: Eradication of invasive, non-native vegetation for this freshwater stream and floodplain restoration project occurred in the summer and fall 2011. River bank stabilization using rock revetment, dead vegetation removal, raking, seeding and tree planting occurred in the spring 2012.

The restoration site covers approximately nine acres along 2,000 linear feet of riparian buffer and floodplain. Once the invasive, non-native plants were satisfactorily eradicated, the river corridor was re-planted with native herbaceous plants (as seed) and woody plants (as container-grown trees). The primary objectives of the project are to restore the benefits of riparian wetlands, floodplain and upland buffer along this segment of the river, especially for water quality improvement, flood mitigation, and fish and wildlife habitat enhancement.

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Long Term Phosphorus Reduction at Four NYC Water Supply Watershed Wastewater Treatment Plants Upgraded to Tertiary Filtration

Paul LaFiandra, NYC Department of Environmental Protection

The Stamford, Hobart, Delhi, and Walton wastewater treatment plants (WWTPs) discharge into the West Branch Delaware River which is the primary water source for the Cannonsville Reservoir, an integral component of the New York City (NYC) water supply system. In an effort to protect and preserve the high quality drinking water supplied by the system, a broad range of watershed protection programs were implemented as part of a filtration avoidance determination (FAD) issued by the United States Environmental Protection Agency to NYC. The Regulatory Upgrade Program was developed as part of the FAD. The objective of this program is to implement a broad range of infrastructure and process improvements at WWTPs in the NYC Water Supply watersheds to facilitate enhanced phosphorus, particulate, biological oxygen demand and pathogen removal. A key component of the upgrade process was the addition in 2002 and 2003of tertiary treatment filtration systems at the four WWTPs studied in this report. Total phosphorus data from effluent samples collected and analyzed by the New York City Department of Environmental Protection (DEP) Water Quality Directorate from 1995 to 2011 were evaluated to compare pre and post upgrade effluent total phosphorus and determine the long term effectiveness of the upgrades. Nine years of uninterrupted tertiary system operation have shown that the tertiary treatment systems are robust, reliable, and capable of meeting design objectives with minimal operator intervention. Following the upgrades, there have been significant and consistent reductions in WWTP effluent total phosphorus concentrations. Measurable improvements in West Branch Delaware River and Cannonsville Reservoir water quality were also realized likely attributable to the WWTP upgrades facilitated by the Regulatory Upgrade Program and other watershed management programs implemented, funded and managed by DEP.

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West Branch Silvicultural Treatment Results 1999-2011

Deborah Layton, Janice Rich, NYC Department of Environmental Protection

Silvicultural treatment of forests on New York City owned watershed lands has been on-going for many years. For lands on the east side of the Hudson River, many of the treatments were initially undertaken as part of dam rehabilitation projects beginning in 1996-1997. The objectives of treatment were to pay particular attention to conifer plantations and nearby natural deciduous stands that were approaching maturity and senescence, removing dead or dying hazard trees and thinning the stands to create openings to assure forest regeneration and remove exotic, invasive species as much as possible. Research plots were established in several locations, beginning in 1999. At West Branch reservoir in Putnam County, NY, these were established on three sites prior to silvicultural treatment and re-measured following thinning in 2001, 2005 and 2011.

Results of this long-term study show that the thinning was successful in reducing the overstory basal area of each of the three study areas, increasing numbers of trees in smaller diameter classes, continued growth of the retained overstory trees, and increasing numbers of tree seedlings. Tree regeneration may have been delayed in some cases by phenolic content of conifer litter which may take several years to become reduced to levels where deciduous seedlings can germinate and grow successfully. Expansion of hay-scented fern populations at one site may have also had a detrimental effect on early regenerations. Ten years following treatment, invasive and interfering species populations were either not significantly higher than pre-treatment or were reduced. Overall results of treatment have been positive for assuring health of watershed forests and their indirect benefits of nutrient uptake and stormwater mitigation.

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Sharing Outstanding Recreational Opportunities on NYC Water Supply Lands

Paul Lenz, Charles Laing, NYC Department of Environmental Protection

While recreational use of City land has been allowed for many years, DEP began a major effort beginning in 2007 to expand recreational opportunities and eliminate barriers to access. Efforts included the 2008 Cooperative Agreement with NYSDEC, the formation of Public Access Areas, eliminating DEP Hunt Tags and expanded recreational boating. Additionally, DEP has issued land use permits to many entities to allow for watershed partners to facilitate recreational activities, such as trail development and maintenance, special events such as walks for fund-raising and playgrounds and ballfields.

In 1999, as part of an MOA deliverable, DEP drafted the "Preliminary Report on Recreational Use of New York City Water Supply Lands." While the report focused primarily on recommendations for lands to be acquired under the MOA, it did speak to lands already owned by the City surrounding the reservoirs as well as recognizing some on-going recreational use. The report also set the framework for what recreational activities would and would not be allowed. Early DEP recreational programs were limited in scope to ensure the recreational uses had no negative impacts to water quality. As DEP gained experience with recreational uses of its water supply lands and waters, and impacts were minimal or non-existent, the decision was made to consider and allow greater recreational uses.

DEP recognizes the important role we play within the water supply watershed, especially in providing opportunities for watershed stakeholders to utilize our lands in ways that are compatible with water quality protection. As more and more private land becomes inaccessible to the general public, public land such as ours becomes increasing important to local economies. Additionally, recreational use such as deer hunting is important for reducing deer impacts on forest ecosystems. Currently, deer hunting is the primary tool for keeping deer numbers, and associated impacts, in check.

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Turbidity in the Esopus Creek Watershed: Historical vs. Recent

James Mayfield, NYC Department of Environmental Protection

In 2011 and 2012 large storm events occurred which resulted in elevated turbidities in the Esopus creek watershed. The impacts and duration of these elevated turbidities will be examined and compared to impacts from other large storm events in past years, some of which also led to the use of alum by NYC in order to meet the turbidity requirements of the Surface Water Treatment Rule. An analysis of seasonal differences of storm impacts on water quality will also be made. Trends in turbidity and streamflow over the past twenty years will also be presented. In addition to the mainstem of the Esopus Creek, results from the tributaries of the Esopus will be included. Additionally turbidity in the lower Esopus watershed over the last two years will be examined during the time that the Ashokan was releasing water downstream via the Ashokan Release Channel and/or the Ashokan Spillway. The Ashokan Release Channel is used to help reduce the amount of alum used by DEP to treat turbid water by releasing turbid water downstream, and can also be used to create a void in the reservoir to help accept storm flows or high seasonal runoff. An interim protocol for using the release channel was issued by NYS DEC in October 2011.

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Green Infrastructure in New York City: Stormwater Source Control Performance

John McLaughlin, Julie Stein, NYC Department of Environmental Protection; Sandeep Mehrotra, Matthew Jones, Hazen and Sawyer

Through pilot implementation and comprehensive monitoring efforts, the New York City Department of Environmental Protection has gained valuable information regarding the benefits of green infrastructure for stormwater management and CSO control, while also gaining insight into the challenges these systems can present. Although evaluations are still ongoing, monitoring data collected during 2011 at a number of source control pilots throughout the City have provided a foundation for preliminary assessments of the performance of these systems. Specifically, monitoring efforts have offered information on the effectiveness of these source controls in reducing the rate and volume of stormwater runoff leaving a site, in addition to qualitative assessments of maintenance requirements, appearance, and perception.

Preliminary assessments have provided information on the performance of bioretention, enhanced tree pits, street-side infiltration swales, permeable pavement, subsurface detention and infiltration systems, blue roofs, and green roofs. At some pilot locations, source control performance has been evaluated for more than 40 storm events, covering a range of storm characteristics and antecedent conditions. Evaluations to date have shown that all of the source control pilots provide some level of stormwater control, although the nature and extent of stormwater management varies. Through infiltration and related processes, many of the source controls are able to retain substantial stormwater volumes, reducing the amount of water that is discharged to the combined sewer system. These source controls have particularly been effective at managing runoff from smaller storm events, fully retaining storm flows in some cases. Detailed evaluations at individual sites have

provided valuable information regarding the performance and effect of individual design components, including curb cuts, conveyance swales, and underdrain systems. These evaluations are expected to assist in better understanding the benefits and challenges of green infrastructure, while also informing future design and implementation efforts.

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On-Site Wastewater Treatment Programs in the Watershed - A Status Update

Michael Meyer, NYC Department of Environmental Protection

For more than 15 years, DEP has worked cooperatively with a number of watershed partners including Catskill Watershed Corporation (CWC), NYS Environmental Facilities Corporation (EFC), counties, municipalities and private entities to develop and implement a number of programs that reduce the potential water quality impacts associated with improperly treated wastewater in the upstate water supply watershed. Collectively, these programs have resulted in approximately 7,000 OWTSs that have either been repaired, rehabilitated or connected to a centralized wastewater treatment system. The repair or conversion of these OWTSs is equivalent to millions of gallons of wastewater flow per day that is now properly treated before discharge into the New York City water supply watershed. Since the 1997 Watershed MOA, the overall contribution by DEP to implement the extensive OWTS rehabilitation or conversion programs exceeds $200,000,000.

Ultimately, these programs improve the quality of the drinking water supplies within the NYC Water Supply System and are a critical component to DEP's Long-term Watershed Protection Strategy. Examples of programs to be discussed include the CWC Septic Repair Program, New Infrastructure Program, Community Wastewater Program, Water Quality Investment Program, and Sewer Extension Program.

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Modeling the Evolution of Catskill Stream Channels - Preliminary Results

Rajith Mukundan, Ph.D., City University of New York; Elliot Schneiderman, Danny Davis, NYC Department of Environmental Protection; Eddy Langendoen, National Sedimentation Laboratory

Catskill Mountain streams provide up to 90% of the municipal water supply for 9 million residents of NYC through a network of six reservoirs draining approximately 3885 km2. High magnitude runoff events with flood frequency recurrence intervals greater than 10 years cause significant suspended sediment turbidity conditions limiting the use of up to 40% of this unfiltered water supply for drinking water. The Catskill Mountains were glaciated in the Pleistocene and the stream network has variably incised into the glacial “legacy” sediments which are enriched in fine sediment. When streams intersect clay-rich glacial till and/or glaciolacustrine silt and clay, fine sediment is entrained during high runoff giving the streams a characteristic red-brown turbidity with levels often exceeding 300 NTU (NYCDEP 2006). A multi-phase research project has been initiated to investigate the processes that control erosion, entrainment and transport of fine sediment in the Catskill Mountain streams as well as developing conceptual and quantitative modeling tools capable of simulating the evolution of stream channels under a range of hydro-climatic and watershed physical conditions. Here we present results from a preliminary analysis using the CONservational Channel Evolution and Pollutant Transport System (CONCEPTS) for Stony Clove, a tributary of the Esopus Creek watershed that drains to the Ashokan reservoir. This deterministic, numerical model is unique in that it accounts for the hydraulic and geotechnical processes that control streambank erosion, in addition to bed processes and the routing of flow and sediment. The potential response of the Stony Clove (representing channels characteristic of those in the Ashokan Basin watershed) stream channels under a range of hydrologic events and an examination of the limitations to the current version of CONCEPTS applied in a glaciated mountain fluvial system will be presented and used to inform the development of subsequent conceptual and quantitative process-based models.

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Mapping and Characterization of Wetlands along the Upper Esopus Creek, Ulster County, NY

Frank Parisio, NYC Department of Environmental Protection

The New York City Department of Environmental Protection conducted a field survey of vegetated wetlands along the 26.4 mile corridor of the Esopus Creek in Ulster County, NY. The survey was conducted during the 2009 and 2010 growing seasons. Sixty one vegetated wetlands were identified within the riparian corridor limits totaling more than 20 acres, which is significantly lower than the roughly 350 acres mapped in the National Wetlands Inventory (NWI). In general, the NWI overmapped the extent of riparian wetlands in the lower reaches of the creek, and undermapped the headwater reaches. Undermapping in the headwaters can be attributed to small wetland size (generally less than 0.1 acre). NWI overmapping

in the lower reaches can be attributed to overestimation of the extent of riparian forest meeting wetland criteria. The survey also characterized the distribution of native and non-native dominant plant species, wetland landscape settings, and noted wildlife use. In addition, a subset of the previously-mapped wetlands was visited after Tropical Storm Irene in 2011. Extensive sediment deposition and hydrologic modification as a result of an avulsed creek channel was observed. Future work is needed for a complete assessment of storm-related wetland impacts.

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The NYC Water Supply Operations Support Tool (OST): Planned Upgrades of Interim Functionality

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

The New York City Department of Environmental Protection (DEP), Bureau of Water Supply, is developing a decision support system called the Operations Support Tool (OST). OST will combine near-real-time data collection, cutting edge forecasts, and linked water quantity-water quality models to provide guidance to DEP managers operating the water supply. The system will help DEP maximize water supply reliability, support downstream water needs, and further enhance the flood mitigation already provided by the reservoirs.

OST is in daily use, but some of the main functionalities are currently interim products. This talk will describe the planned upgrades of several aspects of OST, scheduled to occur in the coming year. Main features include: 1) integration of probabilistic, meteorologically-driven inflow forecasts from the National Weather Service's (NWS) new Hydrologic Ensemble Forecast System (HEFS) to replace the existing Hirsch statistical forecasts; 2) development and integration of water demand forecasts; 3) implementation of a turbidity model for Rondout reservoir, similar to the models currently in use for Ashokan, Schoharie, and Kensico reservoirs; 4) a major expansion of DEP's automated snow monitoring network to provide near-real-time snow water data for OST usage, daily reservoir operations, and to assist NWS with stream forecasting; 5) an enhanced data acquisition, management, and quality assurance/quality control system; 6) improved data visualization, reporting, and alerting tools; and 7) a redesigned graphical user interface (GUI) to enhance use of the system.

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Northeast Orange County, NY Jurisdictions Begin Implementation of Projects to Address Regional Water Supply Goals

Michael Principe, Ph.D., HDR Engineering; David Church, Orange County Planning Department/Orange County Water Authority

Orange County, NY relies on water from both surface and ground water sources within 11 watershed basins within the County, as well as water from the New York City Aqueduct System. The Orange County Water Authority (OCWA) completed the Northeast Orange County (NE OC) Water Supply Feasibility Study in November 2010. This study, which addressed the future water resource needs of the Towns of Newburgh and New Windsor, and the City of Newburgh, evaluated the feasibility of constructing a “regional” water treatment facility that would serve each of these municipalities. In 2011, the OCWA filed an application for and was awarded a project implementation grant application under the New York State Department of State Local Government Efficiency (LGE) Grant Program. The proposed NE OC Water Supply Implementation Plan had two primary objectives: (1) to refine and evaluate the financial and technical details associated with each of the water supply alternatives identified in the feasibility study and (2) to select a preferred regional water supply alternative. Furthermore, the plan focused on the development of a facility plan and a basis of design report for the selected alternative and provided for the establishment of a number of inter-municipal agreements. This paper will present the results of the work that has been performed since the grant was awarded. Tasks undertaken as part of this work included the performance of a safe yield analysis for the City of Newburgh's water supply, an investigation of the options for supplemental water supply to the region, the evaluation and conceptual design of water supply interconnections to improve overall system reliability within the region, and the establishment of an institutional frame work to facilitate the overall regional water supply plan.

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Engaging Youth in Watershed Science through School-based Education Programs

John Schwartz, Kim Estes-Fradis, NYC Department of Environmental Protection; Diane Galusha, Catskill Watershed Corporation

For nearly two decades, DEP has worked alongside the Catskill Watershed Corporation (CWC), Watershed Agricultural Council (WAC), US Forest Service, Catskill Center for Conservation & Development, Trout Unlimited, and several private consultants, to develop and implement a series of interrelated upstate/downstate watershed education programs that target school-based audiences in both New York

City and upstate watershed communities. These programs strive to engage teachers and students in hands-on scientific learning activities such as water testing, stream monitoring, ecological studies, nature observation, and interpretive outdoor experiences. Given society's growing reliance on technology and increased academic attention being paid to “nature deficit disorder” (a term coined by Richard Louv in his 2005 book “Last Child in the Woods”), one core theme of the NYC Watershed's school-based education programs is to get students outside and cultivate a “sense of place” about the natural environment. Ultimately these programs seek to instill a deep-rooted environmental stewardship ethic among the next generation of watershed decision-makers - downstate consumers and upstate residents alike - who will understand the connections between their everyday actions and behaviors in relation to the source and quality of their drinking water supplies. This presentation will highlight individual school-based programs while describing the methods used to engage teachers and students in real-world science and technical issues pertaining to the NYC Water Supply System and DEP's Long-term Watershed Protection Strategy. Examples of programs to be presented include the CWC Public Education Grants Program; WAC Forestry Bus Tour Program; Watershed Forestry Institute for Teachers; Green Connections School Partnership Program; Trout in the Classroom; and the Catskills Stream & Watershed Education Program. Many of these programs take place at local environmental education centers, which themselves play a vital role in delivering hands-on watershed programming to upstate and downstate school-based audiences.

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Disk Filtration for Water Re-Use

David Silverman, PSI Process and Equipment; Daniel Loy, David Popowitch, Nova Water Technologies

Water supplies everywhere are subject to the pressure of external contamination. As supplies of clean water continue to diminish and groundwater supplies are depleted, re-use and reclamation of wastewater has become increasingly widespread as a supplemental water supply for secondary uses such as irrigation of non-food crops and vegetation. Many technologies are available for reclamation of water, and all are improving rapidly.

One such technology, disk filtration, has evolved in recent years and is now accepted for water recycling and re-use under California's Title 22 criteria.

Within the disk filtration category a “high rate disk filtration technology” has been developed to create multiple economic and performance benefits to improve the life cycle costs of reclaim water and tertiary filtration. These include improved effluent quality, higher loading rates, lower energy losses, improved energy efficiency, improved reliability and reduced backwash waste.

In this presentation, the characteristics, benefits and applications of this technology for water re-use will be discussed.

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Disinfection Byproducts (DBPs) in the NYC Water Supply System in the Aftermath of Tropical Storms Irene and Lee

Richard Van Dreason, NYC Department of Environmental Protection

Disinfection by-products (DBPs) in drinking water are a concern to water suppliers because of their suspected carcinogenic properties. 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. Studies have indicated a positive correlation between DBP formation and the concentration of organic carbon in the source water.

In late summer 2011, flooding from Tropical storms Irene and Lee caused organic carbon concentrations to increase throughout the NYC Water Supply, coinciding with elevated organic carbon and DBP concentrations in the distribution system. Operational changes successfully addressed high turbidity and fecal coliform, but elevated organic carbon was still able to reach distribution. Although compliance was maintained with the Stage 1 Disinfectant/Disinfection Byproduct Rule, there is concern that some sites would not meet the more stringent (i.e. site specific) Stage 2 rule, effective April 2012. In this presentation we will examine the storm impacts by presenting water quality data before and after the storms. We will also review operational changes to determine which source waters were likely responsible for the increased carbon observed in distribution and, to close, briefly discuss measures that DEP has taken in order to maintain future compliance with the Stage 2 Disinfectant/Disinfection Byproduct Rule.

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Moving Watershed Management into the Watershed

Rahul Verma, East of Hudson Watershed Corporation

The East of Hudson (EOH) watershed is approximately 375 square miles, and includes 10 reservoir and three lakes that supply approximately 1.3 billion gallons per day of drinking water for NYC. A Total Maximum Daily Load (TMDL) requirement has been developed for EOH for phosphorus. In 1997, The NYC Department of Environmental Protection (NYCDEP) and United States Environmental Protection Agency (EPA) executed the New York City Watershed Memorandum of Agreement (MOA), which established a comprehensive watershed management program.

A key component of the watershed management program is reducing phosphorus loading to the EOH reservoirs. Since 2006, intra-municipal committees in each county have been developing and implementing stormwater retrofit plans to meet this requirement. The EOH Coalition was formed as a regional stormwater entity (RSE). The Westchester and Putnam municipalities have negotiated funding of $38.2 million from the NYCDEP to design and construct stormwater retrofits within the Coalition communities. A major benefit to the Coalition members is that the NYSDEC)has established a "bubble compliance" program, whereby the Coalition members must all construct stormwater retrofits where the aggregate phosphorus reduction is at least 466 kilograms over the five year program.

The East of Hudson Watershed Corporation (EOHWC) was established in November 2011 for the purpose of implementing the stormwater retrofits on behalf of the 19 EOH Coalition communities. EOHWC has merged the three county stormwater retrofit plans into one plan for the EOH watershed. In Year 3, EOHWC will design and construct approximately 40 stormwater retrofit projects. These projects were identified in the inter-municipal committee plans. Other projects have been added to the plan by the host municipality, as existing projects are determined to be infeasible or as more efficient projects are identified. The retrofit practices will range from channel stabilization to basin modifications to filtration systems, with total engineering and construction costs of approximately $10 million.

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Application of a Culvert Assessment Procedure for Determining Compliance with USACE Nationwide and New York Regional Permit Conditions for Aquatic Life Movement and Management of Water Flows

Kevin Verweire, HDR Engineering, Inc.

On March 19, 2012, the U.S. Army Corps of Engineers (USACE) reissued Nationwide Permits (NWP) to authorize certain activities that require permits under Section 404 of the Clean Water Act and/or Section 10 of the Rivers and Harbors Act of 1899. Subsequently, the USACE Buffalo and New York districts issued NWP New York State Regional Conditions (NYSRC) that include new general conditions for all new, replacement or rehabilitated culverts to ensure compliance with NWP general conditions for Aquatic Life Movement (GC2) and Management of Water Flows (GC9). The NYSRC include specific assessment, design, and mitigation requirements that consider impediments to aquatic life movement and accommodation of bankfull flows. In order to meet the NYSRC for rehabilitated culverts at a proposed rail construction project in Saratoga County, the U.S. Forest Service (USFS) National Inventory and Assessment Procedure for Identifying Barriers to Aquatic Organism Passage at Road-Stream Crossings was applied to six existing culverts. The assessment procedure involved collecting information on the culvert structure/condition, surveying stream and culvert critical points, determining dominant substrate, and completing a field passage evaluation for target species. Data collected during the procedure allowed for identification of impediments to aquatic life movement and bankfull flows. The USFS FishXing software was used to further model impediments for target species and served as a useful planning tool. The USFS assessment procedure provided an efficient framework for data collection, analysis, and presentation which quickly led to USACE acceptance and issuance of a permit for the project.

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Piloting Recreational Boating on NYC Reservoirs - a Success in Public and Private Cooperation

John Vickers, NYC Department of Environmental Protection

This presentation will focus on the public and private cooperation that enabled the successful completion of a recreational boating pilot program from 2009 through 2011 at the Cannonsville Reservoir. The purpose was to improve regional recreational opportunities and promote environmentally sound economic development. Historically only metal rowboats were allowed on the reservoirs and only for the purpose of fishing. In 2008, with support from the Delaware County, NYC Department of Environmental Protection (DEP) decided to conduct a boating pilot program at Cannonsville Reservoir to allow other types of watercraft and recreational purposes. Key stakeholders assembled on 25 June, 2008 to initiate the program in the spring of 2009. The stakeholders included Delaware County and Town officials, USEPA, NYSDEC, NYSDOH, Catskill Watershed Corporation, Coalition of Watershed Towns and the Catskill Center for Conservation and Development. DEP and

stakeholder representatives formed a steering committee, established goals, planned critical program components and developed the necessary infrastructure. The committee used a collaborative consensus building process and agreed to three overriding principles - water quality protection, water supply security and public safety and five criteria for success: no measurable significant negative impact on water quality; no introduction of invasive species; enhanced economic development and stimulus; permanent implementation and consideration for expansion elsewhere; and improved relationships between the DEP and program partners. The pilot program ran from Memorial Day weekend 2009 and through Columbus Day and similarly for the next two years. Water quality was strictly monitored including intensified monitoring around the more popular launch sites and July 4th holiday weekends. Existing fisherpersons and the new recreational boaters were surveyed annually for satisfaction and suggested improvements. The pilot program ended in 2011. The program was declared a success and has been expanded it to three additional reservoirs, Neversink, Pepacton and Schoharie, which is being implemented now.

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Beyond Rating Curves: Time Series Models for in-Stream Turbidity Prediction

Lucien Wang, Nova Consulting & Engineering, LLC; Rajith Mukundan, CUNY Institute for Sustainable Cities/Hunter College; Mark Zion, Don Pierson, New York City Department of Environmental Protection

Turbidity control is a critical function of utilities managing surface water supplies. For New York City's System, a logical strategy for turbidity control is to temporarily remove the Catskill System from service. While effective in limiting delivery of turbid water and reducing the need for alum treatment at Kensico, this strategy runs the risk of negatively impacting water supply reliability. Thus, it is advantageous for NYCDEP to understand how long a particular turbidity event will affect their system. In order to understand the duration, intensity and total load of a turbidity event, predictions of future in-stream turbidity values are important. Traditionally, turbidity predictions have been carried out by applying streamflow observations/forecasts to a flow-turbidity rating curve. However, predictions from rating curves are often inaccurate because of inter-event and within event variability in flow-turbidity relations. Fortunately, predictions can be improved by applying an autoregressive moving average (ARMA) time series model on top of a rating curve.

Like streamflow, turbidity time series are serially correlated in time. ARMA models condition predictions using the serial correlation in recent observations. For example, imagine a storm event has passed through a basin; in-stream turbidity spiked in response and now observed turbidity is slowly trending downward. Using a rating curve, predicted turbidity would increase during the storm, but would quickly decrease after flow returns to average hydrology. Using a rating curve supplemented with an ARMA model, the recent observations are taken into account and predictions are adjusted accordingly. As a result, predictions from this model will have a more accurate, gradual slope to ambient conditions. This presentation details the ARMA model selection/calibration procedure and compares its predictive skill to traditional rating curves. Models for Esopus Creek above Ashokan reservoir are provided as examples and will become part of NYCDEP's Operations Support Tool.

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Innovative Trends in Wastewater Treatment for High Volume Hydraulic Fracturing

Ed Weinberg, ESSRE Consulting, Inc.

Marcellus Shale flowback water reuse and management is critical to environmentally and socially responsible natural gas drilling throughout the Appalachia region. Both the quantity and quality of flowback water present challenges in its safe disposal or reuse. Particularly in Pennsylvania, which has the greatest drilling activity for Marcellus Shale gas, PADEP rules and regulations limit the disposal options to out of state deep disposal wells (E. Ohio) and thus promote wastewater reuse as the predominant wastewater management option.

The presentation will provide a brief regulatory background (2011 PADEP rules and regulations) for high volume hydraulic fracturing wastewaters (flowback and produced waters) followed by an overview and evaluation of current, including novel, pretreatment and treatment approaches that promote the recycle or reuse of these wastewaters for beneficial reuse. Beneficial reuses include

- Treatment to a specified quality for reuse as source water for a nearby, subsequent fracking job
- Wastewater reuse as part of a permanent, renewable energy site

Overall wastewater treatment objectives focus on the removal of fouling or scale causing species, the removal or deactivation of microbial organisms and/or their food sources, and the reduction of the chloride levels (Total Dissolved Solids) to protect either downhole or downstream treatment equipment from damage (e.g., corrosion) or impediments to reliable, trouble-free performance. The unit operations (conventional and novel) discussed for pretreatment include filtration, chemical precipitation/sedimentation-clarification, electrocoagulation and sludge dewatering.

The unit operations for desalination include evaporative (thermal) treatment and non-thermal treatments. Lastly Zero Liquid Discharge (ZLD) approaches are discussed, crystallization and renewable energy solar ponds.

For each unit operation discussed, comparisons will be made between conventional equipment and current operating procedures and novel approaches or standard wastewater treatment equipment applied to Marcellus flowback or produced waters for the first time.

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Sustainable Point and Non-Point Source Nutrient Pollutant Phosphorus Control Using Nanotechnology

Ed Weinberg, ESSRE Consulting, Inc.

Nanomanufactured media that exploit adsorptive chemistry and ion exchange treatment to selectively remove and recover nutrients from wastewaters are presented. Impaired watersheds can benefit from improved water quality discharge, along with the added benefit of sustainable recovery of finite resourced nutrient Phosphorus, as soluble reactive phosphate solution, which helps offset the cost of treatment.

Adsorption of dissolved phosphate is enabled because of extremely fast kinetics achieved as a result of the significant increase in iron-oxide surface area of the novel nanomaterials. The presentation describes laboratory test results using Synanomet nanocomposites and commercially available Layne RT nano-based ion exchange media for the removal and recovery of phosphate via media regeneration. These sets of laboratory test results compare Layne RT and Synanomet nanocomposites in dose and mix testing and in an aquarium environment. Results have shown that the nanocomposites are super paramagnetic and also capable of removing odors from tested wastewater samples. Moreover, the test results indicate that Layne RT performed the best for maximum recovery of phosphate from point or non-point sources. Based on performance history of removing Arsenic from municipal drinking water supplies, Layne RT is immediately available for field demonstration of phosphate recovery from wastewater.

Full-scale application examples of nanotechnology, as a new alternative to enhanced chemical phosphorus removal at WWTPs, are provided. Integrated, "enhanced" BMPs are described that use the novel nano-adsorbents to reduce pollutant nutrient phosphorus from agricultural drainage and runoff.

The full-scale application of nanotechnology for sustainable recovery of phosphorus, a finite resource nutrient, will help transform ENR into Enhanced Nutrient Removal & Recovery (ENR&R). The resultant improved discharge water quality will help

- Restore impaired watersheds, i.e., Chesapeake Bay, via point source and non-point reductions in nutrient pollutant overloads
- Slowdown the arrival of “Peak” Phosphorus, which, arguably, is decades away, and
- Complement other point source nutrient recovery systems based on struvite precipitation.

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Innovative Process

Terry Wright, Trans Terra Technical Group (3TG)

The results and findings of a 3-rain event pilot at the Village of Whitehall will evaluate BOD & TSS concentrations of the wastewater and performance of the Flatline product. Whitehall NY was selected due to the high Inflow & Infiltration experienced during rain events >1/4". Wastewater samples will be taken at the start, middle and end of the rain events as well as random samples of the non-diluted wastewater.

The new Flatline Pilot will have the same pump cycles as the main influent pump station and treat the same wastewater as the existing WWTP. A new Flatline SCADA control system will provide automated control of the Flatline process and record real time measurements of COD and TSS. A UVAS and TSS sensor will be provided in this pilot to evaluate Flatline performance and for comparison to laboratory analysis.

New York State Pollution Prevention Institute will provide independent evaluation of the Flatline product in this pilot.

The presentation will include a summary of the test results and a design utilizing the Flatline product to treat a very diluted wastewater to 85%. If successful, the use of the Flatline process will reduce the projected capital costs to resolve the issue from $25 million to under $5 million.

This presentation will be of value to regulators, engineers and municipalities seeking new innovative approaches to resolving pump station bypasses, treatment of weak wastewater to 85%, as well as a new approach to headwork designs of conventional WWTPs.

Test results from a 4-month 7,000 GPD pilot in Guilderland, NY produced a consistent BOD reduction of 68% with a coagulant and 54% without a coagulant.

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An Evaluation of Water Quality Modeling Used to Inform Operational Decisions for the NYC Water Supply

Mark Zion, Donald Pierson, Elliot Schneiderman, NYC Department of Environmental Protection; Adao Matonse, CUNY Institute for Sustainable Cities

Turbidity is a primary factor that potentially limits use of Catskill System portion of the New York City Water Supply. During the elevated turbidity events daily decisions are carefully taken to optimize system operations for turbidity control, while ensuring adequate water storage levels within the entire water system. To support these decisions, a combination of watershed, reservoir water quality and water system simulation models are used to evaluate alternative operational scenarios within a probabilistic framework. These simulation models form the basis for the Operational Support Tool (OST) currently under development by New York City Department of Environmental Protection (DEP).
The OST model predictions are based on future forecasts of meteorology, streamflows, and operations to better understand the implications of a given operating strategy on future water quality. Uncertainty in future forecasts is estimated using a range of possible futures scenarios that are judged to be representative of present conditions, but based on past history. A retrospective analysis of water quality data collected during the model forecast period measures the response that actually occurred during the model forecast period, and gives an indication of the accuracy of the model results. This presentation compares the model forecasts to the data collected during the forecast period to better understand and evaluate the use of the modeling system in minimizing the impacts of turbidity within the water supply system.

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