



## Department of Health

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July 29, 2016

David S. Warne  
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NYC Department of Environmental Protection  
Bureau of Water Supply  
465 Columbus Avenue  
Valhalla, NY 10595

Dear Mr. Warne:

In accordance with the Revised 2007 Filtration Avoidance Determination (FAD), NYSDOH has conducted a review of NYC's compliance with the requirements of the FAD. The findings of this evaluation will serve as a reference as we develop the program requirements for the 2017 FAD. Please feel free to contact me if you have any questions or comments.

Sincerely,

Pamela L. Young, Ph.D.  
Chief, NYC Watershed Section  
Bureau of Water Supply Protection

Att.

Cc (electronic):

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# Implementation of New York City's Watershed Protection Program and Compliance with the Revised 2007 Filtration Avoidance Determination

**July 29, 2016**

Prepared by:  
New York City Watershed Section  
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New York State Department of Health



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## Acronyms

BMPs	Best Management Practices
BWS	Bureau of Water Supply
CATLEFF	Catskill Lower Effluent Chamber
CATUEC	Catskill Upper Effluent Chamber
CDUV	Catskill Delaware Ultraviolet Light Facility
CFR	Code of Federal Regulations
CFU	Colony Forming Units
CSBI	Catskill Streams Buffer Initiative
CWC	Catskill Watershed Corporation
DEL18DT	Delaware Shaft 18 Downtake
EIS	Environmental Impact Statement
EOH	East-of-Hudson
EPA	United States Environmental Protection Agency
EWP	Emergency Watershed Protection
FAD	Filtration Avoidance Determination
FBO	Flood Buy-Out
FEMA	Federal Emergency Management Agency
FMP	Forest Management Plan
GCSWCD	Greene County Soil & Water Conservation District
GIS	Geographic Information System
IMA	Inter-municipal Agreement
LAP	Land Acquisition Program
LFA	Local Flood Analysis
MAP	Management Assistance Program
MOA	Memorandum of Agreement
NIP	New Sewage Treatment Infrastructure Program
NMC	Nutrient Management Credit
NMP	Nutrient Management Plan
NOV	Notice of Violation
NRCS	Natural Resources Conservation Service
NTU	Nephelometric Turbidity Unit
NWI	National Wetlands Inventory
NYCDEP	New York City Department of Environmental Protection
NYCDOHMH	New York City Department of Health and Mental Hygiene
NYCRR	State of New York Codes, Rules, and Regulations
NYSDEC	New York State Department of Environmental Conservation
NYSDOH	New York State Department of Health
OST	Operations Support Tool
PFM	Precision Feed Management
RBP	Riparian Buffer Protection
SEQRA	State Environmental Quality Review
SMP	Stream Management Program
SOP	Standard Operating Procedure
SPDES	State Pollutant Discharge Elimination System

SSC	New York State Sanitary Code
SWTR	Surface Water Treatment Rule
USDA	United States Department of Agriculture
UV	Ultraviolet
WAC	Watershed Agricultural Council
WAP	Watershed Agricultural Program
WDRAP	Waterborne Disease Risk Assessment Program
WFP	Whole Farm Plan
WIG	Watershed Inspector General
WOH	West-of-Hudson
WR&Rs	Watershed Rules and Regulations
WSP	Water Supply Permit
WWQMP	Watershed Water Quality Monitoring Plan
WWTPs	Wastewater Treatment Plants

## Background and Purpose

This report summarizes an assessment by the New York State Department of Health (NYSDOH) of New York City's (the City) compliance with the requirements of its Revised 2007 Filtration Avoidance Determination (FAD). The 2007 FAD was initially granted in July 2007 by the United States Environmental Protection Agency (EPA), in consultation with NYSDOH. The 2007 FAD required the City to support a Land Acquisition Program for a ten-year period and defined the requirements and milestones for a number of other watershed protection programs for the First Five Year Period of the FAD.

The 2007 FAD described that at the end of the First Five Year Period, with the primacy agency taking the lead, EPA and NYSDOH would conduct a review of the City's compliance with the requirements of the FAD. In September 2007, EPA granted NYSDOH primary regulatory responsibility for the Surface Water Treatment Rule (SWTR) as it applies to the Catskill/Delaware water supply, making NYSDOH the primacy agency for oversight of NYC's FAD. As such, NYSDOH conducted the review of the City's compliance with the requirements of the First Five Year Period of the 2007 FAD. Based on its assessment, the *New York City Department of Environmental Protection 2011 Long-Term Watershed Protection Program*, and public input, NYSDOH issued the Revised 2007 FAD in May 2014.

The Revised 2007 FAD requires that NYSDOH, in consultation with EPA, will conduct a review of the City's compliance with the requirements of the Revised 2007 FAD and will issue a report on the findings of that assessment by July 31, 2016. This review, along with a number of other elements, will form the basis for the next renewal of filtration avoidance, scheduled for May 2017. Other key components of the overall FAD renewal process include:

- *2016 Watershed Protection Program Summary and Assessment* (March 2016) report by the City;
- Outreach to Watershed Stakeholders: EPA, NYSDOH and the New York State Department of Environmental Conservation (NYSDEC) have met with various Watershed stakeholders over the past few months to gather input for development of FAD program requirements;
- Public Information Sessions in June and July of 2016, held in Delhi, Hunter, Somers, New York City, and by webinar;
- Issuance of a draft 2017 FAD;
- Public Comment Period early 2017 to solicit comment on the draft 2017 FAD;
- State Environmental Quality Review Act (SEQRA) assessment of the potential environmental impacts of implementation of the 2017 FAD; and
- Issuance of a final 2017 FAD.

Although steps are being taken to develop a 2017 FAD, at any time NYSDOH may make a determination that the City no longer provides adequate protection of its Catskill/Delaware water supply and may require the City to filter that supply.

The remainder of this evaluation will address the City's progress in implementing major programs under the Revised 2007 FAD, as well as certain regulatory compliance

requirements. Unless otherwise stated, for the purposes of this report, the City's compliance with the Revised 2007 FAD requirements was assessed for the period from 2011 to 2015.

## Summary

Overall, the City has successfully satisfied the obligations specified in the Revised 2007 FAD.

For most programs, the City has met deadlines and achieved program goals. Notable accomplishments have been achieved through the Catskill Watershed Corporation's (CWC) Environmental Infrastructure Programs, including the remediation of 1,314 septic systems and pump out of 876 septic tanks in the West-of-Hudson (WOH) Watershed from 2011 to 2015. The Watershed Agricultural Program has successfully enrolled between 91-94% of the large farms WOH and most of these have developed Whole Farm Plans for addressing pollutant sources on farmlands. Progress has been made in developing flood hazard mitigation programs through the CWC and the City's Stream Management Program partners. These programs should help remove potential water supply contaminants from areas vulnerable to flooding, while at the same time reducing the risks of flooding in Watershed communities. The Stream Management Program has also been responsible for the remediation and stabilization of numerous streams and streambanks damaged by severe tropical storms in 2011, reducing inputs of eroded sediments and increasing resiliency to future storms. Improvements to the City's Operations Support Tool (OST) and the completion of an interconnection between the Delaware and Catskill Aqueducts at Shaft 4 have enhanced the City's ability to provide the best quality water to its consumers and to optimize the quantity of supply. Another significant achievement during the period covered by the Revised 2007 FAD was the completion and start-up of the Catskill-Delaware Ultraviolet Light (CDUV) Facility. Operation of the CDUV Facility helps ensure the safety of the City's unfiltered drinking water supply. However, some FAD program elements have experienced delays in implementation. In many cases, these delays were due to circumstances outside of the City's control or due to extreme weather conditions. For example, the community wastewater management projects have taken longer to complete than expected, due in large part to the extensive coordination needed between the City and the communities on both technical and administrative matters. NYSDOH has generally accepted the City's explanations and justifications in such cases. In some cases, continuous program implementation has been put at risk by issues with the City's contracting processes. NYSDOH encourages the City to investigate ways to address these issues to help ensure that FAD due dates are met and watershed protection is maintained.

NYSDOH believes that the City has a comprehensive and robust watershed protection program, which, overall, is being effectively implemented by the City and its partners. The City continues to provide drinking water to NYC and upstate consumers that meets all requirements of the SWTR.

## **Regulatory Requirements and Structure of the Revised 2007 FAD**

The conditions that a public water system must satisfy in order to avoid filtration of a surface water supply are defined in the SWTR and its amendments, specifically 40 CFR §141.71, §141.171, and §141.712 of the federal code of regulations and 10 NYCRR Part 5, Subpart 5-1, Section 1.30(c) of the NY State Sanitary Code (SSC). The federal code separates the filtration avoidance requirements into two categories: source water quality conditions and site-specific conditions. Source water quality conditions include fecal or total coliform levels and turbidity levels measured immediately prior to the first point of disinfection. Site-specific conditions include disinfection, watershed control program, inspection, and distribution water quality requirements, as well as a requirement that the system must not be identified as a source of a waterborne disease outbreak.

The Revised 2007 FAD summarizes the programs, along with activities and schedules, that the City and its partners have committed to as part of their watershed protection and filtration avoidance efforts. The FAD programs are grouped into the following broad categories, which cover both the source water quality and site-specific conditions defined by the SWTR:

- Program to monitor/document compliance with filtration avoidance criteria (“Objective Criteria”) (FAD Section 2);
- Comprehensive environmental infrastructure programs to reduce pollution from sewage and stormwater (FAD Sections 3.1 – 3.5);
- Various protection and remediation programs, such as Land Acquisition and Catskill Turbidity Control, to protect and improve water quality (FAD Sections 4.1 – 4.11);
- Watershed monitoring, modeling and Geographic Information Systems (GIS) (FAD Sections 5.1 – 5.3);
- Regulatory programs to ensure compliance with Watershed Rules & Regulations (WR&Rs; FAD Sections 6.1 – 6.2);
- Construction of the CDUV Facility (FAD Section 7);
- In-City programs to assess risk of waterborne disease and prevent cross connections between the water distribution system and contaminant sources (FAD Sections 8.1 – 8.2);
- Administrative Program to ensure adequate staffing and funding for FAD programs (FAD Section 9); and
- Education and Outreach to enhance understanding of and strengthen collaboration in watershed protection efforts (FAD Section 10).

The inspection element of the SWTR’s site-specific conditions, which is an on-site assessment of the adequacy of the water system’s watershed control program and disinfection processes, is performed annually by NYSDOH.

Evaluations of all FAD programs are provided below.

# Evaluation of the City's Compliance with the Revised 2007 FAD by Program

## *Surface Water Treatment Rule Objective Criteria Compliance*

### **FAD Section 2. Surface Water Treatment Rule Objective Criteria Compliance**

#### Revised 2007 FAD Requirements

The Objective Criteria include numeric requirements for turbidity, fecal coliform bacteria, and disinfection byproducts, as well as requirements for system operations. The water system must provide adequate disinfection, and must also have redundant disinfection system components. Under the Revised 2007 FAD, the City must continue to meet all of the Objective Criteria in order to maintain its filtration avoidance status for the Catskill/Delaware system. The Revised 2007 FAD also obligates the City to conduct a monitoring program and to report results in accordance with applicable State and federal regulations.

#### Evaluation of the City's Compliance

NYSDOH has evaluated the City's compliance with the Objective Criteria for maintaining filtration avoidance through review of the City's monthly monitoring reports and conducting annual inspections of water system infrastructure, treatment processes, and instrumentation. The SWTR specifies that compliance monitoring for source water quality shall be conducted immediately prior to the first or only point of disinfectant application. For the City's Catskill/Delaware water supply, under normal operating conditions, sampling of source water is performed at the Catskill Lower Effluent Chamber (CATLEFF) and at the Delaware Shaft 18 downtake (DEL18DT). Both CATLEFF and DEL18DT are located near the south end of the Kensico Reservoir. As noted in Table 1, the City has satisfied the Objective Criteria's numeric requirements for coliform bacteria for the Catskill/Delaware system. One sample exceeded the numeric requirement for source water turbidity, as explained below.

In addition, the City has not exceeded the concentrations allowed for disinfection byproducts in the distribution system (i.e., 12-month running averages of 80 microgram/liter (ug/L) for total trihalomethanes and 60 ug/L for haloacetic acids). For the Second Five Year Period, the quarterly running averages for total trihalomethanes and haloacetic acids have ranged from 9 – 53 ug/L and 10 – 51 ug/L, respectively. CT values, which are the product of disinfectant concentration and contact time, were adequate during the assessment period (i.e., the daily Inactivation Ratio, or IAR, was always greater than 1.0 during the period).

Table 1. Catskill/Delaware System Source Water Turbidity and Fecal Coliform Levels, 2012-Present.

Year	Catskill Lower Effluent Chamber <sup>(a)</sup>		Delaware Shaft 18 Downtake	
	Maximum 4-Hour Turbidity Measurement (NTU) <sup>(b)</sup>	Maximum Percent of Fecal Coliform Samples >20 CFU/100mL <sup>(c)</sup>	Maximum 4-Hour Turbidity Measurement (NTU) <sup>(b)</sup>	Maximum Percent of Fecal Coliform Samples >20 CFU/100mL <sup>(c)</sup>
2012	1.4	6.1%	6.0	6.5%
2013	Offline		2.2	0.5%
2014	Offline		2.4	0.5%
2015	Offline		1.7	0.0%

Notes:

(a): The Catskill Lower Effluent Chamber was taken offline September 13, 2012.

(b): To maintain filtration avoidance status, turbidity level in a representative sample of the source water cannot exceed 5 Nephelometric Turbidity Units (NTU) unless it is determined that the turbidity was caused by an unusual and unpredictable event, and no more than two such events have occurred in the previous 12 months or five such events in the previous 120 months. An event is a series of consecutive days during which at least one turbidity measurement each day exceeds 5 NTU, see 40 CFR §141.71(a)(2) and 10 NYCRR 5, Subpart 5-1.30(c)(2).

(c): To maintain filtration avoidance status, at least 90% of water samples collected prior to disinfection must exhibit fecal coliform concentrations no greater than 20 Colony Forming Units/100 milliliters (CFU/100 mL) in the preceding six months of water service to the public, see 40 CFR §141.71(a)(1) and 10 NYCRR 5, Subpart 5-1.30(c)(1).

At the entry points to the distribution system, free chlorine residual concentrations were never less than 0.2 milligrams/liter (mg/L) for more than four hours.

In the distribution system, a free chlorine residual was maintained, or a heterotrophic plate count value was less than 500 CFU/mL, in all compliance samples.

The City has also satisfied the system operation requirements, including the operational status of the disinfection facilities at the Kensico and Hillview Reservoirs.

The percentage of total coliform positive samples in the distribution system during the assessment period was as follows: 2012: 0.3%; 2013: 0.2%; 2014: 0.4%; and 2015: 0.6%. There were no *E. coli*-positive compliance samples in the distribution system during the assessment period.

The Revised 2007 FAD includes requirements for the City to begin preparations for an independent outside group of experts to review the City's Long-Term Watershed Protection Plan, water quality and water quality trends, and anticipated future activities that might adversely impact the water supply. The expert panel will evaluate the adequacy of the City's Watershed Protection Programs for addressing these concerns and provide recommendations, as necessary, for improving programs. The City is required to participate in a Watershed stakeholders meeting on the study and submit a Scope of Work for the expert panel; these deliverables were met in March and September 2015, respectively.

All other reporting requirements for this section were satisfied. Therefore, the City has met the objective criteria required to maintain filtration avoidance status for the Catskill/Delaware system.

As shown in Table 2, NYSDOH issued one Notice of Violation (NOV) to the City during the Second Five Year Period. In comparison, during the First Five Year Period, NYSDOH issued seven NOVs to the City. This NOV was for source water turbidity exceeding 5 NTU. On October 29, 2012, wind-induced turbidity experienced during Hurricane Sandy led to an exceedance in the 8:00 PM compliance sample, with a reading of 6.0 NTU. Although operational changes were made at Delaware Shaft 18, including opening the bypass from Delaware Shaft 17, City was unable to avoid exceeding the 5 NTU source water turbidity limit. After reviewing all available data, and due to the transient nature of the event, NYSDOH determined that it did not constitute a public health hazard. However, it did constitute a treatment technique violation for exceeding the source water turbidity limit.

In response to the exceedance, NYSDOH issued a violation on November 5, 2012, requiring the City to perform Tier 2 Public Notification and to submit a Corrective Action Report. The City submitted a Corrective Action Report on December 5, 2012.

Any violations that NYSDOH issues to the City require the City to submit Corrective Action Plans that document the steps taken to remedy the protocols, operations, and site conditions that led to the violations. The City continues to work collaboratively with NYSDOH to minimize future occurrences of violations.

Table 2. Catskill/Delaware System Violations of 10 NYCRR Subpart 5-1, 2012-Present

Violation Number	Date	Applicable Code <sup>(a)</sup>	Remarks
2013-2116	October 29, 2012	5-1.30(c)(2) - Raw Water Turbidity	Treatment Technique Violation

Notes:

(a): Further clarification is provided by 40 CFR §141.71(c)(2)(i), which states that it is a treatment technique violation if the turbidity in a representative source water sample exceeds 5 NTU.

## ***Environmental Infrastructure Programs***

### **FAD Section 3.1 Septic and Sewer Programs**

#### Revised 2007 FAD Requirements

The identification and remediation of septic systems that are substandard, likely to fail, or failing is important in protecting public health and water quality for a number of reasons. First, an improperly working septic system does not protect against environmental exposure to pathogenic microorganisms and viruses that are present in sewage. This is not only a

danger to the City's water supply, but also to local residents who can be exposed to human waste. Second, a poorly functioning septic system can release nitrogen, phosphorus, and organic matter to waterways. These nutrients can lead to excessive growth of algae and increased eutrophication potentially leading to water supply issues such as: harmful algae blooms, loss of deep water oxygen, iron and manganese problems, and taste and odor problems. Furthermore, increased organic matter from algae, septic systems and sewers, as well as from agricultural and natural watershed sources, can lead to elevated water system disinfection by-products.

The Revised 2007 FAD requires the City to continue to implement a Septic and Sewer Program aimed at preventing the potential impacts of improperly functioning septic systems. The City's overall septic and sewer effort is divided into five separate programs: Septic Remediation and Replacement Program, Septic Maintenance Program, Sewer Extension Program, New Sewage Treatment Infrastructure Program, and Community Wastewater Management Program. The latter two programs (New Sewage Treatment Infrastructure Program, and Community Wastewater Management Program) each have their own FAD sections, 3.2 and 3.3, respectively. The City has worked closely with the CWC to implement this program WOH. The City's enforcement of its WR&Rs (in effect since May 1, 1997 and revised April 4, 2010) is also an important component of this program.

#### Evaluation of the City's Compliance

The City has largely been successful in dealing with ongoing elements and new initiatives in the Septic Remediation and Replacement Program. This program was initially designed to provide inspection, pump-outs, and, where necessary, repair or replacement of systems for single or two family residences in the WOH watershed that are failing or likely to fail. Separate septic programs are being implemented East-of-Hudson (EOH) partnering with county health departments. Details of these programs are provided in the Kensico and EOH sections of the Revised 2007 FAD. This WOH program has been implemented since 1997 to prioritize addressing those septic systems most likely to impact the City's water supply (i.e., those closest to intakes and water courses), and the priority areas have expanded to a wider area over time and currently includes systems within 700 feet of a watercourse or the 60 day time of travel. This ongoing part of this program is meeting its goals with 227-292 systems being remediated each year over the last five years and 4,879 systems overall since 1997. The CWC also started a program in 2009 that pays up to 75% of the cost of septic system remediation, with a cap of \$40,000 per system, for small businesses (< 100 employees) within 100 feet of a waterway. Three businesses participated in this program in the First Five Year Period of the 2007 FAD. This program is now expanded to small businesses within 700 feet of a waterway, and twelve more septic systems were remediated between 2011 and 2015.

The 2007 FAD required the City to develop program rules and provide funding for repairing or creating new cluster systems. Cluster System Program rules were accepted by CWC and the City in April 2011 in order to foster support of the continued use of the funding allocated in the First Five Year Period of the 2007 FAD for the Cluster System Program. The City worked with CWC to explore implementation and examine the program terms to facilitate the advancement of the Cluster System Program component of the Septic Remediation and Replacement Program. To date, no communities have applied to participate in this program.

The Septic Maintenance Program is administered by the CWC. Residents who have participated in the septic repair program or whose systems were constructed after 1997 may have 50% of the cost of septic tank pump-out reimbursed. This program also provides educational information to homeowners on septic system use and the role of regular maintenance in avoiding expensive system failures and dangerous sewage releases. This program is gaining in popularity among watershed residents. There were 112 participants in 2011, with the number of participants increasing each year to 224 in 2015. A total of 1,415 homeowners have participated in the program since it started in 2004.

The Sewer Extension Program was developed to extend lines to collect sewage in priority areas with failing septic systems. The projects for the towns of Roxbury (Grand Gorge Wastewater Treatment Plant; WWTP) and Neversink (Grahamsville WWTP) were completed during the First Five Year Period of the 2007 FAD. The Revised 2007 FAD requires work to continue on three additional sewer extension projects. The Hunter-Showers Road (Tannersville WWTP) project was completed in October 2015. Designs have been completed and construction initiated for the remaining two sewer extension projects in the towns of Shandaken (Pine Hill WWTP) and Middletown (Margaretville WWTP). Successful program implementation is dependent upon completion of certain municipal actions. Most recently, a fire destroyed equipment scheduled for installation at these two projects. For these types of reasons, the City is not able to entirely control project completion times; however, the City anticipates the remaining two projects will be completed in 2016. In order to better understand the delays that have impacted these projects, in January 2016, NYSDOH required the City to begin to provide semi-annual updates.

In summary, the City has maintained substantial ongoing progress in Septic and Sewer Programs. The Septic Remediation and Replacement Program is meeting its goals and is now open to homeowners and small businesses within 700 feet of waterways and/or the 60 day time of travel zone that meet the criteria set forth in the CWC program rules. The Septic Maintenance Program is gaining in popularity. All in all, the work performed under these programs in the last five years has strengthened the City's ability to protect the WOH water supply from septic system inputs and to continue to comply with the SWTR.

## **FAD Section 3.2 New Sewage Treatment Infrastructure Program**

### Revised 2007 FAD Requirements

The goal of the New Sewage Treatment Infrastructure Program (NIP) was to assist communities identified in the 1997 Memorandum of Agreement (MOA) in their wastewater management needs and to protect water quality from contamination associated with failing and likely-to-fail septic systems constructed in close proximity to water courses. Through this program the City provided funding to assess communities' wastewater infrastructure needs, and to offer technical assistance and funding for the construction of the recommended solutions. The City implemented the NIP in accordance with the requirements described in its 2011 Long-Term Plan.

### Evaluation of the City's Compliance

Prior to this assessment period, six of the seven NIP projects had been completed in Andes (2005), Roxbury (2005), Hunter (2005), Windham (2005), Fleischmanns (2007), and Prattsville (2007). Due to circumstances beyond the City's control, construction of the seventh project for Phoenicia did not get advanced by the Town of Shandaken.

This voluntary program has effectively protected water quality from the potential contamination associated with failing and likely-to-fail septic systems. Nearly \$80 million was provided by the City to implement the NIP. As indicated in the Revised 2007 FAD, the NIP has met its programmatic goals and was considered concluded in 2012.

## **FAD Section 3.3 Community Wastewater Management Program**

### Revised 2007 FAD Requirements

The Community Wastewater Management Program provides funding for the design and construction of community septic systems, including related sewerage collection systems, and/or the creation of septic maintenance districts, including septic system replacement, rehabilitation and upgrades as well as operation and maintenance of the district. A number of communities are included under this program. In the 2002 FAD, a total of five communities were added to the program. These communities include Bloomville, Boiceville, Hamden, DeLancey, and Bovina. Ashland was added to the program in 2006. The First Five Year Period of the 2007 FAD provided funding for Trout Creek, Lexington, and South Kortright. The Revised 2007 FAD requires the City to commit funding to complete projects for Shandaken, West Conesville, Claryville, Halcottsville, and New Kingston. By the end of June 2016, construction of Trout Creek, Lexington, and South Kortright is to be completed, and a study and design are to be completed for Shandaken and West Conesville. In addition, the City is required to conduct a study to determine the potential need for a community wastewater management system for the Hamlet of Shokan.

### Evaluation of the City's Compliance

This program has deadlines that extend beyond the ending date of the Revised 2007 FAD where communities have been added to the program. Wastewater management systems for all five communities from the 2002 FAD and Ashland have been completed. The City has approved funding for the remaining eight community projects covered under the 2007 and Revised 2007 FADs. A community septic system was completed for Trout Creek in 2014. The Lexington and South Kortright systems missed their completion dates of December 31, 2015 and December 31, 2014, respectively; however, both are expected to be completed by fall of 2016. Preliminary Engineering Reports have been submitted for both the Shandaken and West Conesville projects, but the June 30, 2016 FAD deadline for designs for these two projects was not met.

The City completed a proposal for a study to determine the potential need for a community wastewater management system for the Hamlet of Shokan, but this proposal was not approved by NYSDOH, EPA, and NYSDEC. This study proposed to determine the need for

a wastewater system based entirely on the detection of pathogens and their indicators in the waters in and around the hamlet. This proposal was rejected because NYSDOH determined that non-detection of pathogens/indicators as a result of such a study does not necessarily negate the need for community wastewater management. The study was amended to include some of the same elements that were used to determine the need for wastewater systems for the other communities addressed by this FAD program. Results of this study have been submitted as required and are currently under review by NYSDOH, EPA, and NYSDEC.

The Community Wastewater Management Program has been an effective tool for protecting the Watershed from the potential for contamination from failing septic systems in relatively densely populated areas. However, due to a number of issues, including the length of review and approval processes and land acquisition issues, deadlines have been missed, delaying the construction and operation of these systems. The protection from pathogens and eutrophication-related water quality problems offered by this program are critical to long-term compliance with the SWTR. While there has been substantial success in this regard to date, it is important to understand and minimize delays in the construction of these systems. In order to better understand and help mitigate these issues in a timely manner, in January 2016, NYSDOH required the City to begin to provide semi-annual updates on these projects.

## **FAD Section 3.5 Stormwater Programs**

### Revised 2007 FAD Requirements

The Revised 2007 FAD requires the City to implement and fund the Stormwater Programs as described in its 2011 Long-Term Watershed Protection Program, and meet several other activity and reporting requirements for these programs. The Stormwater Programs are comprised of the Stormwater Retrofit Program, the Future Stormwater Controls Program, and the Local Technical Assistance Program. The Retrofit Program, administered by the CWC and the City, provides grants to implement best management practices (BMPs) and improve water quality for pre-1997 stormwater structures. The Future Stormwater Controls Program, administered by CWC, funds the incremental costs required by the City's Watershed Rules and Regulations (WR&Rs), which are in addition to federal and state requirements. The Local Technical Assistance Program, administered by the CWC and the City, provides grants to support watershed protection and enhance quality of life in watershed communities. In addition, the City is required to ensure adequate funding for an engineering position to assist applicants in complying with the City's WR&Rs.

### Evaluation of the City's Compliance

Revisions were made to the Stormwater Retrofit Program Rules by CWC and the City, and issued in 2015, providing for an annual application and review process, among other changes. Fourteen stormwater retrofit applications were funded and completed for a total of approximately \$4.2 million. The funding focused on street drainage, stormwater separation, and highway maintenance activities. Two stormwater retrofit planning and assessment projects were funded. Six Local Technical Assistance projects were approved during the

period, three of which remained open at the end of 2015. These projects included generic environmental impact statements, comprehensive plans, and zoning law updates. The City also funded approximately \$1.4 million in incremental costs for stormwater controls required by the WR&Rs. With funding from the City, CWC continued to employ a staff person who was available to assist applicants who needed to comply with the stormwater provisions of the WR&Rs.

NYSDOH believes that the Stormwater Programs have been effective, and are an important part of the City's watershed protection program.

## ***Protection and Remediation Programs***

### **FAD Section 4.1 Waterfowl Management Program**

#### Revised 2007 FAD Requirements

The Waterfowl Management Program was developed to evaluate and mitigate pollutant impacts such as fecal coliform bacteria and phosphorus deposition from migratory and resident water birds. The program was initiated in 1993 in response to elevated levels of coliform bacteria at Kensico Reservoir. The program was later expanded to include West Branch, Rondout, Ashokan, Cross River, Croton Falls, and Hillview Reservoirs. Bird harassment and deterrence techniques are utilized to prevent waterfowl from inhabiting the reservoirs.

Bird deterrence methods include nest and egg depredation, overhead wires, bird netting on shaft buildings, meadow maintenance, and other methods. Bird harassment methods include pyrotechnics, motorboats, airboats, remote control boats, propane cannons, and other methods to frighten waterfowl off the reservoirs.

#### Evaluation of the City's Compliance

The City has met all waterfowl management requirements for this program. Avian harassment techniques were used on Kensico between August 1 and March 31 of each year and year round on a daily basis on Hillview Reservoir. Bird harassment was not required at West Branch, Rondout, Ashokan, Cross River, or Croton Falls Reservoirs during the assessment period. Bird deterrent measures were practiced as needed on all the reservoirs covered by this program. All required Summary of Waterfowl Management Program reports were submitted on time.

The Waterfowl Management Program is a critical component of the City's watershed protection plan, and remains an important element of source water protection from contamination by fecal coliform bacteria.

### **FAD Section 4.2 Land Acquisition Program**

## Revised 2007 FAD Requirements

The goal of the Land Acquisition Program (LAP) is to ensure that environmentally-sensitive watershed lands remain undeveloped and permanently protected in order to avoid future degradation in water quality. The terms and conditions of the LAP are defined by the City's Water Supply Permit (WSP), initially issued by NYSDEC in 1997 and renewed in 2010. The historic flooding due to Tropical Storms Irene and Lee in August and September 2011 led to additional components of the program being included in the Revised 2007 FAD. The City is required to participate in the Federal Emergency Management Agency's (FEMA) Flood Buy-Out (FBO) program, which made funds available through the State Office of Emergency Management to help purchase lands with flooded structures and remove or elevate structures out of the floodplain. The City is also required to develop and implement a City-funded FBO program where developed properties can be purchased in order to remove structures that may contribute to flooding and impact water quality. While the City is only allowed to acquire vacant land under most of the LAP, this is not the case for the City-funded FBO program. In order to permit the purchase of properties with habitable buildings for City-funded flood buy-outs, the City is required to request a modification to its WSP by July 31, 2014.

The Revised 2007 FAD requires the City to adequately fund the LAP for the remaining period of the FAD, during which the City committed to solicit to purchase, in fee simple or through conservation easement, at least 300,000 acres of land. Up to 10,000 acres per year of acres solicited for the Riparian Buffer, FBO, and Watershed Agricultural Council (WAC) Farm and Forest Easement programs could also be counted towards this solicitation goal.

Additional requirements for this program include developing and implementing a pilot Riparian Buffer Acquisition Program and developing an Enhanced Land Trust program. The City is also required to provide \$6 million to WAC for a forest conservation easement program, and execute a contract with WAC to support the stewardship and enforcement costs associated with WAC's conservation easements.

## Evaluation of the City's Compliance

The LAP continues to be very successful and has met or exceeded most goals set forth in the FAD. Solicitation goals have been exceeded, the City has successfully developed re-solicitation strategies for specific landowner and property types, and the protected status of high priority sub-basins is steadily increasing. As of March 2016, the City owns or controls 16.7% of its watershed, up from the 3.3% owned prior to 1997. Together with lands protected by other agencies and organizations, nearly 38% of the Watershed is currently permanently protected.

The City provided the local 25% match required under the FEMA FBO program, and LAP staff assisted local communities throughout this process. The City met the FAD requirements for development of and committing funding for a City-funded FBO program. A request to NYSDEC for a WSP modification to implement the program was made on June 11, 2014, meeting the FAD due date. As acquisition by the City of lands with habitable structures and lands within hamlet areas can raise some concerns for Watershed communities, the language of the modification and the process rules for the program

involved months of deliberation, involving the City, Watershed stakeholders, and regulators. Approval for the modification was granted by NYSDEC on June 15, 2016. The City-funded FBO program is now beginning to be implemented. Properties have been identified in a number of completed Local Flood Analyses (LFAs), and more LFAs are underway.

Although the pilot Riparian Buffer Acquisition Program is required by the City's WSP to begin implementation by November 1, 2014, a five-year contract with the Catskill Center for Conservation and Development to implement this program was not executed until July 15, 2015. Delays to implementation were due in part to a change in the land trust that would implement the program and changes in management of the Catskill Center for Conservation and Development. Solicitation for the program began in April 2016, with 47 landowners, involving 477 acres, being solicited. The City is required to submit an evaluation report on the program six months before the end of the pilot program period.

While the City has met all deliverables related to the Enhanced Land Trust Program, and land trusts have been used for some deals, for a variety of reasons this program has not been utilized to the extent anticipated. The Land Trusts were expected to be particularly helpful in working with landowners that did not want to work with the City and in cases where large tracts contained habitable dwellings (which would be subdivided out prior to conveyance of the vacant portion of the parcel to the City). Five WOH towns have opted into the Enhanced Land Trust program. However, to date, only six properties of interest to the Land Trusts have been identified in these towns, and none of these have been acquired. The City continues to work with the Land Trusts in other ways (e.g., to help them obtain accreditation, to assist with outreach related activities, and to support the purchase of insurance policies for some Land Trusts) and will continue to explore other opportunities.

The WAC Forest Easement Program contract was executed in 2013. Since then, program rules and selection criteria for the program have been developed. As of May 2016, 119 landowners were solicited and about 4,800 acres have applied for the program. To date, at least one of these parcels has been appraised. The due date in the Revised 2007 FAD for completing an evaluation of this program is December 15, 2017.

The contract with WAC to fund the costs associated with stewardship and enforcement of WAC's conservation easements was awarded in May 2016, which was later than the FAD due date of March 31, 2015. The City cited delays due to a change in staff in the City's contracting group. Despite the delay, the City continued funding these costs under its existing contract with WAC. Beginning in 2020, the new contract will pay for stewardship and enforcement costs as well as contribute towards an endowment, available in 2036, that will fund these costs in perpetuity.

Unlike most of the other water systems in the United States with filtration avoidance, the NYC watershed contains many communities. Maintaining the economic vitality of these communities has been a consideration in the development of the City's LAP. The City maintains its FAD based on the generally high quality of its water supply, flexibility in the operations of the water system that allows switching between reservoirs and other measures, extensive monitoring and modeling, and a strong watershed protection program. The goal of land acquisition is not necessarily to improve water quality, rather it is designed to preserve the most important of remaining natural features in the Watershed and thereby prevent future degradation of water quality by limiting future development. While

recognizing the limitations on land acquisition that must be considered in a populated watershed, NYSDOH continues to support the City's LAP as an important tool for watershed protection.

## **FAD Section 4.3 Land Management**

### Revised 2007 FAD Requirements

Reservoir water quality is largely dictated by human activities and the nature of the lands in the Watershed. Therefore it is important to foster stewardship and regulate activities that could negatively impact water quality. Establishing conservation easements and purchasing sensitive land are effective tools for maintaining control over watershed land use. However, ownership and/or control of land and a “forever wild” approach are often not adequately protective of water quality. Various levels of active management are frequently required to foster healthy forests and other natural resources, control invasive species, and allow recreational opportunities.

The Revised 2007 FAD requires the City to monitor water supply lands, enforce the conditions of conservation easements, maintain a watershed land information system, implement the City’s Forest Management Plan, conduct forest inventories, assess deer populations and their impacts, develop an Invasive Species Management Strategy by December 31, 2016, and continue to enhance opportunities for public recreational use of the City’s watershed lands.

### Evaluation of the City’s Compliance

All goals of this program continue to be met. Monitoring via site visits, aerial surveillance, and GIS analysis of orthophotos is very important to managing the Watershed land holdings. All pertinent data on properties is stored in the Watershed Land Information System (WaLIS). This system was updated to track community public water system aqueduct connections and billing information. In addition, this system was further improved and individually customized to specific program needs to better serve the City’s staff, and a web-based simplified version was created for less intensive users.

City-owned lands are classified as being High or Standard priority, with inspections taking place annually and at least every five years, respectively. High priority lands consist of: places with an elevated security concern (e.g., intakes), areas with existing or future high intensity recreational uses, and properties with a history of trespass or encroachment. Easements are inspected twice each year. Properties are posted within 90 days of closing, and boundaries maintained during site visits and inspections. It is also important for the City and WAC to maintain good relationships with land owners with conservation easements, particularly when these properties are sold to new owners who may not understand the terms of the easement and/or lack a similar conservation ethic as the previous owner. Along with monitoring, these positive relationships likely contribute to the rarity of easement violations in the Watershed and help the City in its outreach to procure new lands for purchase and easements.

Managing forestry lands is particularly important in protecting water quality, and the City partnered with the US Forest Service to develop its first comprehensive forest management plan. The majority of the forests in the Watershed are relatively old and susceptible to invasive species, and declines in condition may occur without proper management. Timber

harvest plans have been developed to improve forest health, and these harvests are also used to address storm blowdowns and emerald ash borer damage.

The potential impacts of invasive species on the Watershed are the focus of the City's Invasive Species Working Group. Working with its partners, this group has implemented an Early Detection and Rapid Response Plan and its Invasive Species Strategy to help detect, monitor and manage at least 44 species that are considered significant threats to water quality. The City will be further strengthening the efficacy of this program through the development of an Invasive Species Management Strategy.

The City is successfully increasing recreational opportunities in the Watershed, and has developed strong partnership relationships. The City has developed an interactive map of the Watershed Recreation Areas (<http://www.nyc.gov/html/dep/html/recreation/index.shtml>) to allow users to find City-owned properties and the types of permitted recreation in each area. Hunting plays a very valuable role in reducing the deer population, which helps with forest regeneration and increases road safety, and the City has worked with NYSDEC to develop a program to increase the taking of does to provide better population control. The City also allows fishing from steam-cleaned (for zebra mussel control) and registered rowboats that have to remain on site for the season. Day and seasonal use of other non-motorized boat types is now allowed on some WOH reservoirs, and a program was developed to allow vendors to rent boats to users. Reservoir cleanup days and other stewardship activities performed by various organizations are used to make improvements and serve as a valuable education tool.

In addition to recreation, the City allows watershed residents to use some of their holdings for economic benefit. This includes: bluestone mining, timber harvesting (for selective culling and blow down remediation), maple sap collection and some agriculture, primarily on land that was actively farmed at the time of purchase. The City has loosened some of its regulations on the types of activities that are allowed, but they review all proposed activities and take other measures to protect water quality such as maintaining large buffer strips near streams and not allowing manure spreading during the winter.

Management of the City's lands is an important activity to protect the City's investment in these lands and to protect water quality. NYSDOH recognizes the value of these activities and notes that this program will continue to grow as the City continues to acquire more land.

## **FAD Section 4.4 Watershed Agricultural Program**

### Revised 2007 FAD Requirements

The main goal of the Watershed Agricultural Program (WAP) is to reduce pollution associated with agricultural land use and to protect source water quality. Through this voluntary program the WAC, in cooperation with its partners, develops and implements Whole Farm Plans (WFPs), which are compilations of multiple site-specific BMPs intended to reduce environmental risks and mitigate source water quality impacts associated with farming. The planning process includes identification, prioritization, and mitigation of environmental issues on each participating farm, along with establishment of riparian

buffers, when warranted, through the federal Conservation Reserve Enhancement Program (CREP).

The Revised 2007 FAD requires the City to develop 50 new WFPs on large, small, or EOH farms, and maintain at least 90% active large farm participation in the program. The City must also: maintain nutrient management plans (NMPs) on 90% of all active participating large farms; continue to make available the Nutrient Management Credit (NMC) Program to at least 100 watershed farmers; and develop and submit a proposal for funding and implementation of Precision Feed Management (PFM) on 60 eligible farms (unless demonstrated that PFM will provide minimal water quality benefit), and execute a contract change order with WAC to provide funding adequate to support the PFM proposal. The City is also required to develop new, and re-enroll expiring, CREP contracts, and to implement the Farmer Education and Farm-to-Market Programs.

### Evaluation of the City's Compliance

The City's *2016 Watershed Protection Program Summary and Assessment* indicates that WAC was the first local partnership expected to provide a long-term solution for preventing water pollution associated with farming. In addition, through implementation of WAP, the City intended to support sustainable farming traditions in the Watershed. Since WAP's inception in 1993, the City has invested more than \$250 million in its contractual obligations, mainly to support development and implementation of WFPs/BMPs on participating farms, stimulate long-term farm land preservation through the CE program, encourage owners of forested lands to implement forest management plans (FMPs), and provide technical assistance and education on effective water quality protection techniques.

The continued success of the WAP is accomplished through effective partnerships between the farmers and the WAC, as well as local Cornell Cooperative Extensions, county Soil and Water Conservation Districts, and the US Department of Agriculture's Natural Resources Conservation Service (NRCS) and Farm Service Agency. Under the strong leadership of WAC, WAP strives for perpetual programmatic and governance improvements.

During the assessment period WAP has maintained the required 90% active farm participation level. In fact, as of December 2015, the City reported that 195 active large farms out of a total 212 had been participating in the WAP, which represents a 92% participation rate. NYSDOH acknowledges this significant level of participation in a voluntary program.

The Revised 2007 FAD requires WAP to develop 50 new WFPs on large, small, or EOH farms. This metric was met and exceeded. In its *2016 Watershed Protection Program Summary and Assessment*, the City states that during the assessment period WAP developed a total of 55 new WFPs, of which 5 plans were done on large farms, 29 on small, and 21 were developed for the EOH farms.

As the WAP continues to conduct its annual status reviews on farms, this practice has become an integral part of the WFP process. The Revised 2007 FAD requires the City to conduct annual status review of WFPs on at least 90% of all active farms. This requirement was met and exceeded. During the assessment period, the reported average annual completion rate was about 94%.

The City reports that during 2011-2015 WAP has maintained NMPs on 94-100% of all participating large farms, exceeding the level required by the Revised 2007 FAD.

During the assessment period, the metric of making the NMC program available to at least 100 watershed farmers was met and exceeded. More than 100 farms per year have received NMCs since 2012. It must be noted that from 2011 through 2015 WAP has been gradually increasing the number of farms that have received NMCs, reaching its maximum in 2015, when the NMC program was made available to 120 farms.

On September 8, 2014, in consultation with WAC and Cornell Cooperative Extension, the City submitted a proposal for funding and implementation of the PFM program on 60 eligible farms. The proposal was approved by NYSDOH and EPA in October 2014. This was followed by the development and execution of the contract change order with WAC to provide adequate funding for the PFM program. Simultaneously, the City and its partners developed and finalized the program's eligibility criteria. The PFM program was initiated in October 2015, upon its approval by the regulators. Implementation on the first 20 farms is scheduled to begin during 2016, which is consistent with the schedule stated in the proposal.

The Revised 2007 FAD requires implementation of new BMPs and the repair/replacement of existing BMPs on active participating large, small and EOH farms based on the BMP Prioritization Methodology. The prioritization approach was adopted in 2011 and was intended to provide greater and more cost-effective benefits to water quality protection. During the assessment period, the WAP implemented 992 new BMPs and repaired/replaced 246 BMPs, with a cumulative investment of \$6.4 million for additional water quality benefits. In part due to the dedication and productivity of WAP's staff, the program has been experiencing workload issues resulting from the continuous need for implementation of newly identified BMPs and the exponential growth of BMPs that need repair/replacement. To address this issue and to concentrate on higher efficiency of water quality protection, the WAP has revised the farm ranking criteria. NYSDOH appreciates WAP's water quality protection prioritization approach and recommends that the City continues its dialogue with partners, stakeholders, and the scientific community to help develop the most productive resolution to 'the backlog' issue.

Pursuant to the Revised 2007 FAD, on January 31, 2015 the City submitted to NYSDOH and EPA a report, where it evaluated the BMP Prioritization Methodology, summarized the implementation status of the WAP, and reviewed the adequacy of current metrics. This comprehensive report provided valuable and convincing information about the programmatic status, the implementation approach, and suggestions regarding the adequacy of current WAP metrics. As required, in April 2015 the City met with NYSDOH, EPA, and NYSDEC to discuss WAP status and review the adequacy of current metrics. NYSDOH acknowledges the City's position and its justification for revisions of some metrics. NYSDOH and EPA will be re-evaluating all the WAP metrics with input from appropriate stakeholders to ensure that the metrics included in the 2017 FAD continue to promote water quality protection and adequately reflect the effectiveness of the program.

The WAP is required, on an ongoing basis, to enroll new, and re-enroll expiring, CREP contracts. The City reported that as of December 2015, a total of 2,016 acres of riparian

buffers were enrolled in 198 active CREP contracts. CREP re-enrollment is anticipated to spike in the next few years, and managing the workload associated with this spike will need to be addressed. NYSDOH and EPA continue to hold discussions with the City and WAC regarding the most productive solution to this issue.

As the Revised 2007 FAD requires, WAP had to implement the Farmer Education and the Farm-to-Market Programs. During the assessment period WAP conducted more than 140 diverse farmer education programs that were actively attended. The Farm-to-Market Program continues to oversee and implement the Pure Catskills Campaign and sponsor numerous workshops and outreach events.

The reporting requirement for the WAP included in the Revised 2007 FAD was met. Annually by March 31, the City has submitted reports to NYSDOH and EPA, with all specified reporting information provided.

In summary, NYSDOH acknowledges that the WAP has successfully met all metrics listed in the Revised 2007 FAD. The WAP remains an effective and important element of the City's watershed protection program. As the program continues to move forward, some adjustments to prioritization may be warranted to address workload issues, while ensuring that water quality protection is not compromised. As discussed above, NYSDOH and EPA are reviewing the WAP metrics to ensure that they are adequate indicators for ensuring the continued success of the WAP.

## **FAD Section 4.5 Watershed Forestry Program**

### Revised 2007 FAD Requirements

The Watershed Forestry Program is a longstanding partnership between the City, the WAC, and the USDA Forest Service that began in 1997 and has since accumulated nearly two decades of experience working closely with landowners, loggers, foresters, and the wood products industry. The primary focus of the Watershed Forestry Program is to promote good forest stewardship over the long-term for both water quality and economic viability purposes. A secondary focus is to educate students along with the general public in the importance of working forests. To achieve its objectives, the Watershed Forestry Program supports the development of forest management plans (FMPs); the implementation of best management practices during timber harvests; professional training of foresters and loggers; educational programs for landowners; teacher training and educational materials; and watershed model forests are maintained to demonstrate working forest principles and to educate both forest landowners and urban residents.

The Watershed Forestry Program provides cost sharing, technical assistance and other incentives to landowners, loggers and professional foresters to encourage the use of portable skidder bridges and erosion control measures, and the maintenance of forest buffers. Based on recent internal assessment of its programs, the Watershed Forestry Program now puts greater emphasis on encouraging landowners with more than 50 acres of forest to enroll in the NYS Forest Tax Law 480-a tax abatement program which requires a ten year stewardship commitment. A new interactive website for landowners

(MyWoodlot.com) was developed as an educational tool for landowners who do not have a certified forest management plan.

The Revised 2007 FAD requires the City to continue to enroll landowners in WAC FMPs, support the implementation of existing FMPs, and evaluate the implementation status of 5-year-old FMPs. The City is also required to provide funding to support implementation of 45 Management Assistance Program (MAP) projects each year, fund at least 5 Trees-for-Tributaries projects each year, and coordinate and maintain four existing model forests. Other requirements include training and education for loggers, foresters, landowners, and schools.

### Evaluation of the City's Compliance

In compliance with the Revised 2007 FAD, during the assessment period the Watershed Forestry Program continued to fund FMPs for landowners seeking to improve their stewardship of their properties, enrolling 220 first-time participants during the assessment period; provided funding to support implementation of 265 MAP projects; and funded hundreds of forestry BMPs. Over the last five years, the WAC funded FMPs covering more than 61,000 acres. Since program inception, approximately 171,800 acres have been covered by FMPs. The program exceeded its goal of completing 5 Trees for Tributaries projects/year; a total of 42 projects were completed during 2011-2015. During the current assessment period, the Watershed Forestry Program continued to implement a wide range of forestry education and professional training programs for landowners, loggers, foresters, school groups, teachers, and other target audiences. And finally, the Watershed Forestry Program continued to maintain for educational purposes four model forests located in Delaware, Ulster, Greene, and Putnam Counties.

The City has experienced complications in tracking the implementation status of five-year-old FMPs, and is finding that landowners are asking to be removed from the mailing list after completing multiple surveys used to evaluate the status of plans. Moving forward, the program will make use of the 480-a program and MyWoodlot.com website to engage landowners in forestry planning and management and assist in tracking forestry activities.

NYSDOH recognizes the valuable services and contributions to water quality protection provided by the Watershed Forestry Program and support the City and WAC's efforts to most effectively encourage forest landowners to be good stewards of their lands.

## **FAD Section 4.6 Stream Management Program**

### Revised 2007 FAD Requirements

The overall goal of the Stream Management Program (SMP) is to improve water quality and reduce turbidity associated with eroding stream banks. This is accomplished using stream management plans, stream restoration demonstration projects, and locally-led implementation of plan recommendations. The result is long-term stream stewardship, guided by a strong network of partnering agencies and community participation, which seek to improve water quality.

Requirements for the SMP are described in the 2011 Long-Term Plan and the Revised 2007 FAD. These include: submission of biennial action plans for implementation of stream management plan recommendations; establishment and implementation of a local funding program to implement stream management plans; design and completion of five stream and/or floodplain projects; completion of seven stream projects in the Ashokan basin by November 30, 2018; distribution of updated Flood Insurance Rate Maps; and development and funding of a Local Flood Hazard Mitigation Program with Watershed partners.

### Evaluation of the City's Compliance

Following Tropical Storms Irene and Lee, a significant portion of the City's efforts under this program were focused on recovery efforts and technical assistance. Leveraging funds from the NRCS Emergency Watershed Protection (EWP) program, the City and its partners were able to design and construct 37 EWP projects during the reporting period.

Through the date of this compliance assessment, the City has completed three of the required seven stream projects in the Ashokan basin: Chichester Sites 2-3, Warner Creek Site 5, and Stony Clove at Wright Road. Separately, four other restoration projects were constructed on the Stony Clove Creek. The City has notified NYSDOH of three additional Ashokan Basin projects that are expected to commence in 2016: Beaverkill at Van Hoagland Road Site 1, Beaverkill at Van Hoagland Road Site 2, and Stony Clove Hillslope Stabilization at Wright Road.

The Revised 2007 FAD requires the City to submit two deliverables related to water quality monitoring studies. The first is to report on an ongoing USGS study to identify various sources of turbidity in the Ashokan Watershed. This study was completed, and the final report was provided to NYSDOH and EPA. The second deliverable, which was also met, was to submit a proposal and implementation schedule for monitoring at stream management project sites with a goal of evaluating the efficacy of these projects in reducing turbidity.

The new LFA component of the SMP works with area flood commissions and the public to look at flooding in population centers and then, using hydraulic modeling, evaluate the potential options for mitigation. As of the date of this assessment, LFAs have been completed or substantially completed in twelve communities, with work on-going in eleven other communities.

The Local Flood Hazard Mitigation Implementation Program was funded under a \$17 million contract with the City and CWC. This program supports stream projects to reduce flood impacts, secures sources of pollution (like fuel storage tanks), assists qualifying residents relocating under the Flood Buyout Program, and extends the post-flood debris cleanup program. It also makes funding available to communities to explore LFA-recommended projects.

The City has met annually with county partners to review SMP priorities and develop rolling two-year "action plans" to prioritize and implement stream management plan recommendations within each WOH reservoir basin. The [CatskillStreams.org](http://CatskillStreams.org) website is used as a repository for stream management plans, project information, local flood

analyses, watershed stewardship initiatives, research, and as an outreach tool for interested community members. Other outreach and education included 124 technical trainings and workshops, 18 conferences and symposia, and over 20 factsheets and newsletters.

NYSDOH finds the SMP to be an effective tool for restoring, protecting, and enhancing stream stability, thereby reducing sediment contributions from banks and beds to watershed streams. The relationships that the City has fostered with its SMP partners has created a strong platform for implementing this program, which has provided a model for stream management and restoration work throughout New York State.

## **FAD Section 4.7 Riparian Buffer Protection Program**

### Revised 2007 FAD Requirements

The Riparian Buffer Protection (RBP) program focuses on protecting, managing, and restoring riparian buffers along publicly- and privately-owned streamside areas. These efforts are coordinated through the other programs, such as Land Acquisition, Watershed Agricultural, Stream Management, and Forestry Programs. Technical assistance, education, and training are also important components of the RBP, which offer assistance to riparian landowners on various relevant topics, including proper streamside management and riparian plantings.

The RBP Program requires the City to continue and enhance all programmatic RBP efforts, including implementation of the CREP and the Catskill Streams Buffer Initiative (CSBI), facilitating the supply of native plant materials, and completion (by November 30, 2017) of at least 80 CSBI plans and/or projects throughout the WOH watershed. The City is also required to conduct a pilot riparian buffer acquisition program, with solicitation of real property interests along stream buffers and engagement of local land trusts. And finally, the City is required to continue its pursuit of enhanced management agreements (voluntary 10-year or purchased perpetual) for all current and future stream restoration projects.

### Evaluation of the City's Compliance

During the assessment period, the City continued its efforts on riparian buffer protection throughout the Watershed and made substantial progress on successful implementation of the program.

As reported in the *2016 Watershed Protection Program Summary and Assessment*, between 1997 and 2015, the City protected 21,668 acres of buffers under fee simple acquisition and 6,373 acres under conservation easements. An additional 6,729 acres of buffers were protected under the farm easements program through WAC. Through 2015, the City has acquired 13.6% of riparian buffers in the Watershed. This is a significant accomplishment, which assures protection of the 300-foot stream buffers within the Catskill/Delaware watershed, land which is critical to water quality protection.

The Revised 2007 FAD requires the City to continue implementation of CREP, which is a federal program that compensates farmers for taking riparian lands out of farm production

and is implemented in conjunction with Whole Farm Planning under the WAP. This requirement was met. During the assessment period, 26 new contracts engaging 164.7 acres of riparian buffers were enrolled in CREP. Regarding expiring contracts, the owners of 29 contracts (301.9 acres) got re-enrolled and 21 contracts (136 acres) were not re-enrolled by choice of land owners.

The City implements the CSBI program in partnership with the county Soil and Water Conservation Districts, and collaborates with Cornell Cooperative Extension, WAC, CWC, and the Catskill Center for Conservation and Development. During the assessment period, the City completed 67 River Corridor Management Plans for individual landowners, conducted public activities (such as volunteer planting and riparian workshops), developed program marketing and reference materials, and maintained the CSBI website (<http://www.catskillstreams.org/catskill-streams-buffer-initiative/>). During the assessment period, 134 projects were completed under CSBI, including plant installations and bioengineering practices. CSBI coordinators work with the New York Natural Heritage Program to identify appropriate species selections for replanting efforts. The supply of native plant materials is sourced from local plant stock holding areas. The requirements of the RBP related to CSBI were met and exceeded.

Consistent with the 2010 WSP, the Revised 2007 FAD requires the City to pilot a program by hiring a land trust to acquire real property interests along stream buffers. Although the WSP requires the City to begin implementation by November 1, 2014, a five year contract with the Catskill Center for Conservation and Development to implement this program was not executed until July 15, 2015. Delays to implementation were due in part to a change in the land trust that would implement the program and changes in management of the Catskill Center for Conservation and Development. Solicitation for the program began in April of 2016, with 47 landowners, involving 477 acres, being solicited. The City is required to submit an evaluation report on the program six months before the end of the pilot program period.

NYSDOH believes that the Riparian Buffer Program is an integral part of the City's overall watershed protection program and has been effectively implemented by the City. We commend the City for the accomplishments of this program.

## **FAD Section 4.8 Wetlands Protection Program**

### Revised 2007 FAD Requirements

Wetlands are recognized for the important role they play in maintaining and improving water quality, attenuating peak storm water runoff, and contributing to the base flow of streams. The program has collected data on vegetation, soils, and hydrologic information on various types of wetlands in the Catskill/Delaware Watershed for over a decade. This program requires the City to monitor reference wetlands, analyze reference wetlands data, and develop reference standards. One of the primary goals of establishing reference wetlands is to provide metrics to guide the design and assessment of wetland restoration, construction, and enhancement efforts. The information is used to mitigate projects that the City undertakes on its lands, and also those projects that the City reviews throughout the

Catskill/ Delaware Watershed in its regulatory programs. As part of its Wetlands Protection Program, the City is to conduct a small-scale wetland mapping project to ascertain the utility of 2009 LiDAR-derived data to improve the National Wetlands Inventory (NWI) in the Catskill/Delaware Watershed.

## Evaluation of the City's Compliance

The pilot study on enhanced wetland mapping was completed and a report submitted in July 2015. LiDAR-derived topographic index and high resolution orthophotography data sets were coupled with advanced automated mapping protocols to increase the accuracy and completeness of wetland maps. The draft model output for 15 pilot areas was then manually edited to produce a NWI compliant product. The results of this effort significantly increased the mapped acreage of wetlands in the pilot areas and increased detection of wetlands connections to downstream waters. A status report on reference wetland data and development of reference standards and all annual reports for this program were submitted on time.

The Wetlands Protection Program continues to be an important component of the City's overall watershed protection program.

## **FAD Section 4.9 East-of-Hudson Non-Point Source Pollution Control Program**

### Revised 2007 FAD Requirements

The EOH Non-Point Source Pollution Control Program has been developed to reduce inputs of pollutants from stormwater, septic systems, and sanitary sewers to the West Branch, Boyd Corners, Croton Falls, and Cross River Reservoir basins. This is addressed through continued implementation of the WR&Rs, involvement in project reviews, and inspection and maintenance of existing stormwater management facilities. Other elements of this program include stormwater remediation and retrofit projects, stormwater and wastewater infrastructure mapping and inspection, and septic repair programs.

### Evaluation of the City's Compliance

There have been numerous delays with two of the five Stormwater Remediation Projects originally outlined in the 2007 FAD. These projects had an original completion deadline in the 2007 FAD of December 31, 2009. The Revised 2007 FAD included deadlines for completion of two of these stormwater retrofit projects (Maple Avenue and Drewville Road) by December 30, 2015. Due to delays, including redesigning these projects to satisfy town specifications, it is expected the projects will be bid by the end of 2016, with construction beginning in 2017 and completion in 2019. The City completed \$4.5 million in stormwater retrofit grant funding prior to the issuance of the Revised 2007 FAD, as well as the inspection of targeted sanitary infrastructure areas. The City supported use of additional funds that were granted to EOH communities for stormwater retrofits.

The City provides technical assistance in support of county septic management programs in the EOH basins. Program rules for a septic repair program in the West Branch and Boyd Corners basins were submitted in June 2014, and the program commenced implementation in June 2015, as is required by the Revised 2007 FAD. About six septic systems have participated in the program to date. The program has been expanded in phases to address systems farther from watercourses. Currently, septic systems up to 200 feet from a

watercourse are eligible to participate. In addition, the City submitted an initial proposal to expand the septic repair program to the Croton Falls and Cross River basins in June 2015. A final proposal was submitted in November 2015.

NYSDOH finds the EOH Non-Point Source Pollution Control Program to be a critical suite of protection measures targeting potential sources of water quality impairment in the EOH FAD basins. However, NYSDOH notes that there have been significant delays in the completion of two stormwater retrofit projects required under this program. NYSDOH has put in place additional reporting requirements to better track and understand the reasons for delays in implementation of the Maple Avenue and Drewville Road stormwater projects, and urges the City to expedite completion of these projects to the extent possible.

## **FAD Section 4.10 Kensico Water Quality Control Program**

### Revised 2007 FAD Requirements

The goal of this program is to protect, prevent from degradation, and remediate as needed, the water quality in Kensico Reservoir. Due to the fact that Kensico, under normal operating conditions, is the terminal reservoir, defined as the last impoundment of Catskill/Delaware water prior to entering the City's distribution system, its protection remains critically important to maintaining filtration avoidance for the NYC water supply.

Since its inception in 1997, this program has aggressively addressed overall watershed protection, as well as prevention of water quality degradation in Kensico Reservoir. Over the years many protective and remedial projects have been successfully implemented in the Kensico basin. The most recent measures have targeted pollution prevention associated with stormwater and wastewater inputs.

The Revised 2007 FAD directs the City to continue and enhance effective protection of water quality in Kensico Reservoir. On an ongoing basis, the City is required to inspect and maintain nonpoint source facilities within Kensico basin (i.e. stormwater management facilities, turbidity curtains, and spill containment measures). By December 31, 2016, the City must complete the design of a shoreline stabilization project at Kensico Shaft 18. Other requirements focus on the Catskill Upper Effluent Chamber (CATUEC), including a progress report on a draft dredging schedule (due June 30, 2017). The City is also required to continue to implement the Septic Repair Reimbursement Program in the Kensico Basin.

### Evaluation of the City's Compliance

As the terminal reservoir, certain federal water quality standards (i.e., coliform and turbidity levels) apply to Kensico. To comply with these standards, the City has implemented a rigorous water quality control and protection program. Intense study efforts of the Kensico basin have led to implementation of various projects to specifically address localized threats to water quality.

During the assessment period, the City has met the requirements of the Revised 2007 FAD. The turbidity curtains (the primary and the back-up) were routinely inspected to ensure

designed efficiency. The last inspection during the assessment period was conducted in October 2015. No deficiencies in turbidity curtains were detected, and the turbidity curtains were functioning as intended. Spill containment measures are in place around the reservoir, and are regularly inspected.

During the assessment period, as part of the Kensico Action Plan, the City proposed and installed four stormwater treatment facilities. All 47 stormwater and erosion abatement facilities installed by the City throughout the Kensico watershed are routinely inspected and maintained in accordance with the Operation and Maintenance Guidelines.

The Revised 2007 FAD requires the City to complete design of a shoreline stabilization project at Delaware Shaft 18 by December 31, 2016. The City has begun to assess the scope of a project to stabilize the shoreline on both sides of Shaft 18. According to the draft Basis of Design Report, the project will implement shoreline stabilization and protection measures for approximately 700 linear feet on the western shoreline and approximately 475 linear feet on the cove area. The City reports that in 2015, the work on the design of the project continued. In addition, several required permit applications were submitted to various agencies. The project appears to be progressing in accordance with the FAD schedule.

The feasibility and need for the CATUEC shoreline stabilization has not yet been determined. As part of the Catskill Aqueduct pressurization project, the City will determine the most appropriate location for the Catskill System downtake from Kensico Reservoir. Since it is not yet determined whether the CATUEC site will be selected, the review of the potential shoreline project has not taken place. Pressurization of the existing Catskill Aqueduct or construction of a new aqueduct that will provide a connection between Kensico Reservoir and the CDUV Facility will restore a redundancy to the City's water supply that is currently lacking. NYSDOH notes the importance of this project, and recommends that the review process be expedited to the extent possible.

To prevent risks of water quality degradation caused by failing septic systems in Kensico basin, the City implemented the septic reimbursement program through a contract with the New York State Environmental Facilities Corporation. This project provides a portion of the rehabilitation cost of failing septic systems in Kensico basin or connects them to an existing sewage collection system. The City reported that since the inception of the program in 2008, a total of 20 septic systems have participated in the program. It is important to note that 16 of those repairs have occurred since 2011. The City annually mails letter to local residents to remind them about this important program.

Another valuable preventive initiative that the City undertakes to avoid the risk of sewage contamination of Kensico is to work closely with the Westchester County Department of Environmental Facilities to monitor the West Lake Sewer Trunk Line. This line collects and conveys untreated sewage in close proximity to the reservoir. To detect any malfunction, the City installed a sanitary sewer remote monitoring system for this trunk line. The Smart Cover Technology for remote monitoring of manholes was completed in July 2012. The City also conducts annual visual inspections of the line. The last reported full inspection of the line was conducted in October 2015. This full inspection is in addition to a partial inspection conducted in conjunction with ongoing maintenance of Kensico stormwater BMPs. The City reported no abnormalities for the trunk line during the assessment period.

As is required by the Revised 2007 FAD, the City has submitted Kensico Programs Annual Reports, describing the status of and progress on program implementation. This deliverable has been met.

In conclusion, NYSDOH has determined that the Kensico Water Quality Control Program provides adequate protection of the City's terminal reservoir from spills, stormwater runoff, and sewage inputs. While NYSDOH understands the City's reasoning for delaying implementation of the shoreline stabilization project at the CATUEC, we urge the City to address construction of a connection for the Catskill System from Kensico to the CDUV Facility as soon as it becomes feasible to do so.

## **FAD Section 4.11 Catskill Turbidity Control Program**

### Revised 2007 FAD Requirements

Elevated turbidity events have long been associated with the Catskill System and may represent the greatest risk to the City maintaining its filtration avoidance. The majority of turbidity comes during short-term major flow events that result in excessively high turbidity levels in the upper Esopus Creek. This turbidity is primarily generated within the stream itself, rather than the surrounding landscape, and this impact of the underlying geology on water quality was considered when the Catskill System was designed. For example, when the turbidity of Schoharie Reservoir is elevated, this water can be isolated from the Catskill water supply by shutting down the Shandaken Tunnel. In addition, the dividing weir between the West and East Basins of the Ashokan Reservoir gives turbidity another opportunity to settle in the West Basin and again in the East Basin before it moves down the Catskill Aqueduct and into Kensico Reservoir. Once in Kensico, there is additional time to allow turbidity to settle as water moves to the Kensico effluent chamber. While this is normally enough time to have turbidity settle, the system was built with the capacity to add alum above Kensico Reservoir during extreme turbidity events to coagulate and more rapidly settle the particles that cause turbidity.

The 2002 and 2007 FADs required the City to explore options that might reduce turbidity levels in the water entering the Catskill System, and thereby reduce use of alum. The City contracted with engineering consultants to perform the Catskill Turbidity Control Study. The overall goal of this extensive effort was to reduce the potential impact of turbidity levels in the Catskill System on finished water quality while reducing the frequency and duration of alum treatment events. This study was conducted in three phases. Phase I was completed in 2004 largely using existing data and formed the conceptual basis for the future work. Phase II was completed in 2006 and evaluated a Multi-Level Intake, In-Reservoir Baffle, and Modification of Reservoir Operations as a means to reduce the transport of turbidity from Schoharie Reservoir into the lower part of the Catskill System. Based on the Phase II study, modified reservoir operations was selected as the most effective and cost effective tool. The results of the Phase II study were implemented as a requirement of the 2007 FAD. In addition, the FAD required the City to conduct a Phase III study to evaluate engineering and structural alternatives at the Ashokan Reservoir to reduce the level of

turbidity entering the Catskill Aqueduct, then develop a plan to implement the findings of the Phase III study.

The implementation plan for this study included: modifying reservoir operations using the OST, making improvements to the Catskill Aqueduct stop shutters, and constructing a Catskill and Delaware Aqueduct interconnection at Shaft 4 of the Delaware Aqueduct. OST is used to predict Kensico turbidity levels under different operating scenarios and assist the City in making operating decisions. For example, using the Ashokan Release Channel, water may be released to the lower Esopus Creek from the West Basin of Ashokan Reservoir to prevent turbid water from spilling to the East Basin, thereby protecting the quality of water flowing to Kensico Reservoir and, ultimately, to NYC. As a result of severe storm events, reservoir inflows may be too high to preserve low turbidity conditions. In these cases, flow in the Catskill Aqueduct is reduced as much as possible to prevent turbid water from entering Kensico Reservoir. However, there are a number of outside communities that use the Catskill Aqueduct as their drinking water source, and water levels have to remain sufficiently deep for them to draw water. This is done using stop shutters near these intakes to increase the local depth under the lower flows. These shutters needed to be upgraded for easier deployment and to improve their function. Construction of an interconnection at Shaft 4 of the Delaware Aqueduct would allow water from the Delaware Aqueduct to feed the Catskill Aqueduct, improving water quality and maximizing flow. The Revised 2007 FAD requires the City to use the OST, to complete the stop shutter improvements, and to complete the Shaft 4 interconnection.

While these water system operations are very effective in controlling Kensico turbidity and reducing the need for alum treatments, they can result in large, and often sustained, flows of turbid water to the lower Esopus Creek causing environmental and economic impacts. The City and NYSDEC agreed to an interim operating protocol for the Ashokan Release Channel in October 2011. A modified version of that protocol was incorporated into an Order on Consent (DEC Case No.: D007-0001-11)(CO) which was executed by the City and NYSDEC on October 4, 2013 in connection with the Catalum SPDES permit. The Catalum SPDES permit regulates alum use in the Catskill Aqueduct prior to entering Kensico Reservoir. Furthermore, the City submitted an application to NYSDEC to modify the Catalum SPDES permit. As part of the environmental review process for the permit modification request, for which NYSDEC is the lead agency, the City is required to prepare a draft of the Draft Environmental Impact Statement (EIS) and a draft of the final EIS, which will analyze the potential environmental and socioeconomic impacts resulting from the proposed modifications to the Catalum SPDES permit. The Revised 2007 FAD requires the City to meet with NYSDOH, EPA, NYSDEC, and the Watershed Inspector General (WIG) to discuss the findings of the draft and final EIS.

The Revised 2007 FAD requires the City to fund a panel of experts (“Expert Panel”) in reservoir water quality and quantity modeling to review the City’s use of OST for water supply operations, and for evaluation of the proposed modifications to the Catalum SPDES permit and alternatives to be considered in the environmental review. In addition, the Expert Panel will review the City’s climate change studies and relate them to future use of the OST, and will evaluate the City’s performance measures used to assess the efficacy of OST. The findings of the Expert Panel will also be the topic of a meeting with NYSDOH, EPA, NYSDEC, and the WIG.

In addition, the Revised 2007 FAD requires the City to submit a Catskill Turbidity Control management plan for when the Rondout-West Branch Tunnel is shut down for repairs and to submit a summary report on Catskill Turbidity Control measures that were evaluated during the Catskill Turbidity Control Studies and those that will be considered in the EIS for the Catalum SPDES permit modification.

### Evaluation of the City's Compliance

All deliverables with due dates within the time period of the Revised 2007 FAD have been met, and deliverables with future due dates are underway. All reports required by this program have been submitted on time. The Shaft 4 interconnection is completed, and the stop shutter improvements are on schedule. As is required by this program, USGS studies are being used to evaluate sub-basin turbidity contributions in the upper Esopus Creek, and the Stream Management Program has been successful in addressing some turbidity "hot spots". The Expert Panel work plan was submitted on time; however, to date, due to delays in the City's contracting process, the contract for the Expert Panel review has not been executed. Nonetheless, delays in developing the draft EIS continue to keep the Expert Panel review and the draft EIS timelines aligned.

Use of OST and West Basin releases have been very successful in reducing the need for alum treatment of Catskill water. These tools, combined with less severe storm activity, helped ensure that alum treatment was not required during the assessment period. Completion of the Shaft 4 interconnection will provide additional options for the City's operation of its water supply system. While these are positive achievements for the Catskill Turbidity Control Program, sustained releases of turbid water to the lower Esopus Creek remain a potential concern. A goal of the EIS that will be conducted under the City's CO is to mitigate the impacts of these releases. NYSDOH will continue to monitor the EIS and Expert Panel processes to help ensure, to the extent possible, that the Expert Panel will be available in a timely manner to inform the EIS and address the requirements of the Revised 2007 FAD.

## ***Watershed Monitoring, Modeling, and GIS***

### **FAD Section 5.1 Watershed Monitoring Program**

#### Revised 2007 FAD Requirements

Section 5.1 of the Revised 2007 FAD requires that the City conduct a watershed-wide monitoring program in accordance with Section 2.4.1 of its Long-Term Watershed Protection Program and the milestones therein. The monitoring framework is defined by the Watershed Water Quality Monitoring Plan (WWQMP), which describes the City's hydrology, limnology, and pathogen monitoring and surveillance programs, which support trend analysis, modeling efforts, and reservoir operations, as well as regulatory purposes. The WWQMP was recently updated in 2016.

The Revised 2007 FAD requires the City to participate in educational seminars on watershed monitoring, and coordinate annual technical meetings for the Pathogen Working Group. In addition, pathogen reports are provided annually which summarize monitoring results at Kensico Reservoir and the WOH reservoirs. Annual updates on ongoing research activities are also provided. The City also submits a monthly water quality report, which describes its compliance with the objective regulatory requirements for filtration avoidance, such as turbidity and coliform bacteria levels in source water, and disinfection.

The City also commits to continuing a comprehensive evaluation of water quality status, water quality trends, and the overall effectiveness of its watershed protection program. The data generated through the City's monitoring program, in conjunction with other defensible scientific findings, is used to conduct the City's periodic assessment of the effectiveness of the watershed protection program.

In addition, the City is required to provide after-action reports on all chemical treatment activities that are not part of their standard daily operations, as well as other significant or unusual events.

#### Evaluation of the City's Compliance

The *2016 Watershed Protection Program Summary and Assessment* report covering the period of the Revised 2007 FAD was received in March 2016 and serves as a reference for this FAD compliance assessment. It covers activities in the watershed protection programs during the assessment period through 2015, as well as looking at watershed trends over the last twenty years. It also includes information on the City's modeling programs and how they are used both to evaluate the watershed protection programs and as information tools in making operational decisions. During the assessment period, the City submitted after-action reporting on seven incidents involving a loss or unexpected decrease in chlorination at the Kensico Reservoir disinfection facilities.

In accordance with the Revised 2007 FAD, the City has participated in educational seminars on watershed monitoring. During the assessment period, the City, along with other partners, has sponsored an annual watershed conference in September of each year in West Point, NY that allows scientists and technical experts to present research findings and technical data related to water quality and watershed protection.

The City has also participated in the annual Ashokan Watershed Conferences, annual Schoharie Watershed Summits, and the biennial Catskills Environmental Research & Monitoring conferences. The Pathogen Technical Working Group has convened and discussed pathogen research and detection methods in March of each year since 2008. These meetings continued annually during this assessment period.

All reporting requirements for this program have been met. All Watershed Water Quality Annual Reports were submitted. These reports summarize water quality, water quantity, pathogens, watershed management, model development, and research. Special studies have included focused sampling at stream sites suspected of contributing pathogen loadings to Kensico Reservoir and method projects for improved identification of microorganisms.

The City has an extensive and robust monitoring program, which provides the data necessary to confirm that water quality criteria required to maintain filtration avoidance are met, to help assess the efficacy of the City's watershed protection programs, and to detect water quality impairments. As reported in after-action reports, the City has been extremely responsive to unusual water quality or treatment events, addressing the sources of these events in a timely manner and implementing procedures to prevent such events from recurring.

## **FAD Section 5.2 Multi-Tiered Water Quality Modeling Program**

### Revised 2007 FAD Requirements

The Multi-Tiered Water Quality Modeling Program uses integrated reservoir and terrestrial models to evaluate watershed management programs and reservoir operations, as well as long-term water supply planning. This involves using watershed land cover characteristics, weather data, and climate models to simulate the quantity and quality of water entering the City's reservoirs. There are several objectives, among them: to predict turbidity transport within the Catskill System and Kensico Reservoir; to guide reservoir operations; to assist in evaluating the effectiveness of FAD/MOA-related programs; and to support efforts to ensure the long-term availability of high-quality drinking water.

The City has developed the OST to assist with short-term water routing and supply operations, and to evaluate long-term planning decisions. It integrates CE-QUAL-W2 reservoir water quality models and the OASIS reservoir systems model, together with real-time data and historical database information. Separately, GWLF and SWAT watershed models are used, depending on the circumstances. The City maintains the Climate Change Integrated Modeling Project for Water Quantity and Quality to evaluate the potential effects of a changing climate on use and operation of the water supply.

### Evaluation of the City's Compliance

During the assessment period, the City's modeling program investigated a variety of water quality questions, such as how channel processes affect the retention and release of phosphorus in streams, and how ice cover on reservoirs affects turbidity attenuation and phytoplankton succession. Work was conducted on a predictive model of disinfection by-products precursors in source waters and the resulting trihalomethanes in the City's distribution system. Modifications were made to OST to update the hydrologic and meteorological data sets, add real-time data capabilities, and implement improved loading predictions for the Esopus Creek. Through a 2012 contract with USGS, updated high-resolution reservoir bathymetry surveys will be completed for all WOH reservoirs by 2016.

The City has entered into Phase 2 of the Climate Change Integrated Modeling Project, which will explore vulnerability-based approaches to climate change. During the assessment period, the City has maintained a contract with the Research Foundation of the City University of New York that provides support to the City's water quality modeling staff using post-doctoral scientists. The City also participated in numerous conferences and interagency workgroups, and published 24 research papers. For example, the City is a

member of the Water Utility Climate Alliance, and has worked with the Global Lake Ecological Observatory Network. Finally, all reporting requirements from the Revised 2007 FAD were satisfied.

NYSDOH believes that the Multi-Tiered Water Quality Modeling Program has been effective, and is an important part of the City's watershed protection program. We commend the City for its involvement with national and international organizations and initiatives, which helps keep the City up-to-date on data collection, modeling, and climate change issues and provides an opportunity for sharing ideas and collaborating with other experts in these fields.

## **FAD Section 5.3 Geographic Information System**

### Revised 2007 FAD Requirements

The City utilizes an extensive GIS in its watershed protection efforts and water supply operations. In addition to creating maps and illustrating environmental data, GIS is also used in data gathering and management, regulatory programs, satellite imagery analysis, and complex environmental modeling. A few of the key areas where GIS plays a vital role include: land acquisition and management, Catskill turbidity control, water quality modeling, watershed protection evaluation, water system operations for system reliability and maximizing water quality, and long-term planning. Overall, there are few FAD programs where GIS is not an important tool.

The Revised 2007 FAD requires the City to continue to maintain and update its GIS capabilities, and to report on use of GIS, GIS updates, and dissemination of GIS data to stakeholders as needed.

### Evaluation of the City's Compliance

The City continues to have a robust and active GIS program, and has made the updates and improvements necessary to effectively use this technology. Acquisition of higher resolution LiDAR and orthoimagery allowed important updates to watershed hydrography, floodplains, reservoir basins and watersheds, and reservoir bathymetry updates are currently underway. The City also made a number of purchases and improvements to software, hardware, servers, and work stations that give City staff better utility of the GIS system. In addition to serving as an important in-house resource to research and many programs, the GIS group also shares non-sensitive data with partners, stakeholders, watershed communities, state/federal agencies, consultants, universities, non-governmental organizations, and other interested parties.

All deliverables have been addressed, and GIS has been and will remain a critical tool in FAD implementation, SWTR compliance, and other aspects of watershed management and water system operations.

## ***Regulatory Programs***

### **FAD Section 6.1 Watershed Rules and Regulations and Other Enforcement/Project Review**

#### Revised 2007 FAD Requirements

The review of development activities within the NYC watershed and the ongoing inspection of projects under construction or currently operating are the responsibility of the Regulatory and Engineering Programs Division within the NYC Department of Environmental Protection's (NYCDEP) Bureau of Water Supply (BWS). It is composed of two sections that work specifically on wastewater treatment performance and stormwater controls. They review subsurface sewage treatment systems alteration and construction plans, sewer systems, stormwater runoff control, impervious surfaces, nonpoint source discharges, and wetland protection. The City is an Involved Agency on most major projects during the SEQRA process and can issue comments to the Lead Agency regarding activities that may impact water quality in the Watershed.

The BWS also implements the City's WR&Rs. The WR&Rs identify activities that are prohibited in the Watershed, as well as those that require the City's review and approval. Following the approval of proposed regulated activities, the BWS monitors to assure compliance with the conditions of approval. The BWS also conducts inspections throughout the Watershed to identify violations of applicable laws and responds to citizen complaints. The NYCDEP Police are responsible for protection of the City's water supply infrastructure along with protection of the environment and people living in the Watershed.

The Revised 2007 FAD requires that the City enforce its WR&Rs, providing conferences with applicants for regulated activities and guidance documents; work with NYSDEC to coordinate enforcement of stormwater regulations; and report on project activities in the Watershed, enforcement actions, and work done to replace equipment at WWTPs that is required by the City's WR&Rs.

#### Evaluation of the City's Compliance

As is required by the Revised 2007 FAD, the City has submitted semi-annual reports on activities in the Watershed that require review under the City's WR&Rs and on enforcement actions. The enforcement action reports illustrate the City's diligence in identifying violations, communicating with relevant parties, and following up as necessary to ensure violations are corrected.

The City meets quarterly with NYSDEC, NYSDOH, EPA, and the Office of the Attorney General to coordinate enforcement of stormwater regulations in the Watershed.

By 2011, the upgrade of all WOH WWTPs was completed along with nine WWTP's located in the Croton Falls and Cross River basins. The City has continued to fund the operation and maintenance cost of eligible expenses at upgraded WWTP plants and worked closely with operators to insure performance. In 2015, the City funded and executed a capital

replacement agreement with NYS Environmental Facilities Corporation to replace failing equipment that was installed a part of the Upgrade Program.

The City's WR&Rs are a critical component of the City's watershed protection program. The City continues to actively enforce its WR&Rs, working in coordination with other regulatory agencies, to maximize effectiveness of this important protection tool. In consultation with NYSDOH, EPA and NYSDEC, the City is in the process of revising its WR&Rs to update some references and to address some issues raised by Watershed communities. NYSDOH will continue to provide oversight for this process, ensuring that adequate watershed protection is maintained while accommodating community concerns to the extent possible.

## **FAD Section 6.2 Wastewater Treatment Plant Inspection Program**

### Revised 2007 FAD Requirements

The main goal of the WWTP Inspection Program is to prevent degradation of water quality associated with discharges from WWTPs in the NYC watershed. This is accomplished through ensuring compliance with the WR&Rs and State Pollutant Discharge Elimination System (SPDES) permits. With the assistance of NYSDEC, the City administers the WWTP Inspection Program, which is comprised of on-site inspections, monitoring of and assistance with SPDES compliance, and necessary enforcement actions associated with noncompliance.

The Revised 2007 FAD requires that all WWTPs discharging in the Catskill/Delaware watershed are monitored to ensure compliance with their SPDES permits, and that grab samples are collected and analyzed monthly for all non-City-owned WWTPs. The City is also expected, when needed, to provide technical assistance to owners/operators of non-City-owned WWTPs. When noncompliance with either WR&Rs and/or SPDES permits is identified, enforcement actions are taken in accordance with the protocol delineated in the NYCDEP/NYSDEC Memorandum of Understanding (MOU).

In addition, the Revised 2007 FAD requires the City to conduct annually at least four on-site inspections for all year-round SPDES-permitted facilities and at least two on-site inspections for seasonal SPDES-permitted facilities per year at all WWTPs in the Watershed.

The reporting requirements for this program include semi-annual submissions of compliance status and inspection findings for all WWTPs discharging in the Watershed. Another reporting requirement includes submittals, on a semi-annual basis, of the WWTP Water Quality Sampling Monitoring reports.

To expeditiously respond to potential public health risks associated with sewage spills in the City's unfiltered water supply, and establish effective collaboration between agencies, the City is required to electronically inform NYSDOH about any sewage spill exceeding 500 gallons within 24 hours of its discovery of the incident.

## Evaluation of the City's Compliance

Since this program is intended to prevent contamination of the unfiltered NYC water supply from WWTPs that discharge treated sewage in the Watershed, its effective implementation is directly related to public and environmental health protection.

During the assessment period the City has been successfully implementing the program. All requirements of the Revised 2007 FAD, with respective due dates, have been met.

In its *2016 Watershed Protection Program Summary and Assessment*, the City reports that 30 active WWTPs in the WOH and 9 WWTPs in the EOH FAD basins are inspected on a regular schedule, as is required by the Revised 2007 FAD. The WWTP Compliance and Inspection program reports have been submitted to NYSDOH and EPA on time. The reports are well-organized and provide valuable information regarding comprehensive monitoring of the complying WWTPs and demonstrate effective enforcement actions, along with intensive technical and professional assistance, in the event of noncompliance.

NYSDOH would like to acknowledge that quite frequently the City goes above and beyond the requirements to assure that all WWTPs discharging in the Watershed are meeting their SPDES permit requirements and, when necessary, are restored to good working conditions as quickly as possible. In addition, the City conducts follow-up inspections when needed. In rare cases of chronic violations of SPDES permits, effective enforcement actions by the City, NYSDEC, and local health departments take place, followed by a Compliance Conference with the owner/operator to discuss problems and possible corrective actions. The City may also conduct a periodic unannounced follow-up visit to ensure that the WWTP is continuing in its efforts to remain in compliance.

The City takes additional steps to ensure compliance. Its enforcement activities are coordinated with NYSDEC through their quarterly Watershed Enforcement Coordination Committee meetings, where the status of watershed WWTPs is discussed, and actions are taken to restore compliance. Staff from NYSDOH, EPA, and the Office of the Attorney General participate in these collaborative efforts to ensure compliance with regulatory requirements and validate the City's transparency in operations.

NYSDOH concludes that during the assessment period, the City has effectively implemented this program and complied with all requirements of the Revised 2007 FAD. The WWTP Inspection Program remains a vital component of the City's unfiltered water supply protection.

## ***Catskill/Delaware Filtration and UV Disinfection Facilities***

### **FAD Section 7 Catskill/Delaware Filtration and UV Disinfection Facilities**

#### Revised 2007 FAD Requirements

As relief from having to produce a final design for filtration facilities for the Catskill/Delaware water supply, the 2002 FAD required the City to design and construct an ultraviolet light disinfection facility and to provide biennial updates to the preliminary filtration plant design for the Catskill/Delaware system. An enforceable construction schedule was set for the CDUV Facility under an Administrative Order that was signed by EPA and NYSDOH in 2007. The plant is required to be in full operation by October 29, 2012. The Revised 2007 FAD requires that the City implement its program for the CDUV Facility in accordance with Section 2.6.2 of the City's 2011 Long-Term Watershed Protection Program. Section 7 of the Revised 2007 FAD specifically requires the City to adequately staff and commence full operation of the UV disinfection facility, and to provide a biennial report that updates the preliminary design for filtration facilities for Catskill/Delaware water.

### Evaluation of the City's Compliance

The City has met the requirements of this FAD program. The City confirmed in April 2012, that the CDUV Facility was adequately staffed by certified operators, as defined by the NYSDOH Operator Certification Regulation (10 NYCRR Subpart 5-4). The CDUV was placed into full service in October 2012, and was delivering a dose of 40 mJ/cm<sup>2</sup> as required by the Administrative Order. Since that time, with the approval of NYSDOH, the City made programming changes at the CDUV Facility to provide for a lower UV dose. Testing began on December 29, 2014 on a reduced dose of 29.40 mJ/cm<sup>2</sup>; by March 3, 2015, the City had successfully tested a dose of 24.17 mJ/cm<sup>2</sup>, and all units had been reprogrammed with this dose and were providing 2-log *Cryptosporidium* inactivation based on a UV Transmittance of 80%.

In 2013 and 2015, the City proposed, and NYSDOH agreed, that because no design changes to the 2009 preliminary plans for the Catskill/Delaware Filtration Facilities were required or issued, no revisions to the 2009 plans were necessary.

The CDUV Facility satisfies the *Cryptosporidium* inactivation treatment requirements of the Long Term 2 Enhanced SWTR, and, along with chlorination, meets the requirement for a minimum of two types of disinfectant. The CDUV Administrative Order was terminated by EPA on July 7, 2016 based on successful completion by the City of all activities required by the order.

## ***In-City Programs***

### **FAD Section 8.1 Waterborne Disease Risk Assessment Program**

#### Revised 2007 FAD Requirements

The Waterborne Disease Risk Assessment Program (WDRAP) was initiated with the goal of helping the City comply with the FAD criterion that the NYC water supply is not the source of a waterborne disease outbreak and that water consumers are adequately protected against waterborne disease.

Since its inception in 1993, the program has been modified and enhanced to better track the incidence of, and gather epidemiological data on, waterborne diseases, in particular giardiasis and cryptosporidiosis. This is accomplished through: 1) monitoring rates of giardiasis and cryptosporidiosis in NYC, with demographic and risk factors data collection; 2) providing a system that tracks diarrheal illnesses to ensure rapid detection of any outbreaks; and 3) conducting risk assessment to identify potential association, or lack of thereof, between an outbreak and tap water consumption.

The Revised 2007 FAD requires the City to maintain the WDRAP as an effective tool that will help detect the presence of waterborne disease outbreaks and report any evidence of such an outbreak to NYSDOH and EPA in a timely manner. The FAD further requires that, should a water quality “event” occur (e.g. increased turbidity, pathogen detection, disruption in operation, etc.), the City, in coordination with the NYC Department of Health and Mental Hygiene (NYCDOHMH), will provide syndromic surveillance system information to NYSDOH and EPA.

Upon notification by the NYCDOHMH of any significant signs of community gastrointestinal illness, in which the public drinking water supply appears to be the source of illness, the City is required to inform NYSDOH and EPA.

In addition, the Revised 2007 FAD requires the City to submit annual WDRAP reports, which will describe programmatic accomplishments, implementation status, and data interpretation.

### Evaluation of the City’s Compliance

During the assessment period, the WDRAP has met and exceed all requirements of the Revised 2007 FAD. Over the years, not only did this this program enhance its core components (i.e. disease and syndromic surveillances) but it also incorporated some education and outreach activities.

As is required, the City submitted its annual WDRAP report by March 31 of each year. These reports are well-organized, incorporate valuable data regarding comprehensive surveillance, and, based on analysis of available data, have each concluded that there was no evidence of a drinking water-related outbreak in NYC during the reporting period.

Since its inception, the WDRAP has continued to effectively implement the program and maintain compliance with the requirements. NYSDOH would like to commend the City on the implementation of this program. Over the years, the WDRAP has evolved into a state-of-the-art proactive public health protection initiative. NYSDOH believes that this program is key to assessing that the City’s water is not a source of a waterborne disease outbreak, as required by the SWTR for filtration avoidance.

## **FAD Section 8.2 Cross Connection Control Program**

### Revised 2007 FAD Requirements

Cross connections in the distribution system of a water supply can be a serious source of contamination. The City's 2011 Long-Term Watershed Protection Program contains a detailed inspection and reporting schedule for a Cross Connection Control Program (Section 2.7.2). The Revised 2007 FAD requires the City to implement a Cross Connection Control Program in accordance with the milestones in the long-term plan. Requirements of the Revised 2007 FAD include: respond to cross connection control complaints, initiate enforcement for non-compliant hazardous premises, approve backflow preventer plans, accept backflow preventer plans with self-certification, issue NOVs for failure to test annually, review requests for exemption from cross connection control requirements, and perform full inspections of potentially hazardous premises.

### Evaluation of the City's Compliance

The City has a very active cross connection control program, which has exceeded all the performance goals in the Revised 2007 FAD. In 2013, the City launched a pilot effort to accept online applications for cross connection plan review through the Water and Sewer Permitting System. This ongoing effort also includes targeted outreach and education, along with written guidance. In 2014, the City moved from handwritten to digital NOVs, which led to an expedited enforcement process, as well as a strong increase in the number of NOVs issued for failure to annually test backflow prevention devices.

Through inspections of potential sources of cross connections and follow-up enforcement to ensure backflow prevention devices are installed where necessary, the Cross Connection Control Program is an important tool for preventing contamination of the City's water in the distribution system. During the assessment period, the number of NOVs issued by the City for failure to test annually has steadily increased, from 57 in 2011 to 4,449 in 2015. Meanwhile, the number of enforcement actions implemented for non-compliant hazardous premises has steadily decreased, from 4,060 in 2011 to 1,182 in 2015.

During the assessment period, the City responded to four cross connection control complaints. Enforcement was initiated for over 13,500 non-compliant hazardous premises. The City approved over 29,000 backflow preventer plans, and accepted 49 self-certified plans. Over 1,900 requests for exemption from cross connection control requirements were reviewed. Nearly 22,000 inspections were performed of potentially hazardous premises. In addition, the City issued nearly 9,700 NOVs for failure to test backflow prevention devices annually.

While NYSDOH finds that this program is a critical additional barrier to protecting the City's drinking water supply, implementation of a cross connection control program is not one of the criteria defined by the SWTR for maintaining filtration avoidance. Oversight for regulations pertaining to the City's distribution system is performed by the NYCDOHMH. NYSDOH will consider relying on NYCDOHMH's oversight to ensure that the City maintains a robust and effective cross connection control program, rather than continuing this program as a requirement in the next FAD.

## ***Administration***

### **FAD Section 9. Administration**

#### Revised 2007 FAD Requirements

The Revised 2007 FAD requires the City to maintain staffing, funding, and expertise necessary to support all elements of the City's Long-Term Watershed Protection Plan and all activities detailed in the FAD. Specifically, the Revised 2007 FAD annually requires the City to identify actual filled staff position levels versus available positions for each division and section involved in supporting the watershed protection program, and confirm that resource levels are adequate to ensure that all program goals/FAD requirements are met. In addition, the City is required to report annually on the amount (capital and expense) spent in the previous year, the amount appropriated for the current year, and the amount planned for the year thereafter, for watershed protection programs. This reporting also must include costs associated with technical consulting contracts identified in the FAD.

#### Evaluation of the City's Compliance

The FAD requirements for this program have been met. The City's September 2015 report on budget and staffing identified 866 budgeted positions for the Bureau of Water Supply, of which 819 were filled (94.6%). In general, NYSDOH agrees that the City continues to adequately support the watershed protection programs with funding and staff.

## ***Education and Outreach***

### **FAD Section 10. Education and Outreach**

#### Revised 2007 FAD Requirements

The purpose of the Education and Outreach Program is to inform both upstate residents and downstate consumers about the importance of source water protection, water conservation, and environmental sustainability. This collaborative program, in which numerous partners have joined the City, is implemented with the goal of enhancing all FAD-related water quality protection efforts and promoting environmental stewardship.

The Revised 2007 FAD requires the City to continue its education and outreach efforts, targeting specific audiences through the agricultural, forestry, stream, and land management programs, including recreation and invasive species control. The City is further required to continue funding CWC's public education grants program and other community outreach activities relevant to watershed protection.

The City is also required to continue its support of the school-based education and training programs for both the upstate and the downstate communities. In addition, the City is required to participate in a range of community/public outreach events within the watershed and in the City. To effectively disseminate information about watershed protection and conservation to upstate/downstate constituents, the City is required to utilize publications, their website, and social media tools.

In addition, the City is required on an annual basis to submit a report describing program activities by March 31.

### Evaluation of the City's Compliance

NYSDOH acknowledges that during the assessment period all programmatic requirements specified in the Revised 2007 FAD have been met. The program continues to be an effective tool for educating targeted audiences on the topics related to FAD requirements.

Annually in March, as is required by the Revised 2007 FAD, the City compiled and submitted to NYSDOH and EPA for review its education and outreach report, where the overall status of the program and specific accomplishments had been described. Additional information and program summary have been provided by the City in the *2016 Watershed Protection Program Summary and Assessment* report. The report contains valuable information about program accomplishments. The report also confirms that one of the most effective tools for reaching large audiences continues to be their website, which provides a broad spectrum of information ranging from compliance to regulatory requirements to recreational opportunities. With continuous technological advances, numerous opportunities are offered through various social media venues these days. NYSDOH appreciates that the City uses social media tools (e.g., Twitter, Facebook, Flickr, and YouTube) in their attempt to reach a broader audience.

The City works closely with the CWC, Cornell Cooperative Extension, county Soil and Water Conservation Districts, the WAC, the CRISP, the Lower Hudson Partnership for Invasive Species Management, and numerous other partners. Recently the City has enhanced its reporting process by categorizing targeted audiences based on their specific educational interests/needs. This approach helped the City and its partners in planning, execution, and reporting for this program.

Since various components of this program are incorporated into specific Revised 2007 FAD programs, they are reported through them. These include the agricultural, forestry, land acquisition, stormwater, wastewater, stream management and riparian buffer protection programs. During the assessment period a steady yearly increase in the number of unique organized events and expansion in attendance have been achieved through the efforts of those programs. The City estimates, that tens of thousands of specific target audiences were educated or trained every year through outreach activities. This is a very impressive accomplishment, and NYSDOH commends the City and its partners for such an effective education and outreach process.

Another important accomplishment is the continuous financial support of the Public Education Grants Program, administered by the CWC. During the assessment period the CWC awarded \$752,637 for 128 grants to schools and organizations in NYC and the

watershed. Topics of the funded projects ranged from water quality testing experiments, to the Trout in the Classroom project, to arts and performances pertinent to the water supply and its vital role in life. Various workshops, educational materials, and e-newsletters were also sponsored by CWC with financial support provided by the City.

The City's outreach work with land trusts and watershed communities relevant to real property acquisitions, conservation easements, and flood buyouts are important parts of the program.

The support and expansion of environmental stewardship remains an integral and important part of the program. In its *2016 Watershed Protection Program Summary and Assessment* report the City noted that in 2015, approximately 350 volunteers participated in 9 separate reservoir clean-up events. NYSDOH note this accomplishment and congratulate the City on its effective promotion of stewardship.

In conclusion, NYSDOH believes that the Education and Outreach Program continues to be a very successful program and remains a valuable component of the City's overall watershed protection program.

## Conclusions

Overall, the City has successfully satisfied the obligations specified in the Revised 2007 FAD. For most programs, the City has met FAD due dates. However, some FAD program elements have experienced delays in implementation. In many cases, these delays were due to circumstances outside of the City's control or due to weather conditions. For example, the community wastewater management projects have taken longer to complete than expected, due in large part to the extensive coordination needed between the City and the communities on both technical and administrative matters. In some cases, delays in contracting and funding processes have put continuous program implementation at risk. While the City has been able to manage these situations to continue program activities, ensuring that gaps in program activities do not occur is critical to the effective functioning of these programs and meeting the requirements of the FAD. NYSDOH encourages the City to seek ways to address this issue and the potential impacts it could have on successful program implementation.

NYSDOH finds that the City has a comprehensive and robust watershed protection program, which, overall, is being effectively implemented by the City and its partners. The City continues to provide drinking water to NYC and upstate consumers that meets all requirements of the Surface Water Treatment Rule (SWTR).