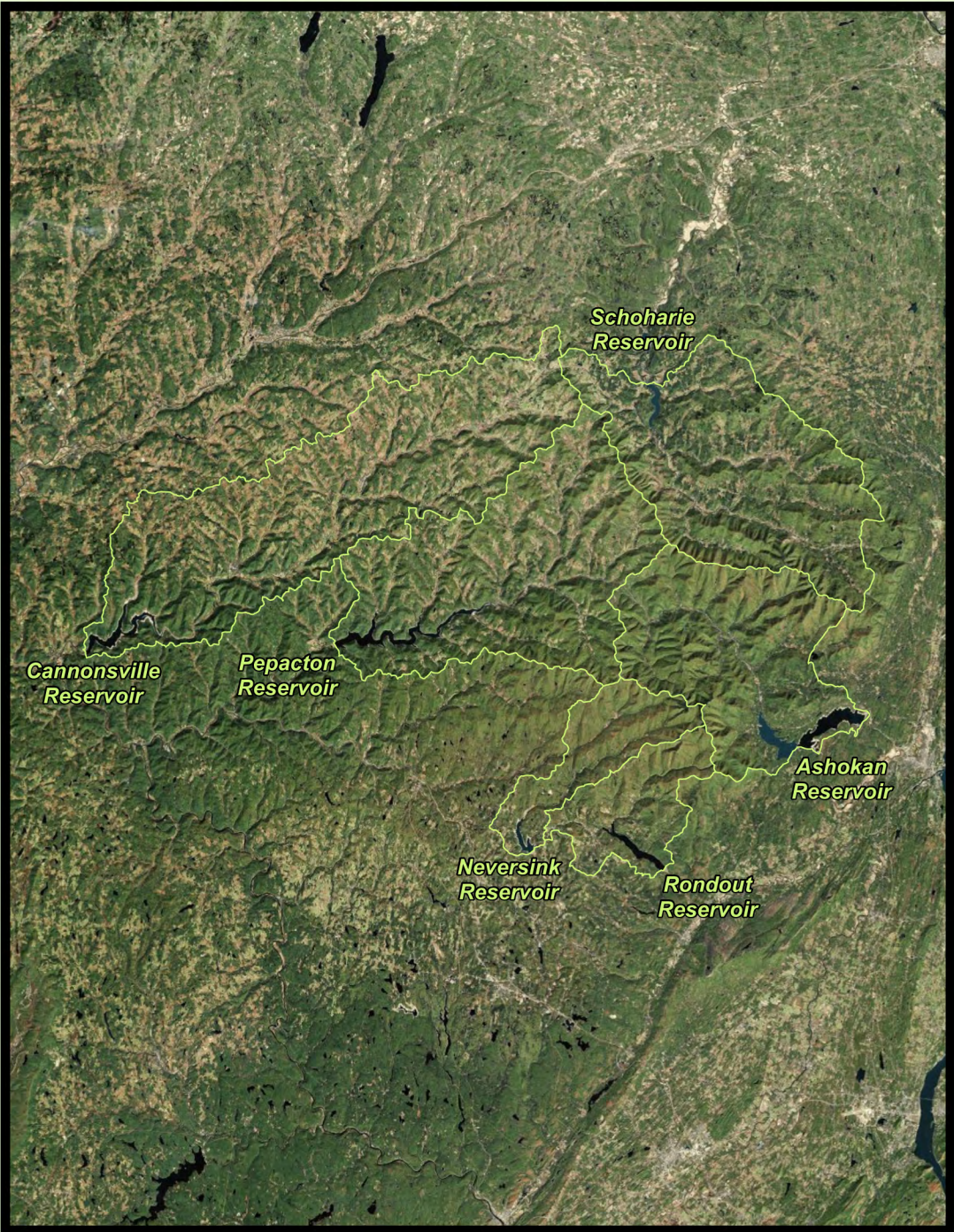


# 2011 Long-Term Watershed Protection Plan

December 2011



New York City Department of Environmental Protection  
Bureau of Water Supply



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## **List of Acronyms**

BMP	best management practice
CAP	<i>Cryptosporidium</i> Action Plan
CATUEC	Catskill Upper Effluent Chamber
CCE	Cornell Continuing Education
CE	conservation easement
CFI	Continuous Forest Inventory
CFR	Code of Federal Regulations
CFU	colony forming units
CREP	Conservation Reserve Enhancement Program
CRISP	Catskill Regional Invasive Species Partnership
CSBI	Catskill Streams Buffer Initiative
CT	contact time
CWA	Clean Water Act
CWC	Catskill Watershed Corporation
CWMP	Community Wastewater Management Program
DEP	New York City Department of Environmental Protection
ECL	New York State Environmental Conservation Law
EOH	East of Hudson
EPA	United States Environmental Protection Agency
FAD	Filtration Avoidance Determination
FEMA	Federal Emergency Management Agency
FIRM	Flood Insurance Rate Map
GIS	Geographic Information System
GPD	gallons per day
GPS	Global Positioning System
GUI	graphical user interface
GWLF	Generalized Watershed Loading Function
IRSP	Individual Residential Stormwater Plan
ISWG	Invasive Species Working Group
KAP	Kensico Action Plan
LAP	Land Acquisition Program
LIDAR	Light Detection and Ranging
LOWESS	Locally Weighted Scatterplot Smoothing
LT2	Long Term 2 Enhanced Surface Water Treatment Rule
MAP	Management Assistance Program
MGD	million gallons per day
MOA	Memorandum of Agreement
MOU	Memorandum of Understanding
NGO	non-governmental organization
NIP	New Infrastructure Program

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NPDES	National Pollutant Discharge Elimination System
NTU	Nephelometric Turbidity Units
NWI	National Wetlands Inventory
NYCRR	New York Codes, Rules and Regulations
NYSDEC	New York State Department of Environmental Conservation
NYSDOH	New York State Department of Health
O&M	Operation and Maintenance
OST	Operations Support Tool
P	phosphorus
PAA	Public Access Area
PAC	Project Advisory Committee
PHL	New York State Public Health Law
PRISM	Partnerships for Regional Invasive Species Management
RBP	Riparian Buffer Program
RCMP	Riparian Corridor Management Plan
SCADA	Supervisory Control and Data Acquisition
SDWA	Safe Drinking Water Act
SEQRA	State Environmental Quality Review Act
SMIP	Stream Management Implementation Grant Program
SMP	Stream Management Program
SPDES	State Pollutant Discharge Elimination System
SSTS	subsurface sewage treatment system
SWCD	Soil and Water Conservation District
SWPPP	stormwater pollution prevention plan
SWTR	Surface Water Treatment Rule
TAP	Turbidity Action Plan
TCR	Total Coliform Rule
TP	total phosphorus
USFS	United States Forest Service
UV	ultraviolet
VE	Value Engineering
WAC	Watershed Agricultural Council
WaLIS	Watershed Lands Information System
WAP	Watershed Agricultural Program
WDRAP	Waterborne Disease Risk Assessment Program
WECC	Watershed Enforcement Coordination Committee
WMP	Waterfowl Management Program
WOH	West of Hudson
WRR	Watershed Rules and Regulations
WSP	Water Supply Permit
WWQMP	Watershed Water Quality Monitoring Plan
WWTP	wastewater treatment plant
WWTPCI	Wastewater Treatment Plant Compliance and Inspection Group

# **1. Introduction**

This report presents New York City's Revised Long-Term Watershed Protection Program (the Program), submitted to the New York State Department of Health (NYSDOH) for continuation of the 2007-2017 filtration waiver for the Catskill/Delaware Systems. Unlike previous Filtration Avoidance Determinations (FADs), the current FAD covers a full 10-year period and calls for a midterm assessment of the City's programs and commitments in 2011, leading to the submission of this Revised Long-Term Watershed Protection Program for the Second Five-Year Period, covering the period 2012-2017. The 2007 FAD requires the City to continue to implement a number of distinct programs that form the core of the overall source water protection program. Through periodic assessments, the New York City Department of Environmental Protection (DEP) has demonstrated the ongoing effectiveness of the overall program in preserving the existing high quality of the Catskill/Delaware waters. The City's most recent assessment, issued in March 2011, confirms that water quality status and trends continue to point to a safe, reliable supply of drinking water for half the population of New York State. With this program, DEP is proposing the continuation of core programs at roughly the same scope and scale as required by the 2007 FAD.

One important development since the 2007 FAD was issued was the issuance, in December 2010, of the City's Water Supply Permit (WSP) by the New York State Department of Environmental Conservation (NYSDEC). The WSP allows the City to continue its willing seller/willing buyer Land Acquisition Program for an additional 15 years and establishes certain conditions for the program. The WSP resulted from extensive discussions among the City, NYSDEC, NYSDOH, the U.S. Environmental Protection Agency (EPA), watershed counties, the Coalition of Watershed Towns, environmental groups, and other stakeholders. In addition to establishing the framework for continued land acquisition, the WSP includes financial and other commitments for many of the programs and activities described in this report.

This document should be viewed in the context of the City's long-running source water protection program. Since its first filtration waiver was issued nearly 20 years ago, DEP has produced a multitude of reports detailing program progress and documenting the continued high quality of the Catskill/Delaware supply. For specifics about the implementation of watershed protection programs, refer to the Annual Reports prepared pursuant to the FAD for the years 2001 through 2010. DEP also produces dozens of quarterly, semi-annual, and annual reports on FAD programs, publishes reports on special studies, and prepares an annual water quality statement which gives detailed information about water quality.

## **Water Supply System Overview**

The New York City water supply system consists of three surface water sources (the Croton, the Catskill, and the Delaware) and a system of wells in Queens (the Jamaica system). The three upstate water collection systems include 19 reservoirs and three controlled lakes with a total

storage capacity of approximately 580 billion gallons. They were designed and built with various interconnections for flexibility to meet quality and quantity goals and to mitigate the impact of localized droughts or storm events. The system supplies drinking water to almost half the population of the State of New York—more than 8.4 million residents of New York City and one million people in Westchester, Putnam, Orange, and Ulster Counties—plus the millions of commuters and tourists who visit the City throughout the year. Overall consumption averages about 1.1 billion gallons a day.

DEP is the City agency charged with primary responsibility for overseeing the operation, maintenance, and management of the water supply infrastructure and the protection of the 1,972-square-mile watershed. Within DEP, the Bureau of Water Supply manages the watersheds and the City's upstate reservoirs and transmission infrastructure and is responsible for all drinking water quality monitoring both in the City and upstate. The Bureau of Water and Sewer Operations operates the City's two main distribution reservoirs—Hillview and Jerome Park—as well as the drinking water distribution and wastewater collection infrastructure. The Bureau of Engineering Design and Construction manages all large contracts for capital construction and maintenance of the water supply system. Other bureaus within DEP provide various support services to ensure the smooth operation of the system. In addition, staff from the New York City Department of Health and Mental Hygiene assist in certain drinking water programs.

The Croton watershed is located entirely east of the Hudson River in Westchester, Putnam, and Dutchess Counties, with a small portion in the State of Connecticut. The oldest of the three systems, parts of the Croton System have been in service since 1842. The watershed covers approximately 375 square miles. Croton's 12 reservoirs and three controlled lakes are connected primarily via open channel streams and rivers, and ultimately drain to the New Croton Reservoir in Westchester County. Approximately 10% of the City's average daily water demand has historically been supplied by the Croton System, although in times of drought it can provide significantly more.

The City is building a water treatment plant under the Mosholu Golf Course in the Bronx to filter the Croton supply. While the Croton System continues to meet all current health-based regulatory standards for a surface water supply, it does experience periodic violations of the aesthetic standards for color, taste, and odor and exceeded the haloacetic acids standard on one occasion in 2003. It is also not clear that the Croton System will be able to meet stricter disinfection by-product criteria that were promulgated in 2006. The Croton treatment plant is expected to resolve these concerns.

The Catskill System consists of two reservoirs—Schoharie and Ashokan—located west of the Hudson River in Ulster, Schoharie, Delaware, and Greene Counties. The Catskill System was constructed early in the twentieth century, beginning with Ashokan Reservoir, which went into service in 1915. Water flows southeast from Schoharie Reservoir via the 18-mile Shandaken Tunnel,



emptying into Esopus Creek at Allaben. From there water continues to flow another 12 miles in Esopus Creek before entering the West Basin of Ashokan Reservoir. Water leaves Ashokan through the 75-mile-long Catskill Aqueduct, which connects to Kensico Reservoir in Westchester County. On average, the Catskill System provides almost 40% of the City's daily water supply.

The Delaware System was constructed in the 1950s and 1960s, and is comprised of four reservoirs: Cannonsville, Pepacton, and Neversink in the Delaware River basin, and Rondout in the Hudson River basin. The first three reservoirs supply Rondout. Water then leaves Rondout and travels to West Branch Reservoir in Putnam County via the 45-mile Rondout/West Branch Tunnel. Water from West Branch flows through the Delaware Aqueduct to Kensico Reservoir. The Delaware System supplies over 50% of the City's daily demand. Because waters from the Catskill and Delaware watersheds are commingled at Kensico Reservoir, they are frequently referred to as one system: the Catskill/Delaware System.

### **Regulatory Context**

The Safe Drinking Water Act (SDWA) amendments of 1986 required EPA to develop criteria under which filtration would be required for public surface water supplies. In 1989, EPA promulgated the Surface Water Treatment Rule (SWTR), requiring all public water supply systems supplied by unfiltered surface water sources either to provide filtration or to demonstrate that they meet certain quantitative and narrative criteria and provide specified treatment techniques. The City decided to apply for filtration avoidance for the Catskill/Delaware System under the terms of the SWTR. To demonstrate a basis for a filtration waiver, DEP advanced a program to assess and address water quality threats to the Catskill/Delaware System. As outlined in the SWTR, issues of concern fall into several categories: coliform bacteria, enteric viruses, *Giardia* spp., *Cryptosporidium* spp., turbidity, disinfection by-products, and watershed control. DEP has developed comprehensive programs addressing each of these.

The City has consistently demonstrated that the Catskill/Delaware supply complies with the quantitative criteria, by showing that (1) the source water has met the turbidity and fecal coliform standards of the SWTR, (2) there have been no source-related violations of the Total Coliform Rule, and (3) there have been no waterborne disease outbreaks in the City. In late summer 2011, runoff from Hurricane Irene and Tropical Storm Lee led to elevated fecal coliform levels in Kensico Reservoir and throughout the system. There were a number of individual exceedances at Kensico Reservoir but DEP maintained compliance with the rule. Investigations point to wildlife as the predominant source of coliforms following the storms.

The narrative criteria of the SWTR require the City to show, through ownership or agreements with landowners, that it can control human activities in the watershed with the potential to harm the microbiological quality of the source water. Meeting this standard presented a challenge

since, in 1991, only 28% of the land in the Catskill/Delaware watershed was publicly owned—21% by New York State within the Catskill Preserve, and 7% by New York City, of which about half consisted of land under City reservoirs.

Over the last 20 years, DEP and its partner agencies and organizations have developed and implemented an aggressive and comprehensive watershed monitoring and protection program that has not only maintained but enhanced the high quality of Catskill/Delaware water. This program has been recognized internationally as a model for watershed protection and has enabled the City to secure a series of waivers (January 1993, December 1993, January 1997, May 1997, November 2002, July 2007) from the filtration requirements of the SWTR and the Interim Enhanced Surface Water Treatment Rule.

### **New York City's Watershed Protection Program for the Catskill/Delaware System**

What began in 1991 as a proposal for comprehensive watershed protection has become, in the past 20 years, a long-term commitment by the City to safeguard its water supply at the source, while monitoring the quality of the water delivered to consumers at the tap. The initial staff of some 230 upstate engineers and watershed maintainers, augmented by a relatively small cadre of scientists and technicians, has grown to more than 900 employees in the watershed, plus 100 more in the City. Before the program was launched, the focus was almost entirely operational: ensuring the smooth running of the reservoir infrastructure and the delivery of water to the City. Water quality samples were taken by watershed maintainers who performed a wide range of tasks related primarily to system operations and maintenance.

Over time, DEP's emphasis has broadened considerably. The Water Quality Directorate now employs approximately 250 professionals who are dedicated to performing 600,000 analyses a year from over 50,000 samples drawn at both in-City sites and across the watershed. As part of DEP's source water monitoring program, samples are collected and tests are conducted throughout the watershed, including sites at aqueducts, reservoirs, streams, and watershed wastewater treatment plants (WWTPs). The monitoring program's fundamental goals are to help manage the system to provide the highest quality water possible, develop a database through which water quality trends can be identified, and identify water quality conditions of concern to better focus watershed management efforts.

The City's source water monitoring program was independently evaluated in 1997 by the National Research Council. The Council found the City's program to be "informed, extensive, and of high quality for a water supply of its size." The Council also noted that "the complexity of the multiple interacting reservoir ecosystems of the New York City water supply imposes major monitoring demands to allow for effective management responses to problems. In general, DEP has been performing these formidable tasks excellently." Accordingly, findings of the City's peer-reviewed source water monitoring program have reliably served as the scientific basis for the City's watershed protection program.

Based upon the information collected through its monitoring and research efforts, DEP designed a comprehensive watershed protection strategy, which focused on implementing both protective (antidegradation) and remedial (specific actions taken to reduce pollution generation from identified sources) initiatives. DEP's assessment efforts pointed to several key potential sources of pollutants: waterfowl on reservoirs, WWTPs discharging into watershed streams, failing septic systems, the approximately 350 farms located throughout the watershed, and stormwater runoff from development. DEP crafted a protection strategy to target these primary pollution sources and a host of secondary ones. DEP has initiated and advanced many protective programs as well.

### **Implementing the Watershed Protection Program with Local Partners**

In January 1997, after 14 months of intense negotiations, the New York City Watershed Memorandum of Agreement (MOA) was signed, ushering in a new era of watershed protection and partnership with numerous watershed stakeholders. The MOA signatories include the City; New York State; EPA; watershed counties, towns, and villages; and certain environmental and public interest groups. This unique coalition came together with the dual goals of protecting water quality for generations to come and preserving the economic vitality of watershed communities. The MOA establishes the institutional framework and relationships needed to implement the range of protection programs identified as necessary by the City, the State, and EPA. In the past 15 years, DEP and its partners have focused on several key watershed protection initiatives: the Watershed Agricultural Program (WAP), the acquisition of watershed lands, the enforcement of updated Watershed Rules and Regulations, and the initiation and expansion of environmental and economic partnership programs that target specific sources of pollution in the watershed. In addition, the City continued its enhanced watershed protection efforts in the Kensico Reservoir basin and advanced the upgrades of City-owned and non-City-owned watershed WWTPs.

## **1.1 Water Quality Conditions**

### **Water Quality Monitoring Overview**

Water quality throughout the watershed is constantly monitored for compliance and operational purposes in addition to program watershed protection evaluation. In the early 1990s, DEP embarked on an aggressive program to protect and enhance the quality of New York City's drinking water. Since that time, DEP has been able to demonstrate, as indicated above, that the Catskill/Delaware supply has consistently met all the SWTR objective criteria. In addition, Water Quality monitoring has allowed DEP to meet the subjective criteria of the SWTR, which require DEP to demonstrate through ownership or agreements with landowners that it can control human activities in the watershed which might adversely impact the microbiological quality of the source water.

Since the inception of the watershed protection program in the early 1990s, the City has supported an extensive monitoring program. Each year, DEP collects nearly 19,000 samples from approximately 475 sites throughout the watershed—at aqueducts, reservoirs, streams, and WWTPs. The purpose of this intensive monitoring effort is to demonstrate compliance with all water quality standards, to help operate and manage the system to provide the best possible water at all times, to develop a record to identify water quality trends, and to focus watershed management efforts. This robust monitoring program provides the scientific underpinnings for the source water protection programs and policies.

Data are currently collected through an objective-based monitoring program defined in the 2008 Watershed Water Quality Monitoring Plan. The accumulation of a long-term database has allowed DEP to identify and address existing water quality conditions, identify long-term trends, guide operations, and determine effectiveness of watershed programs. The 2011 Watershed Protection Program Summary and Assessment provides the most recent evaluation of water quality conditions. The findings of that report are re-stated in subsequent sections.

### **Water Quality Data Analysis**

The water quality data record used for this analysis begins in 1993, which represents conditions at the outset of filtration avoidance when many watershed protection programs were in their infancy. The data analysis extends from 1993 through 2009, a 17-year period when new and intensified watershed protection programs were implemented. This long-term data analysis allows for time lags which occur between program implementation (causes) and the resulting water quality changes (effects). Sufficient time must pass after programs are in place in order to see the full effects of programs on water quality. Further improvements in water quality are expected to evolve as the full effects of the programs are realized.

The water quality monitoring program analytes examined for status and statistically significant trends were those most important for the SWTR and meeting the requirements of the 2007 FAD. The established benchmarks for such analytes are as follows: fecal coliforms (20 CFU 100 mL<sup>-1</sup>), turbidity (5 NTU), and total phosphorus (TP) (15 µg L<sup>-1</sup>). (These values are referred to as “benchmarks” because they are used for individual sample comparisons, whereas standards may apply to a percentage of samples over a time period.) In addition, macroinvertebrate data provided insight into the ecological condition of streams and formed the basis for an index that can demonstrate changes in water quality. The Waterfowl Management Program (WMP) continued to demonstrate its effectiveness in controlling and reducing fecal coliform bacteria. The many facets of the protection program are tracked and their effectiveness is evaluated through the ongoing growth of the water quality database.

In addition to statistical analysis, DEP conducts modeling analyses. Models are used by DEP to manage water quality over both long- and short-term periods. Model analysis using the long-term database allows DEP to separate the effects of important natural factors that influence

water quality from the effects of watershed protection programs. Further, it allows DEP to estimate the relative effects of different watershed protection programs and may be used to guide priorities. DEP employs models for short-term events (on the order of months) to optimize reservoir operations and to determine when treatment may be necessary. Model application is thus used at DEP for diagnostic analysis and water supply decision support. A brief description of model applications follows the summaries of water quality conditions below.

### **Water Quality Conditions for the Catskill System**

DEP has continued to enhance watershed protection in the Schoharie basin, and since 2004, three WWTPs have been constructed (in Hunter, Windham, and Prattsville). With these improvements, the TP load decreased from 240 kg yr<sup>-1</sup> in 2004 to < 50 kg yr<sup>-1</sup> in 2009. In addition, more than 100 septic systems have been remediated since 2004, increasing total remediations to over 600 in the Schoharie basin since the WWTP upgrade and septic rehabilitation programs began.

Water quality status in Schoharie Reservoir from 2007-2009 was good. Monthly median fecal counts and monthly median phosphorus concentrations never exceeded benchmarks.

Monthly mean turbidities exceeded 10 NTUs on only three occasions. Trophic status was mesotrophic. Downward phosphorus trends were detected and attributed primarily to load reductions at WWTPs. Despite the decline in nutrients, the Trophic State Index showed an upward trend, presumably caused by improvements in water clarity. Increasing trends in fecal coliform counts appear to be associated with large runoff events and to the generally wet conditions in 2003-2005.

Biomonitoring results at Schoharie Creek indicated non-impairment for the three sites sampled during the 2007-2009 status evaluation period, while long-term trend analysis indicated improvement at one site and no change at the remaining two.

Three sites above Schoharie Reservoir were routinely monitored for *Cryptosporidium* and *Giardia*. *Cryptosporidium* oocysts have declined since 2007, coinciding with such watershed improvements as septic remediation and the construction of, or improvements to, WWTPs in the Schoharie basin. A reservoir output site is also monitored. Results at this site are typically lower than at the stream sites since reservoir processes (e.g., settling, predation, die-off) provide an effective reduction in protozoan numbers detected downstream.

Watershed protection efforts in the Ashokan basin continue to show water quality benefits. Between 2004 and 2009, phosphorus loads from WWTPs were reduced from 50 kg yr<sup>-1</sup> to approximately 25 kg yr<sup>-1</sup>. The reduction in load was primarily the result of earlier WWTP improvements and more recent repair of numerous failing septic systems. Since 1996, over 900 septic systems have been remediated, with about 350 repairs occurring since 2005.

Water quality status in the West Basin of Ashokan Reservoir was good during the 2007-2009 status evaluation period. Monthly median fecal counts were predominantly at or just above detection limits, with one exception of 20 CFU 100 mL<sup>-1</sup>. Monthly median turbidities were mostly below 5 NTU, with two exceptions related to storm events. TP values were also low, with most monthly medians below 10 µg L<sup>-1</sup>. The West Basin was in the lower range of mesotrophic. Long-term water quality trend results were mixed. Phosphorus decreased, in part due to watershed programs, but turbidity, fecal coliforms, and conductivity all increased during the 1994-2009 period. A large spring runoff event in 2005 was largely responsible for these apparent upward trends.

Water quality status downstream in the East Basin was better than in the West Basin. The highest monthly median fecal coliform count was 3 CFU 100 mL<sup>-1</sup>. All other months had fecal coliform counts below 1 CFU 100 mL<sup>-1</sup>. Most turbidity values were below 3 NTU, and phosphorus was generally below 10 µg L<sup>-1</sup>. The trophic state in the East was in the mesotrophic to oligotrophic range.

Biomonitoring results generally indicated that the main input to Ashokan Reservoir, Esopus Creek, was in good health. Long-term trend data available at two sites indicated improvement at one site and no change at the other.

Waterfowl numbers on Ashokan have decreased dramatically. This decrease is primarily attributable to closure of nearby landfills outside of the watershed and a consequent shift in gull migratory patterns. During the current assessment period, fecal coliform numbers have been low enough to obviate the need for “as needed” management.

Four sites on the Esopus and one reservoir output sample have been routinely monitored for *Cryptosporidium* and *Giardia*. Reservoir output results were much lower than those of the incoming streams, indicating that reservoir processes (e.g., settling, predation, die-off) provide an effective barrier, resulting in a reduction of protozoan numbers detected downstream. This result is similar to the observations in all other basins where inputs and outputs were monitored.

### **Water Quality Conditions for the Delaware System**

Exceptional improvements in watershed protection have been implemented throughout the Delaware System. Seventeen WWTPs have been constructed or upgraded since 1996, resulting in dramatic reductions to the phosphorus load. Three of these 17 plants are located in the Pepacton watershed, and came online after 2004. The septic remediation program continues to be very active. Since 2004, about 455 systems have been repaired, for a grand total of nearly 1,900 in the Delaware watershed since 1997. In addition, nearly 2,500 agricultural best management practices (BMPs) have been implemented since 1996, with over 80% occurring in the Cannonsville watershed.



Due to DEP's watershed protection efforts, the water quality status of all four Delaware System basins continues to be very good. Monthly median fecal coliform counts were at or near detection limits. Monthly median turbidity ranged from 1.0 NTU at Neversink and Rondout Reservoirs to about 2.0 NTU at Pepacton and Cannonsville. Monthly median phosphorus ranged from  $6 \mu\text{g L}^{-1}$  at Neversink to approximately  $14 \mu\text{g L}^{-1}$  at Cannonsville. No monthly medians greater than  $10 \mu\text{g L}^{-1}$  were observed during the 2007-2009 period at Neversink, Pepacton, or Rondout, indicating low nutrient levels.

Long-term (1993-2009) trend analysis results indicate continued improvement in some water quality parameters. Watersheds with very active remediation programs (e.g., Pepacton, Cannonsville, and Rondout) all experienced strong downward trends in TP. Downward fecal coliform trends were detected in the Cannonsville and Rondout basins as well. Notable improvements were also observed in the Trophic State Index at Cannonsville. Certainly, lower phosphorus loads were a factor, but poor water clarity from large storm events also contributed to limiting algal productivity in this reservoir. Turbidity trends (both up and down) were small in magnitude and appeared to be related to precipitation patterns and, to a lesser extent, algal blooms. Most basins also experienced increases in conductivity coinciding with a consistent increase in chloride, and associated with changes in precipitation.

Biomonitoring trend analysis on 14-16 years of data indicated improvement at two sites in the Cannonsville System, presumably related to WWTP upgrades (among other watershed improvements) and the resultant reduction in phosphorus loads.

Waterfowl management in Rondout Reservoir is conducted on an as needed basis. During the current assessment period, fecal coliform numbers increased to a level that triggered implementation of the management program from 12/22/05-3/4/06. Shortly after waterfowl harassment began, fecal coliform counts dropped sharply.

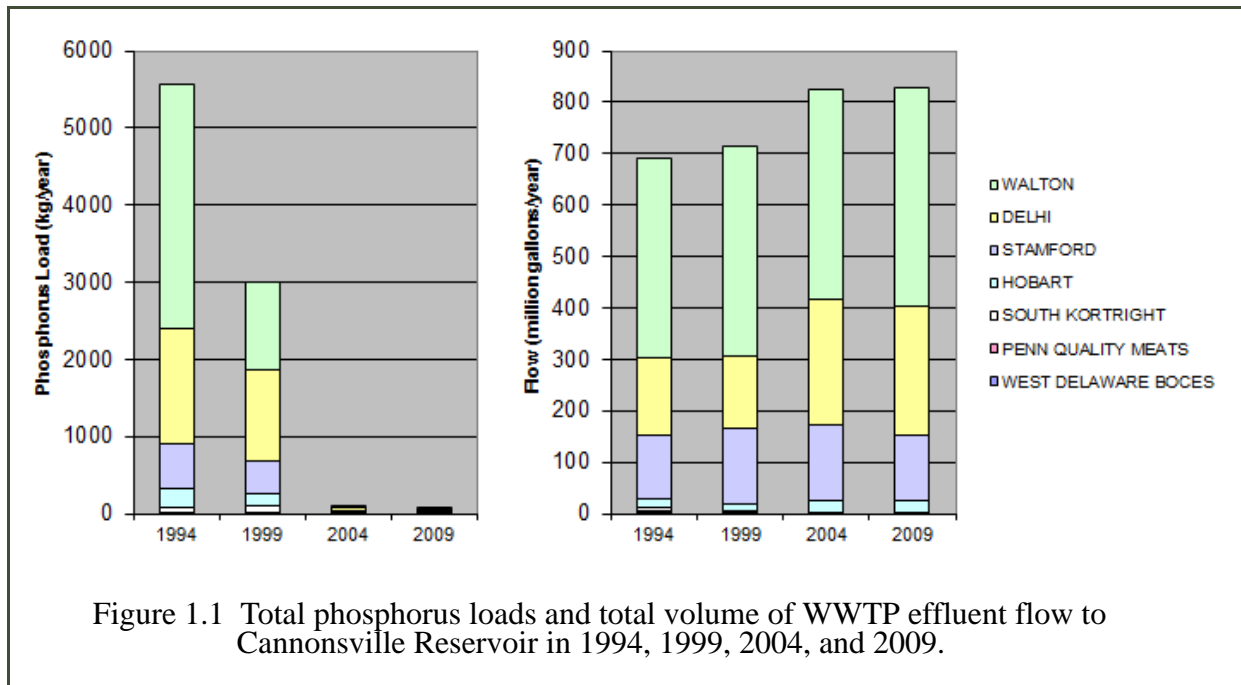
*Cryptosporidium* and *Giardia* pathogen monitoring has been conducted on the major inputs to all four reservoirs of the Delaware System. As with the Catskill System, reservoir output results were much reduced compared to those for input streams, indicating that reservoir processes (such as die-off, sedimentation, and predation) were effective in limiting the transport of pathogens downstream.

## **Case Study: Highlights of Phosphorus Load Reduction in the Cannonsville Reservoir Basin**

DEP's watershed protection programs in the Cannonsville Reservoir watershed have yielded enormous water quality improvements. Up until the early 1990s, when DEP became more active in its watershed protection efforts, Cannonsville Reservoir was in relatively poor condition compared to other reservoirs in the Catskill and Delaware Systems. Nutrient loading, mainly due to agricultural runoff and WWTP effluent, caused large algal blooms in the summertime. As these massive blooms of algae died, they consumed a significant portion of available dissolved oxygen, essentially starving other resident organisms of necessary elements for survival. This imbalance threatened the health of the reservoir and rendered its waters undrinkable. During summer months, the approximately 95.7 billion gallons of water stored in Cannonsville were used primarily to maintain flow in the Delaware River below the dam.

Subsequent to the adoption of the new, more aggressive watershed protection measures in the early 1990s, water quality markedly improved in the Cannonsville basin. DEP actively sought to eliminate and control sources of nutrients, phosphorus in particular. Addressing the various sources of phosphorus in the basin required a multi-faceted, synergistic effort. In particular DEP's Wastewater Treatment Plant Upgrade, Septic Remediation and Replacement, and Watershed Agricultural Programs have greatly reduced the amount of nutrient-rich runoff in the basin. Through the collective actions of these programs, Cannonsville has not been listed as a phosphorus-restricted basin since 2002.

As illustrated in Figure 1.1, phosphorus (as TP) loads from WWTPs were considerably reduced from 1994 to 1999. This was accomplished in large part through the intervention and assistance of DEP at Walton and at Walton's largest commercial contributor, the dairy processing plant operated by Kraft Foods, Inc. The substantial additional reductions in phosphorus loads realized after 1999 can be attributed to final upgrades of several plants and consolidation of one other.



### Case Study of the Benefit of Wastewater Treatment Plant Upgrades

The Walton WWTP is located on the West Branch of the Delaware River approximately 5 miles upstream of Cannonsville Reservoir. It is the largest treatment plant (1.55 MGD) in the Cannonsville watershed, servicing about 3,000 residents in the village of Walton. Starting in 1988, DEP established monitoring sites upstream and downstream of the treatment plant to evaluate the impact of the plant on the water quality of the river. Monthly TP and fecal coliform data from 1993-2008 from the upstream and downstream sites are provided in Figure 1.2. Prior to completion of the major upgrades in 1999, the data clearly indicate much higher TP and fecal coliform levels at the downstream monitoring site compared to the upstream site. With the initiation of plant improvements in 1995 this gap began to close. By the year 2000, fecal coliform levels were indistinguishable at the upstream and downstream sites, as was the case for TP in 2006.

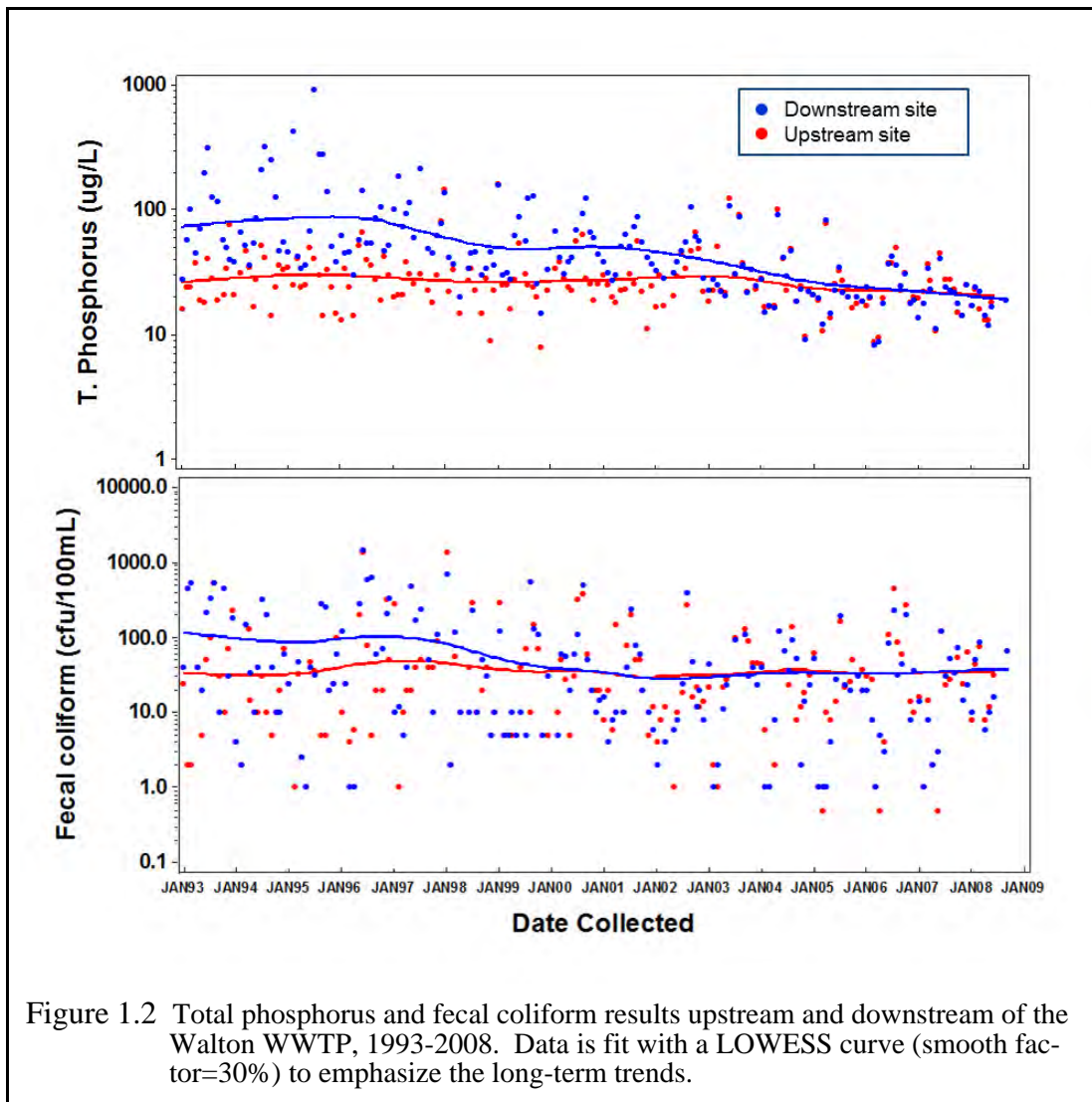


Figure 1.2 Total phosphorus and fecal coliform results upstream and downstream of the Walton WWTP, 1993-2008. Data is fit with a LOWESS curve (smooth factor=30%) to emphasize the long-term trends.

### Water Quality Conditions for the East of Hudson Catskill/Delaware System

DEP has continued to enhance watershed protection in the West Branch, Boyd Corners, and Kensico basins. In the West Branch and Boyd Corners basins, 37 stormwater remediation projects were completed in the 2003-2009 period, with five large projects scheduled for completion by 2012. In the Kensico basin, 41 projects have been completed since 1997, with five more to be finished in 2012. In 2009, a second turbidity curtain was installed in the Malcolm Brook cove to protect the water entering the Catskill Effluent Chamber from stormwater runoff.

The WMP continued its long-term efforts to reduce waterbird populations on and around Kensico Reservoir. In early 2007, bird harassment strategies similar to those used on Kensico were successfully employed on West Branch Reservoir as well.

Water quality status evaluations continued to be excellent during the 2007-2009 period in West Branch and Kensico Reservoirs. Median and highest values (of the monthly reservoir-wide medians) were all well below the established benchmarks for fecal coliforms (20 CFU 100 mL<sup>-1</sup>), turbidity (5 NTU), and TP (15 µg L<sup>-1</sup>).

Trend analyses indicated maintenance of and even some improvements to the excellent water quality in the West Branch and Kensico basins. Turbidity and fecal coliform decreases detected in the local stream inputs to West Branch may be due, in part, to the extensive stormwater management projects that have been completed in the West Branch and Boyd Corners watersheds. A downward trend in phosphorus at the input from Rondout Reservoir was noted, along with some declines in more recent years in the local stream inputs, in the reservoir, and in its output. Trophic state increases in West Branch Reservoir, and turbidity increases in both the reservoir and output, are likely due to changes in the operational mode in the latter half of the data record.

In the Kensico basin, downward trends were detected for both fecal coliforms and TP. The decrease in fecal coliform counts is due to lower inputs from the Catskill and Delaware Systems and to the successful ongoing efforts to reduce bird populations on the reservoir. The decrease in phosphorus is explained by the net effects of the ongoing watershed protection programs in these systems. Slight upward trends in turbidity and in trophic state were coincident with improved water clarity prior to 2005 in the Catskill System.

Biomonitoring results are available for the largest local stream inputs to West Branch and Kensico Reservoirs. Notably, the influence of these streams on reservoir water quality is very small because the largest inputs are from the Catskill and Delaware reservoirs via aqueducts. Results for the West Branch input—Horse Pound Creek—indicated optimal conditions for the macroinvertebrate community both in recent years and long term. Whippoorwill Creek, the largest local input to Kensico, was rated slightly impaired. Although long-term trends were not statistically significant, a notable decline was observed in the most recent two years, presumably the result of an increase in sediment loading from eroding streambanks upstream of the sampling site. Stabilization of these streambanks is expected in the near future.

Since 2002, *Giardia* and *Cryptosporidium* pathogen monitoring has been conducted at least weekly at the Catskill and Delaware influents and effluents of Kensico Reservoir. *Giardia* counts at the effluent sites have been generally low, averaging 1.89 cysts 50 L<sup>-1</sup>. Effluent counts were generally lower than influent counts, due to reservoir processes such as sedimentation, dieoff, and predation. Instances of higher effluent counts are thought to be due to inputs from local streams, since storm-related inputs are known to have higher concentrations. *Cryptosporidium* counts were usually an order of magnitude lower than those for *Giardia*, making it impossible to discern statistical differences between influent and effluent counts.

## Water Quality Conditions for the Potential Delaware System Basins

The Cross River and Croton Falls basins are classified as “potential” Delaware system basins because water from these basins only enters the Delaware Aqueduct when intentionally pumped into it, and this is a rare occurrence. Improvements are ongoing, with 32 stormwater control projects, mostly in the Croton Falls basin, completed by 2009. Upgrades to WWTPs in the Cross River basin were initiated in 2008-2009. Some upgrades have also occurred in the Croton Falls basin, including the diversion of three WWTPs to the City-owned Mahopac WWTP. Consequently, phosphorus loads in the Croton Falls basin have decreased from 2,400 kg yr<sup>-1</sup> in 1994 to about 100 kg yr<sup>-1</sup> in 2009.

Long-term (1993-2009) trend analysis results did not indicate consistent changes in the key water quality indicators. In the Croton Falls basin, turbidity and phosphorus increases coincided with increases in precipitation, while increases in conductivity were associated with development activity in the watershed. A strong downward trend in fecal coliform was apparent in the West Branch release, which is the primary input for Croton Falls. In Cross River Reservoir, conductivity, turbidity, and phosphorus increases were also apparent. A weak decrease was detected in the fecal coliform trend. Recent status results indicate that the main basin of Croton Falls Reservoir is eutrophic, with monthly phosphorus concentrations exceeding 15 µg L<sup>-1</sup> about 50% of the time. Monthly median turbidity was 2 NTU, but on several occasions exceeded 5 NTU. Cross River water quality status was somewhat better: trophic state was usually in the mesotrophic range, monthly turbidity did not exceed 4 NTU, and phosphorus levels were slightly lower than those observed at Croton Falls. Elevated conductivities in both basins are indicative of development pressure. Given these conditions, it is more likely that Cross River would be chosen as a supplementary water source in the rare situations when pump stations are operated and system demand can be reliably met through the use of one pump station, although either source is generally acceptable.

## Summary of Program Effects Estimated by Models

The effects of nonpoint source management, point source upgrades, and land use change on eutrophication in the Cannonsville and Pepacton Reservoirs were evaluated using DEP’s Eutrophication Modeling System. Output from the Generalized Watershed Loading Function (GWLf) model provided loading estimates to evaluate the effects of watershed management programs and the ongoing effects of land use change. A baseline scenario (*BASELINE*) representing conditions in the 1990s prior to implementation of FAD programs, and two FAD evaluation scenarios representing conditions of the early 2000s (*FADPERIOD1*) and late 2000s (*FADPERIOD2*), were used. Nutrient reduction factors due to the Watershed Agricultural Program, Urban Stormwater Retrofit Program, Septic Remediation and Replacement Program, and WWTP Upgrade Program were applied to represent watershed management effects in each of the scenario periods. In addition, declines in agricultural land use and agricultural activity that occurred from the early 1990s to the late 2000s independent of deliberate watershed management were evaluated.



Changes in nutrient loading due to the combined effects of land use change and FAD programs were examined by comparing the *FADPERIOD* scenarios to the *BASELINE*. There was a ~49% reduction in dissolved phosphorus (P) loads from the Cannonsville watershed from the *BASELINE* to *FADPERIOD1* and an additional ~7% reduction from *FADPERIOD1* to *FADPERIOD2*. The large reductions seen between the *BASELINE* and *FADPERIOD1* correspond to a combination of high rates of new program implementation and a substantial reduction in agricultural activity during that period. Continued but slower declines in P loads from *FADPERIOD1* to *FADPERIOD2* occurred as FAD programs became more focused on maintenance and improvement than on new program development, and the reduction in agricultural activity continued. Simulations examining the relative effects of land use change versus watershed management on load reductions found that land use change (decline in agriculture) and watershed management both produced substantial reductions in P loading. Loading reductions due to land use change alone were ~18% for dissolved P in Cannonsville while the combination of land use change and watershed management produced reductions of ~55%. WWTP upgrades and the implementation of agricultural BMPs by the WAP provided most of the management-derived loading reductions, with minor reductions from septic system remediation and urban stormwater management.

The consequences of these changes in nutrient loading on the trophic status of Cannonsville Reservoir were evaluated by driving reservoir water quality models with the different nutrient loading scenarios. Simulated loading reductions due to combined land use change and watershed management between *BASELINE* and *FADPERIOD1* resulted in a ~34% reduction in the May-October epilimnetic chlorophyll concentrations, and a ~30% reduction in the May-October epilimnetic TP concentrations in Cannonsville Reservoir. Examination of daily, as well as long-term, mean reservoir chlorophyll levels suggests that the occurrence of extreme “bloom-like” epilimnetic chlorophyll concentrations are also affected by differing nutrient loading scenarios, and that the implementation of watershed management programs had an even greater impact on reducing the frequency of extreme epilimnetic chlorophyll concentrations than in reducing long-term mean concentrations.

A similar analysis on Pepacton Reservoir and its watershed produced similar relative declines in nutrient loading, reservoir TP, and chlorophyll concentration. However, the magnitude of the changes was less, since the reservoir was less eutrophic under baseline conditions and the reservoir watershed was less impacted by agricultural activity.

A case study for the winter of 2010 was used to demonstrate the use of the DEP modeling system to inform reservoir operational decisions under the Catskill Turbidity Control Program. A series of events during the winter of 2010 led to a prolonged period of elevated turbidity in Ashokan Reservoir. Throughout this period, a number of operational steps were employed to maintain high water quality in Kensico effluents without alum usage, and modeling simulations helped to inform the timing and level of these operational decisions. A hindcasting simulation was used to

examine the effectiveness of the chosen turbidity control operations that were, in part, based on modeling forecasts. The actual conditions during the turbidity event were compared to scenarios simulated using the LinkRes reservoir model for Ashokan and Kensico Reservoirs. The scenarios examined the beneficial effects of using the Ashokan Release, and of using stop shutters to reduce Catskill Aqueduct flow. The results indicated that, for this particular event, use of the stop shutters to reduce Catskill System turbidity loads had the greatest impact on Kensico effluent turbidity. Use of stop shutters allowed simulated Kensico effluent turbidity to remain generally below 2 NTU. Use of the Ashokan Release led to a marginal improvement of Kensico effluent turbidity and to a small decrease in the spill volume out of Ashokan Reservoir.

The case study demonstrates the effectiveness of DEP's efforts to mitigate the effects of elevated turbidity in the Catskill System on the quality of water entering the distribution system from Kensico Reservoir. Despite turbidity inputs to Ashokan Reservoir of over 1,000 NTU and West Basin turbidity levels of over 200 NTU, Kensico effluent turbidity levels never exceeded 2 NTU and chemical treatment of the water entering Kensico was not required during this event. However, it is important to note that the results of this case study may not hold true for other situations, such as cases when turbidity in Ashokan Reservoir may be more persistent, or when it would not be possible to effectively isolate the two Ashokan basins, or when extended periods of reduced Catskill Aqueduct flow may not be possible.

## **1.2 Highlights of the Watershed Protection Program**

Since the program's inception in 1991, New York City has invested more than \$1.5 billion to ensure the long-term protection of its extraordinary water supply. A comparison of Figures 1.3 and 1.4 illustrates the extent and diversity of watershed protection measures implemented in the Catskill/Delaware watershed since the Memorandum of Agreement (MOA) was signed in 1997.

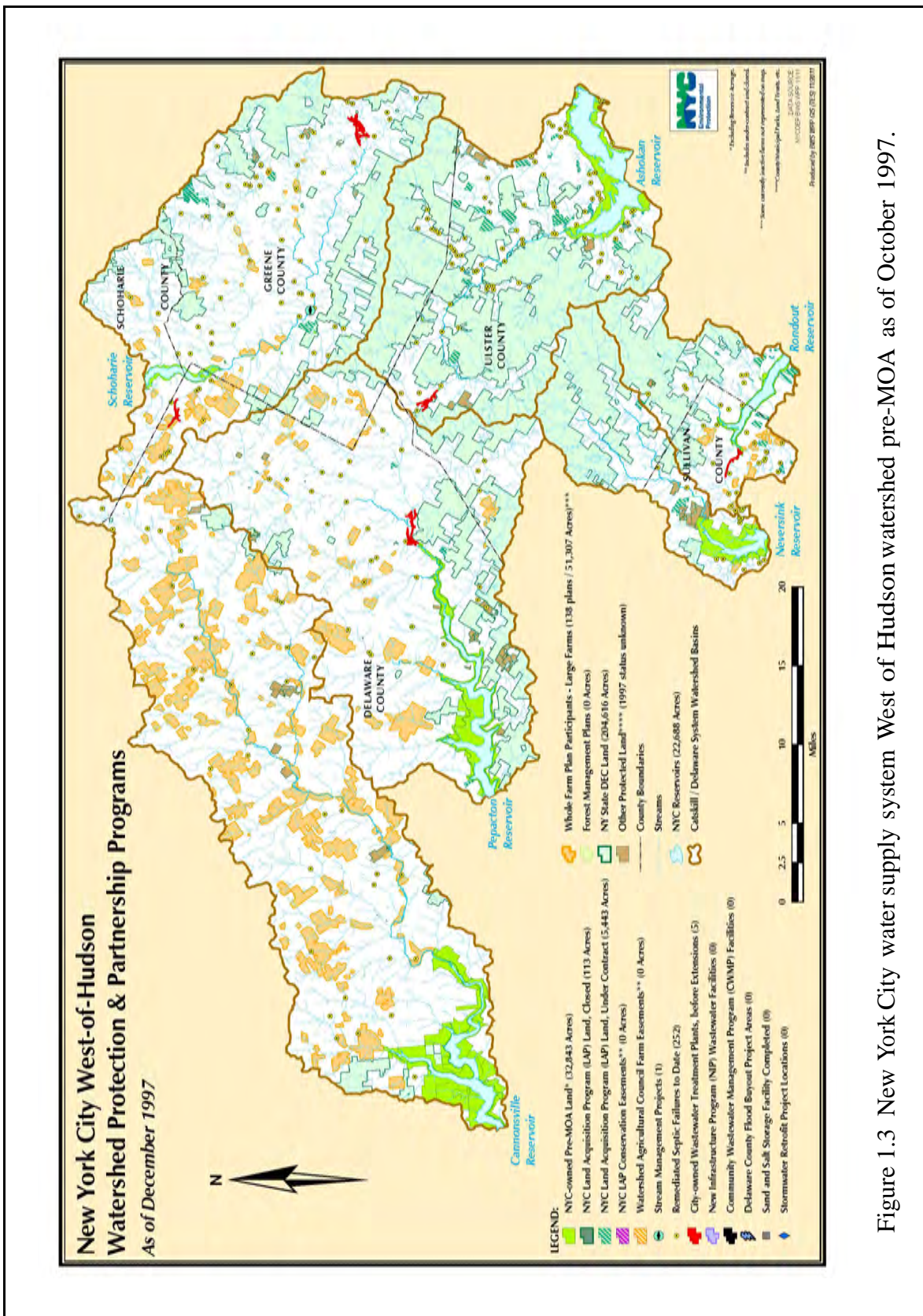


Figure 1.3 New York City water supply system West of Hudson watershed pre-MOA as of October 1997.



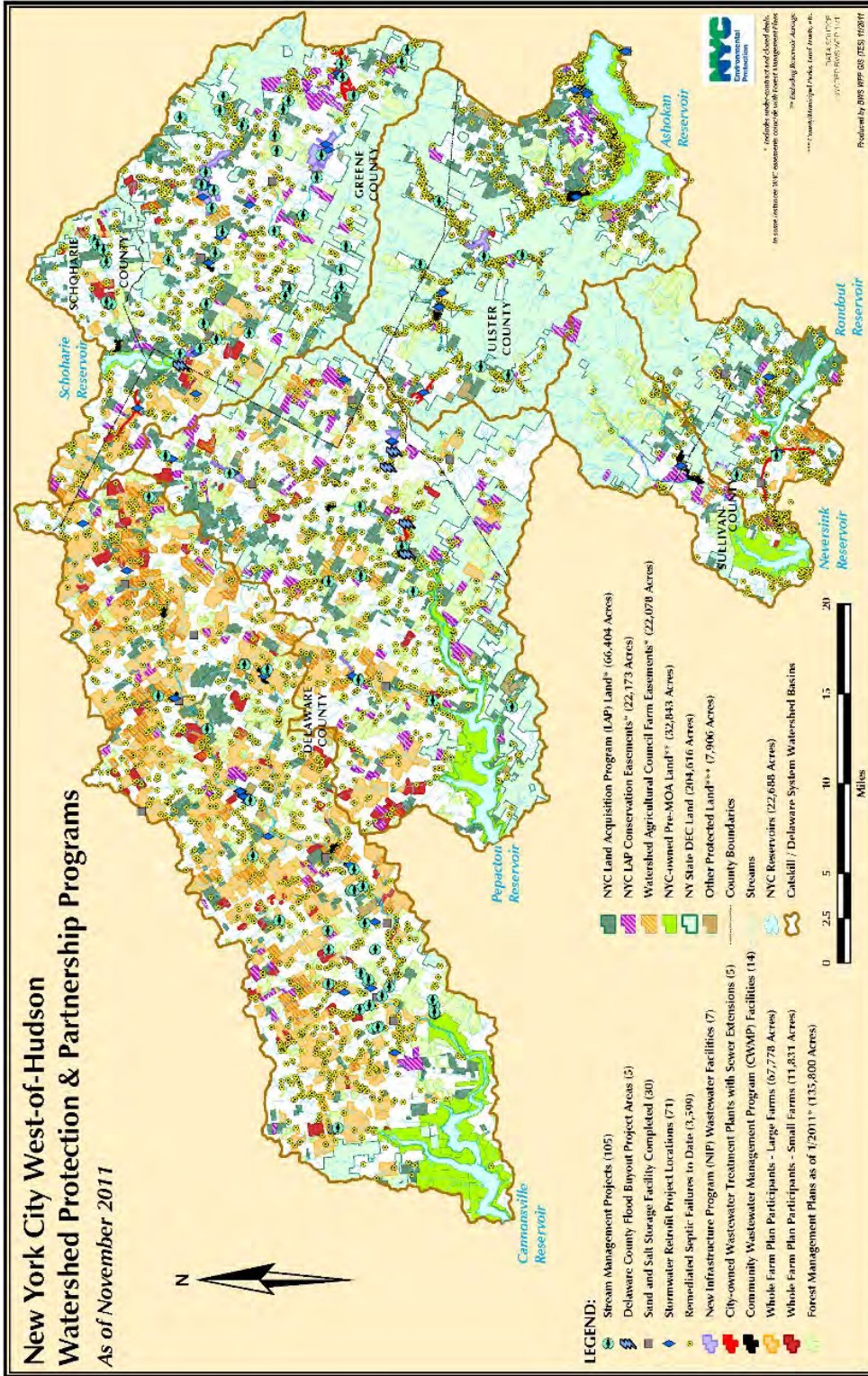
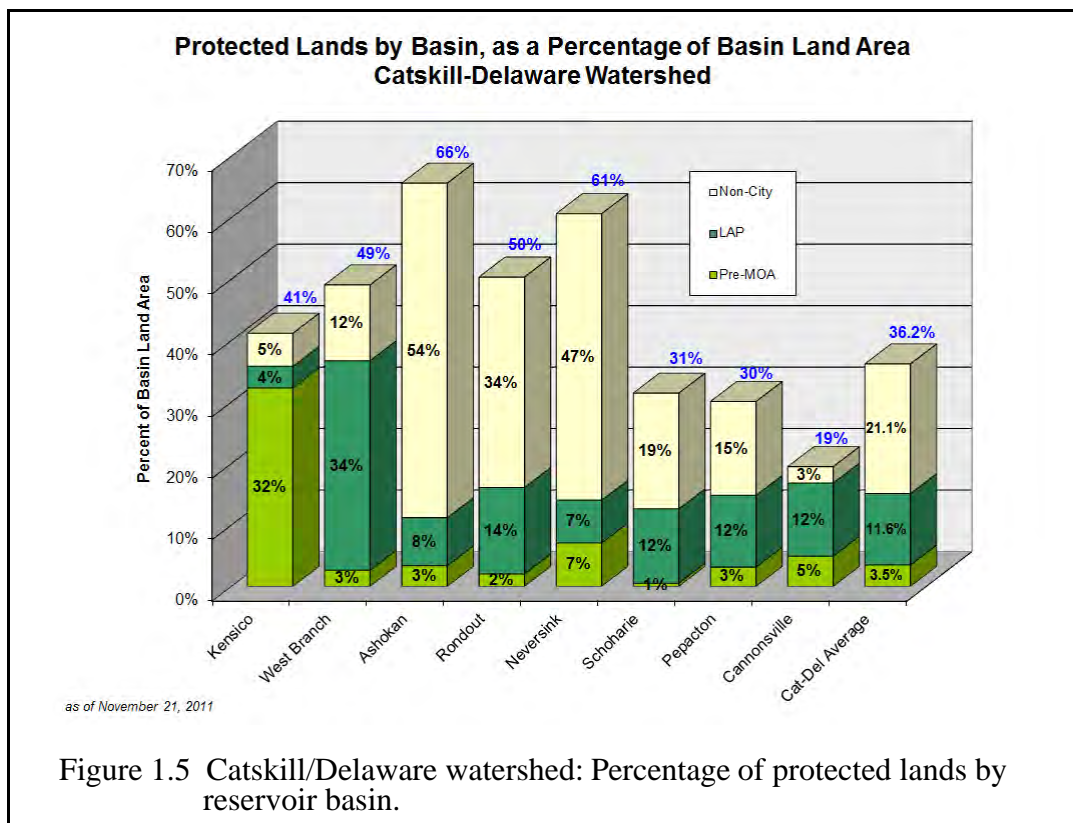


Figure 1.4 New York City water supply system West of Hudson watershed protection programs as of November 2011.

Achieving such an extensive network of watershed safeguards would not have been possible without the support and cooperation of other interested parties. Although the City was initially hesitant to delegate control of certain programs to upstate partners, what has evolved is a thriving collaboration among City, state, and federal agencies, as well as watershed governments and residents, working together to protect the waters of the Catskill and Delaware watersheds while supporting the economic vitality of the region.

Key elements of the program, including major progress made since the last FAD, include:

- Land Acquisition.** When the Land Acquisition Program began 15 years ago, New York City owned just 3.5% of the land in the Catskill/Delaware watershed. Today, including conservation easements (CEs), that proportion has jumped to 15%. As noted earlier, New York State’s Catskill Preserve protects an additional 21%. Figure 1.5 demonstrates the extraordinary achievements of DEP’s Land Acquisition Program since its inception.



Since 1997, DEP has solicited at least once, and in most cases twice or more, the owners of over 480,000 acres of land. Furthermore, since 2008, DEP has solicited the owners of approximately 90,000 acres of land not previously solicited. Watershed-wide, these solicitation efforts have resulted in the City securing 98,121 acres in fee simple or CE, with another 22,234 acres of farm easements secured by the Watershed Agricultural Council (WAC). Since 1997, the City’s ownership interest in watershed real property has increased by 321%. In

December 2010, New York State issued DEP a new Water Supply Permit (WSP), which not only allows continued land acquisition for the next 15 years, but also ensures continuation of the full range of watershed protection programs.

- **Waterfowl Management Program.** DEP's Waterfowl Management Program (WMP) was established in 1992 to measure fecal coliform levels in the City's water supply attributable to avian wildlife and the resulting impact on water quality. The management of waterbird populations at terminal and distribution reservoirs in the New York City water supply system is an integral part of DEP's continued ability to meet the Surface Water Treatment Rule's (SWTR) standards. Bird hazing efforts have been very successful where implemented. Despite a few exceedances due to minor seasonal elevations of both birds and bacteria, DEP has remained in compliance with the federal rule stating that values may not exceed 20 CFU (fecal coliform forming units) per 100 mL in more than 10% of the water samples collected over the previous six months.
- **Wastewater Treatment Plant (WWTP) Upgrades.** By 2002, DEP had completed, at a cost of \$240 million, upgrades of six City-owned wastewater treatment facilities that together account for 40% of the WWTP flow in the West of Hudson watershed, using technologies that include phosphorus removal, sand filtration, back-up power, back-up disinfection, microfiltration or an approved equivalent, flow metering, and alarm telemetering. Upgrades of the 34 non-City-owned WWTPs in the Catskill/Delaware watershed, which produce the remaining 60% of the flow, have also been completed. The upgrade program is essentially finished. In addition to these capital improvements, DEP is committed to funding certain operation and maintenance costs over the long term.
- **Stream Management.** The primary goal of the Stream Management Program (SMP) is to preserve and/or restore sustainable levels of stream system stability and ecological integrity by encouraging and supporting the long-term stewardship of streams and floodplains. Since the 2002 FAD, the SMP and its partners have completed six stream management plans. Over the past five years, the program has transitioned to implementation of stream management plan recommendations to demonstrate successful management techniques. In 2010, DEP and its stream management partners launched the Catskill Streams Buffer Initiative, which coordinates funding and outreach for an array of programs. DEP's partners in the SMP include county Soil and Water Conservation Districts (SWCDs), streamside property owners, state agencies, the Cornell Cooperative Extension, local governments, and environmental and recreational organizations.
- **Wastewater Infrastructure Programs.** The MOA New Infrastructure Program (NIP) anticipated that DEP would fund new WWTPs in seven communities. Six communities have completed WWTPs: Roxbury, Andes, Windham, Hunter, Fleischmanns, and Prattsville. DEP provided the entire capital funding for these projects, and has set aside additional funding for the seventh community. In addition, DEP is committed to paying a portion of the costs of operating and maintaining these facilities, which assists in making wastewater services affordable to local residents.



The Community Wastewater Management Program (CWMP) is providing centralized (community septic systems and, in some instances, WWTPs) and decentralized (septic maintenance districts) wastewater solutions in communities smaller than those included in the NIP where there is nonetheless a potential threat to water quality posed by failing and likely-to-fail septic systems. CWMP has funded construction of wastewater systems tailored to the site-specific needs and conditions of five watershed communities: Bovina, Bloomville, Boiceville, Hamden, and Delancey. An additional four communities are in the process of planning and developing wastewater management systems.

Over the past five years, sewer extensions in the Towns of Neversink, Roxbury, Middletown, and Shandaken, and in the Villages of Margaretville and Hunter, have either been completed or are making demonstrable progress. Construction was completed on three extension projects, while two other projects are nearing the completion of the planning and design phase.

Collectively, these dramatic improvements in wastewater management, on scales large and small, mean that watershed communities can thrive without harming water quality, enhancing their appeal as places to live and to visit as well as supporting the City's need for water supply protection.

- **Managing Use of City-owned Lands.** As noted below, DEP has taken significant steps towards increasing the acreage of its lands available to the public. DEP welcomes the opportunity to share its water supply lands with the public so long as that can be achieved with no adverse impacts to water quality.

In 2007, DEP revised its "Rules for Recreational Use of Water Supply Lands and Waters" to allow for Public Access Areas (PAAs) on its West of Hudson watershed lands. PAAs do not require users to have a DEP access permit and allow users to hunt, hike, fish, and trap. In 2009, DEP again revised its rules for recreation and eliminated the DEP Hunt Tag requirement. Eliminating this requirement and increasing PAA designations are expected to increase the number of deer hunters on City land. Deer hunting is one of the most successful tools land managers have to control adverse deer impacts on forested lands.

- **Watershed Agricultural Program.** In the early 1990s, the City proposed extensive regulation of farms within the watershed. The farming community expressed concern that further regulation would drive farms out of business, leaving farmlands vacant and available for development. Recognizing the mutual benefits of a healthy, environmentally conscious farming community, the City teamed with upstate partners to develop the voluntary Watershed Agricultural Program. Working through the WAC, the City funds development of farm plans and implementation of structural and non-structural best management practices (BMPs). To date, more than 95% of watershed farms have signed up to participate in the program. In addition, the City has augmented the program by adding a City/federal cost-sharing effort known as the Conservation Reserve Enhancement Program (CREP). CREP pays farmers to take sensitive riparian buffer lands, adjacent to waterbodies, out of active farm use and re-establish a vegetative buffer.

- **Watershed Partnership Programs.** In addition to the programs already mentioned, the City and its partners continue to broaden their efforts to improve the environmental infrastructure of the watershed as well as stimulate the local economy. The City is working with local foresters to improve land management techniques while providing resources for that segment of the economy. The City continues to fund the Catskill Watershed Corporation (CWC) to implement septic rehabilitations and pump-outs, as well as installation of stormwater BMPs critical to water quality protection.

### **DEP's Long-Term Program**

Over the past 20 years of source water protection, the City has developed and implemented an enhanced, comprehensive long-term program that forms the basis for its continued filtration waiver under the 2007 FAD. DEP's plan for the next five years is outlined in the following sections of this document. The proposed program represents DEP's continued commitment to long-term watershed protection. The City expects that, so long as the Catskill/Delaware System remains unfiltered, these core programs will remain in place. DEP intends to continue to review and refine these programs, with input from the primacy agency and other watershed stakeholders. It is possible that, based on those reviews, some programs will be modified or phased out if they are no longer needed. Nonetheless, the City regards the overall program it is proposing as representing a long-term commitment to watershed protection and water quality.

Support from and cooperation with watershed partners is essential to the successful implementation of the City's program. It is important to emphasize that no protection program for the City's water supply, no matter how carefully crafted, can succeed without support and involvement of the City's partners and watershed stakeholders. Perhaps the greatest achievement of the past 20 years has been the development of vital, locally-based organizations working with DEP on the common goal of watershed protection. Initially, the City was reluctant to cede responsibility for program implementation to others, but the development of successful partnerships with organizations like the CWC, the WAC, county SWCDs, EPA, the New York State Department of Health, and NYSDEC led the City to recognize that long-term watershed protection can and will be advanced through such partnerships. Continued cooperation with DEP's implementation partners is an integral part of the City's long-term vision for protecting the water supply.

Independent of and reinforcing DEP's commitments under the FAD, the 2010 WSP requires DEP to fund and implement many of these same programs. Consistent with the language of the SWTR, the FAD requires DEP to implement its watershed control program based on science and results, and does not characterize requirements in terms of monetary commitments. Similarly, while the partnership between the City and the watershed communities, among other entities, is an important element of DEP's ability to implement the watershed control program effectively, and therefore important to filtration avoidance, the FAD itself focuses on program implementation rather than specifically on partnership commitments. DEP will comply with its commitments under the WSP, but notes that these requirements are not themselves enforceable requirements of the FAD.

## 2. Long-Term Watershed Protection Program

### 2.1 SWTR Objective Compliance

The Surface Water Treatment Rule (SWTR) at 40 CFR §141.71 and the Interim Enhanced Surface Water Treatment Rule at 40 CFR §141.171 require that all surface water supplies provide filtration unless certain source water quality, disinfection, and site-specific avoidance criteria are met. In addition, the supplier must comply with: (1) the Total Coliform Rule (TCR), and (2) the Stage 1 Disinfectant and Disinfection Byproducts Rule. Further, the Stage 2 Disinfectant and Disinfection Byproducts Rule and the Long Term 2 Enhanced Surface Water Treatment Rule (LT2) establish additional important requirements for unfiltered systems, although these provisions are not identified in U.S. Environmental Protection Agency (EPA) regulations as filtration avoidance criteria. The 2007 Filtration Avoidance Deliverable (FAD) required ongoing monitoring and periodic reporting related to Safe Drinking Water Act (SDWA) compliance activities. In addition, there are some reporting requirements relating to SDWA compliance that, while not specifically required under the SWTR, and therefore not included as a FAD reporting requirement below, will be reported elsewhere for SDWA compliance purposes. This includes: (1) reporting to EPA and the New York State Department of Health (NYSDOH) on the operational status of the UV plant as required by LT2 or State Sanitary Code requirements, and (2) notifying EPA and NYSDOH by the end of the day when a sample from a TCR distribution system compliance site tests positive for *E. coli*.

#### Program Goals

The 2007 FAD requires the continuation of the above monitoring requirements as specified in the City’s Long-Term Watershed Protection Program (SWTR Objective Criteria Compliance) and in accordance with the milestones contained therein, and in accordance with any additions/clarifications below:

Table 2.1. SWTR Objective Compliance Program planned activities/milestones (2012-2017).

Requirement	Due Date
Continue to meet SWTR Objective Criteria (Sections §141.71 and §141.171) and submit reports and certification of compliance on:	monthly
<ul style="list-style-type: none"> <li>• §141.71(a)(1) - raw water fecal coliform concentrations</li> <li>• §141.71(a)(2) - raw water turbidity sampling</li> <li>• §141.71(b)(1)(i)/§141.72(a)(1) - raw water disinfection CT values</li> <li>• §141.71(b)(1)(ii)/§141.72(a)(2) - operational status of Kensico and Hillview disinfection facilities including generators and alarm systems</li> <li>• §141.71(b)(1)(iii)/§141.72(a)(3) - entry point chlorine residual levels</li> </ul>	

Table 2.1. (Cont.) SWTR Objective Compliance Program planned activities/milestones (2012-2017).

Requirement	Due Date
<ul style="list-style-type: none"> <li>• §141.71(b)(1)(iv)/§141.72(a)(4) - distribution system disinfection levels (DEP will include a discussion of any remedial measures taken if chlorine residual levels are not maintained throughout system)</li> <li>• §141.71(b)(5) - distribution system coliform monitoring including a summary of the number of samples taken, how many tested positive for total coliform, whether the required number of repeat samples were taken at the required locations, and which, if any, total coliform positive samples were also <i>E. coli</i> positive. For each <i>E. coli</i> positive sample, include the investigation of potential causes, problems identified and what has or will be done to remediate problems. Include copies of any public notices issued as well as dates and frequency of issuance.</li> </ul>	
<p>All requirements described in Section §141.71(b)(4) must continue to be met. Notify NYSDOH and EPA within twenty-four hours of any suspected waterborne disease outbreak.</p>	event based
<p>All requirements described in Section §141.71(b)(6) and §141.171 must continue to be met. Submit report on disinfection byproduct monitoring results.</p>	quarterly
<p>Notify NYSDOH and EPA within twenty-four hours, if at any time the chlorine residual falls below 0.2 mg/l in the water entering the distribution system.</p>	event based
<p>Notify NYSDOH and EPA by the close of the next business day whether or not the chlorine residual was restored within 4 hours.</p>	event based
<p>Report on the operational status of Kensico Reservoir, West Branch Reservoir (online or by-pass), Hillview Reservoir, and whether any of these reservoirs experienced unusual water quality problems.</p>	monthly
<p>Regarding the emergency/dependability use of Croton Falls and Cross River source water:</p> <p>(A) The City shall not introduce Croton Falls or Cross River source water into the Catskill/Delaware water supply system without the prior written approval of NYSDOH/EPA.</p> <p>(B) As a condition of approval, the City must demonstrate continuing, substantial compliance with the watershed protection program elements being implemented in the Croton Falls and Cross River watersheds that are contained in this Determination.</p> <p>(C) As a condition of approval, until filtration of the Croton system has been achieved, the City must have submitted all relevant water quality data as specified in the Judicial Order on Consent, including any supplements, in <i>United States v. City of New York</i>, 97-CV-2154 (NG). Once filtration of the Croton system has been achieved, the City will submit water quality data and monitor water quality at Croton Falls and/or Cross River, pursuant to the approved sampling plan submitted to NYSDOH/EPA in May 2010, or as revised thereafter.</p>	continuous

Table 2.1. (Cont.) SWTR Objective Compliance Program planned activities/milestones (2012-2017).

Requirement	Due Date
(D) NYSDOH/EPA approval under this Section may include additional conditions, including but not limited to, project schedules or specific operating goals or parameters for the City’s water supply facilities (such as maximizing use of the Croton Filtration Plant, or operation of the Catskill/Delaware UV Plant at 3-log inactivation).	
(E) As used in this Section, the term “NYSDOH/EPA” is defined as the primacy agency. In evaluating requests for approval from the City, the primacy agency shall consult with the cooperating regulatory agency.	

## 2.2 Environmental Infrastructure

### 2.2.1 Septic and Sewer Programs

The New York City Department of Environmental Protection (DEP) implements a comprehensive set of programs that serve to reduce the number of failing or potentially failing septic systems in the watershed. The Septic and Sewer Programs are composed of the following elements:

- Septic Remediation and Replacement Program
- Septic Maintenance Program
- Sewer Extension Program
- Alternate Design and Other Septic Systems

Also integral to the programs are the implementation and enforcement of the Watershed Rules and Regulations (WRR) that have been in effect since 1997.

#### Septic Remediation and Replacement Program

Funds the Catskill Watershed Corporation (CWC) administered septic inspection/pump out/remediation program that is a continuation of the Watershed Memorandum of Agreement (MOA) septic program. Additional program elements include septic system remediation for cluster system areas (Cluster System Program) and small businesses (Small Business Program).

#### Program Goals

Remediate/replace approximately 300 failing or likely-to-fail septic systems per year. Support the assessment and implementation, where feasible, of the Cluster System Program based on water quality and the program rules. Support the continued implementation of the Small Business Program. The City will support the continued availability of the funding provided in the first five years of the 2007 FAD for the Cluster System Program and for the Small Business Program in accordance with the program rules for those programs.

Table 2.2. Septic Remediation and Replacement Program planned activities/milestones (2012-2017).

Activity/Milestones	Due Date
In accordance with Septic Remediation and Replacement Program Rules (dated 7/5/11 or as may be amended), provide adequate funding in support of the Septic Remediation and Replacement Program at a funding level sufficient to address 300 septic systems per year.	Ongoing

Table 2.2. (Cont.) Septic Remediation and Replacement Program planned activities/milestones (2012-2017).

Activity/Milestones	Due Date
In accordance with Cluster Septic System Program Rules (dated 4/5/11 or as may be amended), support the continued use of the funding allocated in the first five years of the 2007 FAD for the Cluster System Program and work 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.	Ongoing
In accordance with Small Business Septic System Rehabilitation and Replacement Program Rules (dated 3/1/11 or as may be amended), support the continued availability of the funding allocated in the first five years of the 2007 FAD for the Small Business Program component of the Septic Remediation and Replacement Program.	Ongoing
DEP to meet with the New York State Department of Health and EPA to review implementation and status of Cluster System Program and Small Business Program.	7/31/13

Table 2.3. Septic Remediation and Replacement Program reporting milestones (2012-2017).

Report Description	Due Date
Report annually on implementation of the Septic Remediation and Replacement Program, including the Cluster and Small Business Programs.	3/31

**Septic Maintenance Program**

Funds periodic maintenance of residential septic systems located in the West of Hudson (WOH) watershed.

**Program Goals**

Continue to fund 50% of the cost for septic pump-outs to qualified properties in order to enhance the functioning and reduce the incidence of failures of septic systems throughout the WOH watershed.

Table 2.4. Septic Maintenance Program planned activities/milestones (2012-2017).

Activity/Milestones	Due Date
Provide additional funding, if necessary, to allow maintenance each year of 20% of the total number of septic systems eligible under the Septic Maintenance Program Rules (February 2008).	Ongoing



Table 2.5. Septic Maintenance Program reporting milestones (2012-2017).

Report Description	Due Date
Report annually on implementation of the program.	3/31

### Sewer Extension Program

As per the MOA and the FAD, the program provides funding for the design and construction of wastewater sewer extensions connected to WOH City-owned wastewater treatment plants (WWTPs). The program reduces the number of failing or potentially failing septic systems in the WOH watershed by extending the WWTP service areas to priority areas.

### Program Goals

Program implementation is dependent upon certain steps being completed by municipal action; therefore, not all program components are controlled by DEP. DEP will work to do what is within its control to complete projects at Pine Hill-Shandaken (Pine Hill WWTP) by June 2014, Showers Road-Hunter (Tannersville WWTP) by December 2014, and Margaretville-Middletown (Margaretville WWTP) by June 2015. Community participation and completion of key tasks is required for project progress and timely completion.

Table 2.6. Sewer Extension Program planned activities/milestones (2012-2017).

Activity/Milestones	Due Date
Continue to work with the Town of Shandaken on the construction of the sewer extension at Pine Hill.	Ongoing
Continue to work with the Town of Hunter on the construction of the sewer extension at Showers Road.	Ongoing
Continue to work with the Town of Middletown and Village of Margaretville on the construction of the sewer extension at Margaretville.	Ongoing

Table 2.7. Sewer Extension Program reporting milestones (2012-2017).

Report Description	Due Date
Report annually on program implementation.	3/31



**Alternate Design Septic Program**

The Alternate Design Septic Program funds the eligible incremental compliance costs of the septic provisions of the WRR for new septic systems with available program funding through the FAD term, but only to the extent those provisions exceed state and federal requirements. The City funded the Alternate Design Septic Program under the MOA.

Table 2.8. Alternate Design Septic Program planned activities/milestones (2012-2017).

Activity/Milestones	Due Date
Support the use of the funding already provided to fund the eligible incremental compliance costs of the WRR septic provisions to the extent they exceed state and federal requirements.	Ongoing

Table 2.9. Alternate Design Septic Program reporting milestones (2012-2017).

Report Description	Due Date
Report annually on program implementation.	3/31

### 2.2.2 New Infrastructure Program (NIP)

Funds assessment of wastewater infrastructure needs and provides technical assistance and funding for the construction of the recommended wastewater solution. All MOA-listed projects have been completed, with the exception of the Phoenicia project in the Town of Shandaken. Phoenicia previously rejected the installation of a wastewater collection and treatment system but restarted a review of wastewater options in 2010.

Table 2.10. Status of New Infrastructure Program Projects.

Municipality	Permitted Flow (GPD)	Status
Hunter	338,400	Completed 2005
Fleischmanns	160,000	Completed 2007
Windham	373,800	Completed 2005
Andes	62,000	Completed 2005
Roxbury	100,000	Completed 2005
Phoenicia	185,000 (Estimated)	In Design Review Phase
Prattsville	86,000	Completed 2007

#### Program Goals

Support the assessment of potential wastewater collection and treatment options for the Phoenicia project in the Town of Shandaken. It is anticipated that the Town will either decide to move forward with the design of a project or opt out of the NIP in December 2011.

Table 2.11. New Infrastructure Program planned activities/milestones (2012-2017).

Activity/Milestones	Due Date
Based on the Town of Shandaken’s progress to achieve project milestones, continue to work with the Town on the wastewater collection and treatment system for Phoenicia.	Ongoing

Table 2.12. New Infrastructure Program reporting milestones (2012-2017).

Report Description	Due Date
Report annually on progress of NIP projects in Phoenicia and Windham until laterals funded through the NIP have been completed.	3/31

### 2.2.3 Community Wastewater Management Program (CWMP)

Funds construction of community septic systems and/or septic maintenance districts in communities identified in Paragraph 122 of the MOA (the 8-22 communities).

Table 2.13. Status of Community Wastewater Management Program projects.

Community	Project	Flow (GPD)	Status
Bloomville	Community Septic w/Sand Filter	30,000	Completed 2009
Boiceville	Collection System w/WWTP	75,000	Completed 2010
Hamden	Community Septic w/Sand Filter	26,000	Completed 2009
DeLancey	Septic Maintenance District	NA	Completed 2007
Bovina	Community Septic System	25,000	Completed 2006
Ashland	Collection System w/WWTP	26,000	Completed 2011
Haines Falls	NA – Sewer Extension Program		Completed 2006
Trout Creek	Community Septic w/Sand Filter		In Design
Lexington	Community Septic w/Sand Filter		In Design
South Kortright	Collection System pumped to Hobart WWTP		In Design

#### Program Goals

Complete construction at the two additional communities identified in the 2007 FAD (Trout Creek and Lexington); complete construction at the third additional community identified in the 2007 FAD (South Kortright); complete the study, design, and construction for two additional communities (Shandaken and West Conesville); and complete the study, design, and construction for three final communities per the schedule below (Claryville, Halcottsville, and New Kingston).

Table 2.14. Community Wastewater Management Program planned activities/milestones (2012-2017).

Activity/Milestones	Due Date
Execute contract changes with CWC in support of the CWMP that include funding sufficient to complete the five final projects.	Date of commencement of Second Five-Year Period + 12 months
Construction complete for Trout Creek <sup>1</sup>	12/31/13
Construction complete for Lexington <sup>1</sup>	6/30/14
Construction complete for South Kortright <sup>1</sup>	6/30/14
Study complete for Shandaken, West Conesville <sup>1</sup>	6/30/14
Design complete for Shandaken, West Conesville <sup>1</sup>	6/30/15

Table 2.14. (Cont.) Community Wastewater Management Program planned activities/milestones (2012-2017).

Activity/Milestones	Due Date
Construction complete for Shandaken, West Conesville <sup>1</sup>	6/30/17
Study complete for Claryville, Halcottsville, New Kingston <sup>1</sup>	6/30/16
Design complete for Claryville, Halcottsville, New Kingston <sup>1</sup>	6/30/17
Construction complete for Claryville, Halcottsville, New Kingston <sup>1</sup>	6/30/19

<sup>1</sup> Milestone dates are contingent on the communities executing the necessary study, design, construction, municipal authorizations, and agreements with CWC in order for the projects to proceed.

Table 2.15. Community Wastewater Management Program reporting milestones (2012-2017).

Report Description	Due Date
Report annually on program implementation.	3/31

### 2.2.4 Stormwater Programs

As a result of the MOA, DEP established the following Stormwater Cost-Sharing Programs: (1) Future Stormwater Controls paid for by the City for Single Family Houses, Small Businesses and Low Income Housing, and (2) WOH Future Stormwater Controls (administered by CWC). These programs provide financial support for the cost of designing, constructing, and, in some cases, maintaining stormwater controls that are required by the WRR, but are not otherwise required by federal or state law, for certain new development projects. DEP fully funded the incremental design and construction cost under the 1997 MOA and no additional funds are needed for the continuation of the WOH Future Stormwater Controls Program. Pursuant to the 2007 FAD, DEP provided CWC with adequate funds for an appropriate engineering position at CWC to assist applicants undertaking regulated activities to comply with the stormwater provisions of the WRR.

In addition, the Stormwater Retrofit Program, also administered by CWC, was established in the MOA to address existing stormwater runoff problems through the construction of stormwater best management practices (BMPs) in concentrated areas of impervious surfaces in the WOH watershed, based on water quality priorities.

#### **Stormwater Cost-Sharing Programs Goals**

The goals of the Stormwater Cost-Sharing Programs are to (1) support the use of allocated Program funds to pay the eligible incremental costs of complying with the stormwater provisions of the WRR, to the extent those provisions exceed state and federal requirements and consistent with the WOH Future Stormwater Controls Program rules (May 2011), (2) assist applicants undertaking regulated activities to comply with the stormwater provisions of the WRR, and (3) provide funding in accordance with the MOA for certain incremental costs for single family homes, small businesses, and low-income housing.

Table 2.16. Stormwater Program planned activities/milestones (2012-2017).

Activity/Milestones	Due Date
Fund, in accordance with the MOA, the eligible incremental costs to comply with the stormwater provisions of the WRR to the extent they are not otherwise required by federal or state law.	Ongoing
Ensure adequate funding for an appropriate engineering position at CWC to assist applicants undertaking regulated activities to comply with the stormwater provisions of the WRR.	Ongoing

Table 2.17. Stormwater Program reporting milestones (2012-2017).

Report Description	Due Date
Report annually on program implementation.	3/31

### Stormwater Retrofit Program Goals

The goals of the Stormwater Retrofit Program are to (1) continue support of the installation of stormwater BMPs and community-wide stormwater infrastructure assessment and planning consistent with the Stormwater Retrofit Program rules (October 2009) and within agreed-upon program funding throughout the WOH watershed, and (2) support the use of program funding for retrofit projects installed in coordination with CWMP projects.

Table 2.18. Stormwater Retrofit Program planned activities/milestones (2012-2017).

Activity/Milestones	Due Date
Continue to provide the funding needed to allow the Stormwater Retrofit Program to continue at a level of activity that has been maintained since the inception of the program consistent with the Stormwater Retrofit Program rules (October 2009), provided the demonstrated need for such funding continues. Support the use of program funding for retrofit projects installed in coordination with CWMP projects.	Ongoing
Continue to provide the funding needed for the Operations and Maintenance of retrofit projects funded through the Stormwater Retrofit Program consistent with the Stormwater Retrofit Program rules (October 2009), provided the demonstrated need for such funding continues.	Ongoing

Table 2.19. Stormwater Retrofit Program reporting milestones (2012-2017).

Report Description	Due Date
Report annually on program implementation.	3/31

## **2.3 Protection and Remediation Programs**

### **2.3.1 Waterfowl Management Program**

In 1992, as part of DEP's original Watershed Protection/Filtration Avoidance Program, a Waterfowl Management Program (WMP) was established to measure the level of potential impact imposed by wildlife at Kensico Reservoir in Westchester County, NY. Waterbirds (geese, gulls, ducks, swans, cormorants, and duck-like birds) were surveyed to determine species richness and evenness. Preliminary surveys conducted by DEP indicated several species population fluctuations occurred daily (diurnal/nocturnal), seasonally, and spatially. A relationship between avian populations and bacteria (fecal coliform) levels from untreated water samples revealed a significant positive correlation. As a result, DEP instituted a management program in 1993 to reduce or eliminate all waterfowl activity in order to mitigate seasonal fecal coliform bacteria elevations. The program has continued through the present with an expansion to several more reservoirs. The WMP remains an important element of the FAD. Since its inception in 1993, the program has been highly effective in controlling fecal coliform contributions from birds, which helps the City meet federal and state drinking water quality standards.

During the 2012-2017 Filtration Avoidance period, the WMP will continue waterfowl management at Kensico Reservoir and several other reservoirs throughout the NYC water supply on an "as needed" basis. Each NYC reservoir has been categorized with a different level of mitigative intensity using similar waterfowl management techniques, including a standard daily operation at Kensico and an "as needed" program triggered by elevated waterfowl populations and increases in bacteria levels at three additional reservoirs (West Branch, Rondout, and Ashokan). An "as needed" program will also be implemented for Croton Falls and Cross River Reservoirs prior to the start-up of the reservoirs' pump stations. In addition, a variety of bird deterrent measures will be employed and modified as deemed necessary on an annual basis.

The term "as needed" refers to implementation of avian management measures based on the following criteria:

- Current bird populations, including roosting or staging locations relative to water intakes
- Fecal coliform bacteria concentrations approaching or exceeding 20 CFU 100 mL<sup>-1</sup> at reservoir effluent structures coincident with elevated bird populations
- Recent weather events
- Operational flow conditions (e.g., elevations, flow patterns, amounts of flow) within the reservoir
- Reservoir ice coverage and watershed snow cover
- Determination that active bird management measures would be effective in reducing bird populations and fecal coliform bacteria levels



The term “bird harassment” refers to the use of pyrotechnics, motorboats, airboats, remote control motorboats, propane cannons, and other methods to physically chase waterbirds from the reservoirs or deter them from inhabiting the reservoirs. The term “bird deterrence” refers to preventive methods employed to prevent waterbirds from inhabiting the reservoirs. Bird deterrent measures include nest and egg depredation, overhead bird deterrent wires, bird netting on shaft buildings, and meadow maintenance, among others.

**Program Goals**

- Contribute to compliance with EPA’s Surface Water Treatment Rule for fecal coliform bacteria for selected NYC reservoirs.
- Monitor and curtail local and migratory waterbird populations that utilize the above mentioned reservoirs through a variety of bird harassment and deterrence techniques.
- Monitor and curtail local breeding populations of selected waterbird species that have been linked to elevated fecal coliform concentrations, using depredation measures.
- Implement best management practices (BMPs) to reduce or eliminate the attractiveness of reservoir locations to birds.

Table 2.20. Waterfowl Management Program planned activities/milestones (2012-2017).

Activity/Milestones	Due Date
Active bird harassment—Kensico Reservoir, annually, 8/1 to 3/31.	Ongoing
“As needed” bird harassment—West Branch, Rondout, Ashokan, Croton Falls, Cross River, and Hillview Reservoirs, annually, 8/1 to 4/15.	As needed
“As needed” bird deterrent measures—Kensico, West Branch, Rondout, Ashokan, Croton Falls, Cross River, and Hillview, year-round.	As needed

Table 2.21. Waterfowl Management Program reporting milestones (2012-2017).

Report Description	Due Date
Annual summary of WMP activities (all reservoirs).	9/30

### **2.3.2 Land Acquisition**

The Land Acquisition Program (LAP) was initiated in 1997 following execution the same year of the MOA, the Water Supply Permit (WSP), and the 1997 FAD. In the last 15 years, the City has secured over 120,000 acres of land and conservation easements (CEs), compared with 35,588 acres of reservoir buffer land owned by the City as of 1997. Three hundred sixty-eight thousand acres (36%) of the Catskill/Delaware watershed (1,023,000 acres) are now permanently protected by the City, state, and/or other entities such as towns and land trusts.

Land protection activities (including DEP acquisitions in fee simple and CEs, and Farm CEs acquired by the Watershed Agricultural Council (WAC) using City funds) have been particularly successful in the highest priority areas. As of 1997, only 3% of the West Branch/Boyd Corners Reservoir basin (Priorities 1A and 1B) was owned by the City, with another 12% protected by other entities; today, 37% is owned by the City and fully 49% of the basin is protected in all. Similarly, only 2% of the Rondout Reservoir basin (Priorities 1A and 1B) was owned by the City in 1997; 15% is now owned by the City and, including land owned by other entities, Rondout is 50% protected. Forty-one percent of the Kensico basin (Priorities 1A and 1B), 66% of the Ashokan basin (Priorities 1A, 1B, and 2), and 61% of the Neversink basin (Priority 4) are now protected. Thus, all of the highest priority basins, as well as Neversink, enjoy levels of protection between 41%-66% due in large part to the City's acquisition efforts since 1997. The remaining basins of the Catskill/Delaware watershed, all principally Priorities 3 and 4—Cannonsville, Pepacton, and Schoharie—stand at 19%, 30%, and 31% protected, respectively. Since 1997, the City's efforts have brought the protected status of the entire watershed from 24.6% to 36.0%, an average advance of almost 1% annually.

The City concentrates on acquiring properties that both exhibit development potential and are located near surface water features, and therefore represent a possible threat to future water quality. The quality of these acres protected by the City—in addition to the overall quantity—is therefore relatively high.

The significant progress made since 1997 in protecting land within various priority areas, basins, and sub-basins has led to shifts in LAP strategies over time. The 2012-2022 Long-Term Land Acquisition Plan (a 2007 FAD deliverable, issued by the City in September 2009) references this progress and has generally refocused acquisition activities toward less-protected basins and sub-basins. This shift likewise reflects the fact that land in many of the basins where the City has made significant progress (eastern Catskill/Delaware watershed) is relatively more expensive than land in less-protected basins (western). Thus the marginal benefits of increasing protected status from, say, 70% to 71% in an expensive and highly-protected sub-basin are generally considered less beneficial and cost-effective than increasing protected status from 10% to 11% in a less-protected, lower-cost sub-basin.

The 2007 FAD required the City to develop a Programmatic Strategy to “substantially increase the use of land trusts.” DEP issued this Strategy on 11/15/07. The Strategy was the subject of many meetings and discussions during development of the 2010 WSP, and continues to be implemented.

The City’s successor WSP, issued by the New York State Department of Environmental Conservation (NYSDEC) on 12/24/10, provides new parameters for LAP, all of which are being adhered to on an ongoing basis:

- Natural Features Criteria thresholds have been established: properties or CEs acquired must contain at least 50% slopes (steeper than 15%), or 7% water features. Exceptions to these limits are allowed in aggregate up to 300 acres per county and 1,500 acres in the West of Hudson (WOH) watershed.
- The WSP authorized towns to expand their existing hamlets and many of them have done so, effectively expanding the areas where LAP is prohibited.
- The 2010 WSP authorizes the City to acquire up to 106,712 acres of land or CEs between 1/1/10 and 1/1/25.

### **Funding Requirements**

The 2007 FAD required the following steps in regard to LAP funding:

- The City was required to allocate an additional \$241 million to LAP hard and soft costs, in several tranches. To date, \$162.5 million has been allocated, \$72.5 million as of 12/31/08 and \$90 million as of 12/31/11.
- The City was also required to allocate \$23 million to the WAC Farm CE Program within one year of being directed to do so by the New York State Department of Health (NYSDOH). This deadline (4/30/09) was missed due to continuing negotiations with WAC over stewardship issues, but funding is expected to be allocated in a new program contract effective in 2012.
- The City was required to allocate an additional \$500,000 to the Catskill Watershed Corporation (CWC) for Local Consultation. This was completed by 2/28/08.

### **Program Goals**

The goals for the LAP through 2017 are to:

- Continue to acquire land (and easements) in accordance with the Long-Term Land Acquisition Plan (specifically, the goals stated on pp. 16-18 of the plan) and all program requirements set forth in the MOA and the most recent FAD and WSP.
- Continue to work with and support partners, including WAC and land trusts, to secure properties and CEs pursuant to the applicable programs (Farm CE, Forest CE, Riparian Buffer, and Enhanced Land Trust) and related requirements.

Under the 2007 FAD, the City was to continue the core LAP and pursue a number of new initiatives, including development of a long-term strategic plan covering 2012-2022 (issued 9/30/09) and a Land Trust Programmatic Strategy (issued 11/15/07). In addition, the following pending activities are required by either the 2007 FAD or the 2010 WSP:

Following the floods of August and September 2011, a number of watershed stakeholders have discussed developing a program to purchase improved properties in floodplains as well as stream mitigation and other measures to reduce the impacts of future floods on homes and businesses. DEP is interested in working with its watershed partners, including DOH and EPA, to explore participating in such a program, and further is willing to allocate a portion of its existing land acquisition funding to support a program. DEP will only consider such an initiative in communities that specifically request our involvement and we believe it is important that any funding we provide be used to leverage State or federal funding to extend the benefits. Any program that is developed would need to be consistent with the terms of the 2010 Water Supply Permit.

Table 2.22. Land Acquisition Program planned activities/milestones (2012-2017).

Activity/Milestones	Due Date
Dedicate previously-allocated \$241 million through 2017, to be deposited in LAP-segregated account in three allocations, one of which—\$78.5 million—remains.	12/31/14
Solicit at least 25,000 acres annually, and provide biannual solicitation plans for each two-year period, beginning October 2012.	Ongoing
Biannually meet with regulators to review status of Farm CE Program.	Ongoing
Implement the Land Trust Programmatic Strategy.	2/26/08 (ongoing)
Consult with regulators regarding potential need for additional monies.	Ongoing
Develop and implement a \$5 million Riparian Buffer Acquisition Program with a land trust.	Ongoing, in accordance with the 2010 WSP
Develop an Enhanced Land Trust program through which large properties with dwellings will be acquired by land trusts, and vacant portions conveyed to DEP.	Ongoing, in accordance with the 2010 WSP
Develop a \$6 million pilot Forest Easement Program through WAC.	Ongoing, in accordance with the 2007 FAD

Table 2.23. Land Acquisition Program reporting milestones (2012-2017).

Report Description	Due Date
Submit semi-annual reports.	1/31 and 7/31
Submit annual report.	3/31

### **2.3.3 Land Management**

DEP's land management activities consist of three major elements, among many others, primarily focused on City-owned lands:

- Management of City water supply lands and CEs
- Forest management
- Invasive species control

#### **Land Management**

The City has made a significant investment, and continues to do so, in purchasing water supply lands and CEs. Purchasing the land is one step; however, to maximize the utility of these lands in protecting the long-term water supply for the City, they must be monitored, managed, and secured properly. Effective and routine monitoring of lands and easements is vital to discovering encroachments, timber trespass, overuse of fee lands, and potential violations of easement conditions. DEP inspects fee lands on a prioritized basis per its fee monitoring policy (up to once per year) and easements bi-annually. When discovered early, encroachments can be addressed in a timely manner.

The City supports and allows many recreational uses of its land, such as fishing. As the second largest public land holder in the watershed, the City has made major efforts to expand and open as many of its lands and waters as possible for expanded recreational uses. Improving some of these lands for recreational access, particularly along the reservoirs, can help address the impacts of overuse if they arise. City lands can also be an important economic component for local communities, and, to facilitate that, the City continues to allow agriculture and various uses under the program of revocable land use permits.

#### **Forest Management**

Healthy forests are an important factor in protecting and enhancing the water supply, and this is reflected in the significant acreage in forest lands held by the City, and by the City's continuing acquisition of such lands. Forests on older City lands, however, are commonly declining in vigor, have limited diversity, and display little to no regeneration, which is critical for the future of the forest. Some recently acquired forests are in poor condition also, due to management practices of previous landowners. These declines in ecological integrity can have a negative impact on the water supply. To address them, DEP foresters conduct assessments and implement silvicultural prescriptions that increase species and age structure diversity.

In order to improve the long-term management of City forest lands, the development of a comprehensive watershed forest management plan was initiated under the 2007 FAD in partnership with the U.S. Forest Service (USFS). The purpose of the watershed forest management plan is to set forth the management goals, objectives, strategies, and guidelines for all current and future City-owned water supply lands, and basin-specific objectives where appropriate, based on current scientific principles for the management of watersheds and natural resources.

An assessment of current forest conditions is necessary for the development of the forest management plan. A forest inventory of City lands was initiated in 2009 and completed in 2010. The data were analyzed in 2011 and the data and information will be the basis for the plan. The plan was completed in November 2011, with implementation expected to commence in 2012.

### **Invasive Species**

The Invasive Species Program began in 2007 and is charged with identifying potential threats from invasive species that may have a deleterious impact on water quality and/or the natural systems that support water quality; preventing these species from entering City lands; and managing those that currently exist on City lands. This includes monitoring for early detection and rapid response to new occurrences, developing decision-making tools to prioritize response, developing and employing BMPs to control the spread and introduction of invasive species, and education and outreach to the public and other stakeholders.

Much of this work is being accomplished through the DEP Invasive Species Working Group (ISWG). The ISWG was formed in 2008 to develop a comprehensive invasive species management strategy. Much of the work of the ISWG focuses on prevention, early detection, prioritization, and management of invasive species on City-owned reservoirs and lands. DEP also actively partners with federal, state, and local agencies, NGOs, the two watershed Partnerships for Regional Invasive Species Management (PRISMs) (the Catskill Regional Invasive Species Partnership (CRISP) and Lower Hudson Valley), and other stakeholders to address invasive species on a watershed scale. For example, DEP has been actively involved in coordinating with NYS-DEC on the recently discovered Emerald Ash Borer.

Invasive species can have significant impacts on water supply infrastructure, water quality, and the “green infrastructure” of the watershed. While potential impacts of the zebra mussel on water supply infrastructure are well known and currently under control, there are many aquatic invasive species whose impacts are not known. In addition to aquatic invasive species, terrestrial invasives can also contribute to water quality degradation by impairing the watershed ecosystem’s water quality functions.

The following is a brief list of tasks the ISWG is undertaking for the period 2010-2012:

- Develop a risk assessment protocol for invasive species.
- Generate a priority species list for the watershed.
- Develop and implement the early detection/rapid response protocol for City lands.
- Identify internal practices/procedures to reduce the introduction and spread of invasive species.
- Plan a comprehensive aquatic invasive species inventory for reservoirs.
- Continue training and education for DEP staff and watershed partners.

### **Program Goals**

The goals for management of City water supply lands and CEs are:



- Conduct routine monitoring and inspections of City watershed protection lands to meet the primary mission of water quality protection.
- Ensure encroachments and other unauthorized uses of City land are dealt with in a timely manner.
- Facilitate and coordinate the protection and wise use of City lands and natural resources.
- Provide community benefits by allowing recreation and agricultural uses and issuing revocable land use permits.
- Ensure the long-term protection and management of the City's fee lands and CEs, in which it has significant investment.

The Forest Management Program goals for the 2012-2017 FAD period will focus on implementing DEP's comprehensive forest management plan and will include the following:

- The overarching goal of the Forest Management Program is to increase diversity of species and age structure of City forest lands to enhance forest vigor and forest resiliency. Promoting these forest conditions increases nutrient retention in the forest and promotes a forest that effectively responds to catastrophic events, thus protecting the water supply.
- Use of silvicultural activities such as harvesting, following resource conservation guidelines set forth by DEP Conservation Practices, and construction of enhanced BMPs.
- Implementing assessment strategies for lands acquired since the development of the plan, including forest inventories and assessment, and incorporation of newly acquired lands into the management scheme.
- Assessing deer populations and population management strategies in order to minimize deer impacts on the forest and promote forest regeneration. Deer browsing is one of the primary limiting factors for forest regeneration success.
- Developing and initiating a land restoration strategy for high-graded properties as recommended by DEP's forest management plan.

The goals of the Invasive Species Program are:

- Develop and adopt a proactive, agency-wide comprehensive plan to identify, prioritize, and address invasive species threats before they become entrenched and intractable. For those invasive species that are currently present in the watershed, this plan would provide guidance for identification and prioritization, eradication and/or control, as appropriate, to reduce or eliminate the threat of spreading.
- Implement the elements of the management plan.
- Continue to work with watershed partners to address invasive species issues within the watershed and state.

Table 2.24. Land Management Program planned activities/milestones (2012-2017).

Activity/Milestones	Due Date
Monitor and actively manage water supply lands.	Ongoing
Monitor and enforce watershed CEs.	Ongoing
Continue to assess and implement strategies to increase the public's recreational use of water supply lands.	Ongoing
Maintain a Watershed Land Information System (WaLIS).	Ongoing
Provide NYSDOH, NYSDEC, and EPA opportunities to review and comment on modifications to plans for land management.	As modifications are made to such plans
Support and implement BMPs consistent with Conservation Practices as described in the DEP Forest Management Plan for forest improvement projects on City-owned lands.	Ongoing
Continue to assess deer populations and their impacts on forest regeneration on City-owned lands.	Ongoing
Continue to conduct forest inventories on City-owned lands, including long-term continuous forest inventory (CFI) plots.	Ongoing
Develop an Invasive Species Management Strategy.	12/31/16
Engage watershed partners and residents to coordinate efforts in invasive species prevention and control.	Ongoing

Table 2.25. Land Management Program reporting milestones (2012-2017).

Report Description	Due Date
Report on land management activities in FAD Annual Report.	3/31

### **2.3.4 Watershed Agricultural Program**

The Watershed Agricultural Program (WAP) is a component of DEP's Long-Term Watershed Protection Strategy as well as mandates pursuant to the July 2007 and all prior FADs.

Through multiple successor contracts with the locally-based WAC, DEP has supported the WAP since 1992. The WAP was originally implemented in the WOH watersheds, but it was expanded in 2001 to also include the East of Hudson (EOH) watershed. Since WAC's inception, DEP has always been a voting member on its Board of Directors while directly participating in all WAC program committees and project working groups.

The WAP is a voluntary partnership that strives to maintain and protect source water quality by reducing agricultural pollution, with particular emphasis on waterborne pathogens, nutrients, and sediment. To date, the WAP has developed nearly 400 Whole Farm Plans and implemented nearly 6,000 BMPs on large, small, and EOH farms. The WAP also supports a Farmer Education Program, Farm to Market Program (including the "Pure Catskills" Buy Local Campaign), and the federal Conservation Reserve Enhancement Program (CREP). Numerous agencies and organizations directly support the WAP through local and federal staffing arrangements, including the United States Department of Agriculture, Cornell Cooperative Extension (CCE), and Soil and Water Conservation Districts (SWCDs).

#### **Objectives and Principles**

Well-managed farms are considered preferred watershed land uses for water quality protection. Thus, the underlying objective of the WAP is to protect the City's water supply from non-point sources of agricultural pollution while keeping private working farms in operation as economically viable watershed land uses. Towards this end, the WAP provides technical assistance and financial incentives to help farmers voluntarily adopt and implement Whole Farm Plans. The WAP actively enrolls new participants every year while conducting a comprehensive range of training and education/outreach programs for the full spectrum of agricultural stakeholders.

The WAP is guided by the following principles:

- Scientifically-based framework for watershed protection
- Multiple barrier approach to pollution prevention
- Regulatory relief for watershed agricultural operations without compromising water quality or public health goals
- Public-private partnership based on local leadership, voluntary participation, and upstate/downstate collaboration
- Combination of technical assistance, financial incentives, targeted education, public outreach, and professional training
- Ongoing evaluation and refinement of program methodology

## Program Enhancements

Since 1992, the WAP has evolved and expanded through various enhancements that include: the addition of economic development and natural resource viability programs in 1997; the addition of CREP and the WAC Easement Program in 1998; the addition of a Small Farms Program in 2000; a programmatic expansion to the EOH watershed in 2001; expansion of the Nutrient Management Credit Program in 2008; limited support of the Delaware County Precision Feed Management Program where appropriate (DEP/WAC support complemented funding provided to CCE by the NYSDEC and US Army Corps of Engineers through the federal Water Resources Development Act); the ongoing development and refinement of numerous program policies, strategies, and prioritization methodologies; and the completion of several comprehensive program assessments and project-specific evaluations.

During 2010, as required by the 2007 FAD and in consultation with the WAC Advisory Committee, DEP conducted a review of the existing program evaluation criteria. The review resulted in development of a new prioritization strategy and replacement of the “substantially implemented” FAD metric with metrics that take into account farmer participation and nutrient management plan implementation. In December 2010, DEP submitted a comprehensive WAP evaluation report which highlighted a continuing decline of large farms generally and commercial dairy farms specifically. The report noted that at least 25% of all large WOH farms have become inactive since developing a Whole Farm Plan through the WAP. Thus, as the WAP transitions away from working with large commercial farms towards smaller farms with fewer animals and less cropland, the WAP will need to balance future water quality investments against potentially incremental improvements. NYSDOH and EPA acknowledged these trends in a letter to DEP (February 2011) while also recognizing that a programmatic shift towards new prioritization methodologies would optimize the use of WAP funds to achieve maximum water quality protection in the most cost-effective manner.

During the period 2012-2017, DEP anticipates maintaining all previous WAP enhancements while striving to improve coordination with other WAC programs as appropriate and necessary. Examples of prior programmatic enhancements to be maintained include the current Nutrient Management Credit Program and targeted integration of certain key precision feed management concepts into the WAP’s nutrient management planning and farmer education programs.

Moving forward, DEP seeks to continue emphasizing prioritization methodologies and strategies, programmatic flexibility, and targeted allocation of resources to maximize water quality protection on the substantial portfolio of agricultural lands already enrolled in the WAP. Towards this end, DEP will continue working with WAC to identify and secure federal funding support that complements the WAP; central to this effort will be the potential re-enrollment of 118 CREP contracts that are scheduled to expire during 2012-2017 and the possibility of educating interested watershed farmers about federal assistance for transitioning to organic farming.

**Program Goals**

- Maintain at least 90% active large farm participation.
- Develop 50 new Whole Farm Plans on large, small, or EOH farms during the five-year period 2012-2017.
- Conduct annual status reviews on at least 90% of all active Whole Farm Plans each year (with a goal of 100%) and revise Whole Farm Plans on large, small, and EOH farms as needed based on their priority status.
- Maintain current nutrient management plans (developed within the last three years) on 90% of all active participating large farms.
- Continue to make available the current Nutrient Management Credit Program to at least 100 watershed farmers.
- Implement new BMPs and repair/replace existing BMPs on active participating large, small, and EOH farms according to an approved BMP Prioritization Methodology (which incorporates the BMP Repair & Replacement Strategy).
- Evaluate the BMP Prioritization Methodology and propose new metrics to help guide the WAP moving forward.
- Develop new CREP contracts and re-enroll expiring CREP contracts for 10-15 year terms contingent upon federal funding, reauthorization, and CREP re-enrollment policies.
- Continue implementing a Farmer Education Program and Farm to Market Program in a manner that is complementary to other WAC programs.
- Continue to monitor and track WAP-related scientific research.
- Secure long-term federal funding support to complement DEP funding.

Table 2.26. Watershed Agricultural Program planned activities/milestones (2012-2017).

Activity/Milestones	Due Date
Maintain at least 90% active large farm participation.	Ongoing
Develop 50 new Whole Farm Plans on large, small, or EOH farms during the five-year period 2012-2017.	Ongoing
Conduct annual status reviews on at least 90% of all active Whole Farm Plans (with a goal of 100%) and revise Whole Farm Plans as needed based on their priority status.	Ongoing
Maintain current nutrient management plans on 90% of all active participating large farms.	Ongoing
Continue to make available the Nutrient Management Credit Program to at least 100 watershed farmers.	Ongoing
Implement new BMPs and repair/replace existing BMPs on active participating large, small, and EOH farms according to a BMP Prioritization Methodology.	Ongoing
Evaluate the BMP Prioritization Methodology, summarize the implementation status of the WAP, and review the adequacy of current metrics.	1/31/15

Table 2.26. (Cont.) Watershed Agricultural Program planned activities/milestones (2012-2017).

Activity/Milestones	Due Date
Meet with NYSDOH, EPA, and NYSDEC to discuss program status and review the adequacy of current metrics.	4/31/15
Develop and submit a CREP assessment report that describes potential program alternatives in the event that CREP is not reauthorized by Congress as part of the 2012 federal farm bill.	9 months after farm bill reauthorization
Develop new CREP contracts and re-enroll expiring CREP contracts.	Ongoing
Implement the Farmer Education Program and Farm to Market Program.	Ongoing

Table 2.27. Watershed Agricultural Program reporting milestones (2012-2017).

Report Description	Due Date
<p>Watershed Agricultural Program Annual Report, to include:</p> <ul style="list-style-type: none"> <li>•Number of new and revised Whole Farm Plans on large, small, and EOH farms</li> <li>•Number and types of new BMPs implemented on large, small, and EOH farms</li> <li>•Status of BMP Prioritization Methodology (including the number of renewed/extended Operation and Maintenance (O&amp;M) agreements and number/types of BMPs repaired or replaced)</li> <li>•BMP implementation workload for the following year</li> <li>•Annual BMP expenditures for current year and following year</li> <li>•Number and status/summary of annual status reviews completed on large, small, and EOH farms</li> <li>•Number of new and updated nutrient management plans completed on large, small, and EOH farms</li> <li>•Status and accomplishments of the Nutrient Management Credit Program</li> <li>•Status and accomplishments of CREP</li> <li>•Status and accomplishments of the Farmer Education Program and Farm to Market Program</li> <li>•Summary of WAP-related research activities</li> <li>•Status of farmer enrollment in the WAC Easement Program and WAC Forestry Program</li> </ul>	3/31
BMP Prioritization Methodology Evaluation and WAP Metrics Assessment Report	1/31/15
CREP Alternatives Assessment Report (if needed)	9 months after farm bill reauthorization



### **2.3.5 Watershed Forestry Program**

The Watershed Forestry Program is a component of DEP's Long-Term Watershed Protection Strategy as well as mandates pursuant to the July 2007 and all prior FADs. The program is also a component of the 1997 NYC Watershed Memorandum of Agreement (MOA).

Through multiple successor contracts with the locally-based WAC, DEP has supported the Watershed Forestry Program since 1997. In addition, the USFS is a significant program partner, providing annual grant funding and ongoing technical assistance to support various forestry projects. Since WAC's inception, DEP has always been a voting member on its Board of Directors while directly participating in all WAC program committees and project working groups.

The Watershed Forestry Program is a voluntary partnership that promotes and supports healthy, well-managed working forests for multiple benefits: safe, clean drinking water for downstate consumers; a viable rural economy for upstate watershed communities; and the preservation of natural resources for future generations. A primary focus of the program is to encourage and promote good forestry practices and stewardship behaviors by watershed landowners, foresters, loggers, and members of the forest products industry. To date, the program has developed more than 850 forest management plans covering more than 150,000 acres, in addition to training hundreds of loggers/foresters and educating thousands of landowners, teachers, students, and other upstate/downstate audiences. The Forestry Program is active in both the Catskill/Delaware and Croton watersheds.

#### **Objectives and Principles**

Well-managed healthy forests are considered a preferred watershed land use for water quality protection. Thus, the underlying objective of the Watershed Forestry Program is to protect the City's water supply from nonpoint sources of forest-based pollution while keeping private working forests in operation as economically viable watershed land uses. Towards this end, the program provides technical assistance and financial incentives to help forest landowners voluntarily adopt and implement long-term forest management plans. The program actively enrolls new participants every year while conducting a comprehensive range of training, education, and outreach programs for the full spectrum of forestry stakeholders.

The Watershed Forestry Program is guided by the following principles:

- Scientifically-based framework for watershed protection
- Large tracts of well-managed unfragmented forest land are beneficial land uses for water quality protection
- Regulatory relief for watershed forestry operations without compromising water quality or public health goals
- Public-private partnership based on local leadership, voluntary participation, and upstate/downstate collaboration
- Combination of technical assistance, financial incentives, targeted education, public outreach, and professional training

- Ongoing evaluation and refinement of program methodology

### Program Enhancements

The Watershed Forestry Program has been a relatively consistent program since 1997, with the most significant enhancement being the pilot Management Assistance Program (MAP) in 2005 and its subsequent expansion in 2009. In addition, the forestry BMP programs were recently reorganized to include greater focus on stream crossings, while the program in general has increasingly emphasized riparian management and invasive species control. Over the years, WAC has developed and refined numerous policies and strategies based on project-specific evaluations.

During the period 2012-2017, DEP anticipates maintaining all previous program enhancements made to the Watershed Forestry Program while striving to improve coordination with other WAC programs as appropriate and necessary. Moving forward, DEP seeks to continue emphasizing prioritization strategies, programmatic flexibility, and targeted allocation of resources to maximize water quality protection on the substantial portfolio of forestry lands already enrolled in WAC programs.

### Program Goals

- Continue enrolling eligible watershed landowners in WAC forest management plans (including riparian plans) and annually evaluate the implementation status of five-year-old WAC forest management plans.
- Continue supporting the implementation of WAC forest management plans through the MAP.
- Continue supporting the implementation of forestry BMP projects, with a focus on timber harvest roads and forestry stream crossings.
- Explore potential programmatic collaborations for establishing forested riparian buffers in the Catskill/Delaware and Croton watersheds.
- Continue supporting professional training workshops for watershed loggers and foresters as well as educational programs for forest landowners.
- Support and participate in watershed forestry invasive species programs.
- Continue implementing the Urban/Rural School-based Education Initiative.
- Coordinate, maintain, and utilize four existing model forest sites, including one EOH model forest.
- Secure long-term federal funding support to complement DEP funding.

Table 2.28. Watershed Forestry Program planned activities/milestones (2012-2017).

Activity/Milestones	Due Date
Enroll landowners in WAC forest management plans.	Ongoing
Evaluate the implementation status of five-year-old WAC forest management plans.	3/31

Table 2.28. (Cont.) Watershed Forestry Program planned activities/milestones (2012-2017).

Activity/Milestones	Due Date
Support implementation of WAC forest management plans and forestry BMP projects.	Ongoing
Provide funding to support the implementation of 45 MAP projects every year.	Ongoing
Explore programmatic collaborations for establishing riparian buffers in the Catskill/Delaware and Croton watersheds.	Ongoing
Conduct training workshops for loggers and foresters.	Ongoing
Conduct forest landowner education programs.	Ongoing
Implement the Urban/Rural School-based Education Initiative.	Ongoing
Coordinate and maintain four existing model forest sites.	Ongoing

Table 2.29. Watershed Forestry Program reporting milestones (2012-2017).

Report Description	Due Date
Watershed Forestry Program Annual Report, to include: <ul style="list-style-type: none"> <li>•Number of forest management plans completed (including acreage and riparian plans)</li> <li>•Evaluation update regarding implementation status of 5-year-old WAC forest management plans</li> <li>•Status and accomplishments of the MAP</li> <li>•Number and types of forestry BMP projects implemented</li> <li>•Status and accomplishments of logger and forester training program, forest landowner education, and Urban/Rural School-based Education Initiative</li> <li>•Status of the watershed model forest program</li> </ul>	3/31

### 2.3.6 Stream Management Program

The broad goal of the Stream Management Program (SMP) is to protect and restore achievable levels of stream system stability and ecological integrity by facilitating the long-term stewardship of WOH watershed streams and floodplains. The SMP seeks to do this through the development and implementation of stream management plans. To date, stream management plans have been completed in the Ashokan basin for Broadstreet Hollow, Stony Clove, and Esopus Creek; in the Schoharie basin at Batavia Kill, West Kill, East Kill, Manor Kill, and Schoharie Creek; the East and West Branches of the Delaware River in the Pepacton and Cannonsville basins, respectively; Chestnut Creek and Rondout Creek in the Rondout basin; and the Neversink River in the Neversink basin. The recommendations within each stream management plan define a “road map” for achieving the program’s broad mission. The recommendations for implementation are realized through the following program areas:

- Stream Projects
  - the Catskill Streams Buffer Initiative (CSBI)
  - the Stream Management Implementation Grant Program (SMIP)
  - Education/Outreach/Training

Program implementation funding is tied to municipal adoption of each plan, stream stewardship principles, and commitments to partner with SWCDs in local stream work. The SMP is implemented in each reservoir basin by an SWCD partner, and work is guided by a Project Advisory Committee (PAC) comprised of local leaders and agency staff. Each year a two-year plan of work (“Action Plan”) is put together by the SWCD and DEP and endorsed by its PAC. PAC meetings and subcommittee work provide an opportunity for key partners and stakeholders, such as the CWC, the WAP, and the NYS Department of Transportation, to synchronize and coordinate their priorities with the priorities of the SMP by bringing projects, trainings, and other opportunities to the table. Expanding partnerships strengthens the network upon which the SMP is built.

The primary goal of DEP *Stream Projects* is to demonstrate in-stream, riparian, and floodplain water quality protection practices through the application of natural channel stability principles. The pollutants addressed by the SMP include in-channel sources of suspended sediment and pollutants in runoff. Stream restoration demonstration projects have been a program element since program inception. The scope of this element has evolved to allow for a wider range of projects demonstrating a broader range of practices. Projects may include, but are not limited to, stream and floodplain restoration, bank stabilization, flood response and recovery projects, and addressing hydraulic constrictions.

The *CSBI*’s primary goal is to inform and assist landowners in better stewardship of their riparian area through protection, enhancement, management, or restoration. DEP and its partners (county SWCDs) assist private, riparian landowners by providing (1) Riparian Corridor Management Plans (RCMPs) to create awareness about riparian management issues specific to individual properties, (2) BMP design and installation, and (3) educational materials and actions needed by

landowners to understand the critical role of stream buffers on their property and how to maintain buffers in optimal functioning condition. CSBI coordinators diagnose streamside-related problems and recommend solutions to more effectively manage streamside buffers.

Each reservoir-scale SMP team has established an *SMIP*, a competitive grant program to fund projects and programs that advance recommendations in stream management plans. Funding categories include restoration, stormwater and infrastructure, recreation, education, planning, and applied research/monitoring. Examples of projects include community flood inundation mapping, streambank stabilizations at key infrastructure, stream-related environmental education, and planning for improved recreational access.

The DEP and reservoir-scale SMP teams collaborate in implementing an *Education/Outreach/Training* strategy. Target audiences include town, county, and state officials (highway, planning and zoning, flood emergency response and recovery, permitting), landowners, and businesses. Training includes designing channels and infrastructure for sediment transport and fish passage; floodplain management; and management of gravel, large woody debris, and roadside ditches.

Taken as a whole, these program elements address the concerns of multiple stakeholders, further DEP's goals for water quality protection, and provide a comprehensive approach to regional stream management.

### **Program Goals**

Implementation of the SMP through its four program elements will improve management of streams, riparian buffers, and floodplains; continue to demonstrate multi-objective BMPs in stream work; and continue to train key stakeholders in their application and design. Projects, programs, and policies are implemented in partnership with key local leaders where stream management expertise has been developed over several years. Through these partnerships, DEP seeks to develop an informed constituency of regional stream managers and community members who will influence stream-related actions and decisions to ensure that they are multi-objective, support the interests of stakeholders, and restore and protect water quality within the WOH watershed.

Table 2.30. Stream Management Program planned activities/milestones (2012-2017).

Activity/Milestones	Due Date
<b>Program Elements</b>	
<i>Stream Projects</i>	
Design and complete construction of five additional stream and/or floodplain projects that have a principal benefit of water quality. Details of these projects will be provided to NYSDOH, EPA, and NYSDEC.	11/30/17
<i>CSBI</i>	
Continue to provide technical assistance and conservation guidance to riparian landowners. (This program is also included in Section 2.3.7, the Riparian Buffer Protection Program.)	
•Convene annual meeting of Riparian Buffer Working Group.	11/30
•Facilitate the supply of native plant materials to the CSBI.	Ongoing
•Implement Education, Outreach, and Marketing Strategy with partners.	Ongoing
•Complete at least 80 plans and/or projects throughout the WOH watershed.	11/30/17
<i>SMIP</i>	
Continue the local funding programs for the enhanced implementation of stream management plan recommendations in each of the Schoharie, Delaware (Cannonsville and Pepacton), and Ashokan basins.	Ongoing
Initiate adoption of Rondout and Neversink stream management plans.	1/30/12
•With the Neversink-Rondout Watershed Advisory Group, finalize program rules, application form and guidance, and scoring criteria; develop process for reviewing, awarding, contracting, and evaluating projects.	11/30/12
•Upon adoption of stream management plans, initiate implementation of Rondout and Neversink stream management plan recommendations.	4/30/13
Complete commitment of funds to a minimum of 65 SMIP projects throughout the WOH watershed.	11/30/17
<i>Education/Outreach/Training</i>	
•Propose a plan and schedule for providing routine, systematic training in stream, floodplain, and watershed management techniques targeted to local officials.	11/30/12
<b>Annual Action Plans</b>	
•Meet annually with county contracting partners to review progress made in the previous year within each program area (Stream Projects, CSBI, SMIP, Education/Outreach/Training) and re-evaluate priorities as the basis for preparing a new Action Plan for the current year.	1/31
•Each year, submit a rolling two-year Action Plan for each of the basins that outlines the upcoming projects in the four program areas (Stream Projects, CSBI, SMIP, and Education/Outreach/Training).	5/31



Table 2.30. (Cont.) Stream Management Program planned activities/milestones (2012-2017).

Activity/Milestones	Due Date
<b>Flood Maps</b>	
<ul style="list-style-type: none"> <li>•Develop and distribute updated preliminary Flood Insurance Rate Maps (FIRMs) for the WOH watershed in collaboration with the Federal Emergency Management Agency (FEMA) and NYSDEC.</li> </ul>	12/31/15
<ul style="list-style-type: none"> <li>•Continue to support watershed community utilization of FIRMs and their participation in a variety of floodplain management, flood hazard mitigation, and flood preparedness programs.</li> </ul>	Ongoing
<b>Addendum A</b>	
<ul style="list-style-type: none"> <li>•Meet annually with NYSDEC regarding the implementation of Addendum A to the 1993 Memorandum of Understanding between NYSDEC and DEP as it pertains to the review of Article 15 Stream Disturbance Permits, to enhance coordination between the agencies with the goal of ensuring consistency with the recommendations in stream management plans and implementation of stream management projects.</li> </ul>	11/30
<b>Progress Meeting</b>	
<ul style="list-style-type: none"> <li>•Convene a progress meeting with NYSDOH, EPA, and NYSDEC, with office and field components. Office by 8/30; field following construction season by 10/31.</li> </ul>	Annually

Table 2.31. Stream Management Program reporting milestones (2012-2017).

Report Description	Due Date
<ul style="list-style-type: none"> <li>•Submit the Conine Stream Restoration Project’s Water Quality Monitoring Report.</li> </ul>	12/31/12
<ul style="list-style-type: none"> <li>•Submit an annual report evaluating the overall progress made in implementing the SMP. The report will provide a discussion of progress made in implementing specific stream management plans, site selection, and construction status of all applicable stream projects. The report will include the following metrics: number of projects completed within each project category (Stream Projects, SMIPs, CSBI projects) and their respective length and acreage treated; for the SMIP, the number of projects approved within the SMIP project categories and funding committed; number of Outreach/Education/Training programs offered and total number of stakeholders reached.</li> </ul>	3/31

### 2.3.7 Riparian Buffer Protection Program

The Riparian Buffer Protection Program was initiated under the 2007 FAD, committing the City to continue its riparian buffer protection efforts through the existing programs (e.g., Land Acquisition, Watershed Agricultural, Stream Management, and Forestry Programs) as well as initiating selected program enhancements. The primary programmatic enhancement has been the CSBI, a component of the SMP (Section 2.3.6), which targets improved riparian buffer protections along privately-owned and primarily non-agricultural streamside areas. Since 2007, CSBI has been planned, staffed, and launched, and has just completed its second annual grant application round. Program continuation will enable the marketing, education, and outreach plan completed in 2009 to commence implementation through a contract with CCE of Greene County in 2012.

A new initiative on riparian buffer protection to be undertaken in 2012 is piloting a Riparian Buffer Program (RBP), potentially in coordination with a local land trust, a condition of the WSP of 2010. This program is intended to enhance the City’s existing easement program by focusing on easements lying solely along riparian buffers. This pilot program will be designed to determine the feasibility of acquiring easements using this approach.

The overall success of DEP’s Riparian Buffer Protection Program hinges on enhanced coordination and communications among all the involved stakeholders. The CSBI and the Schoharie RBP will expand communications between the landowners and riparian buffer protection experts, and annual meetings of the Riparian Buffer Working Group and its subcommittees will provide for ongoing regional collaboration among agencies toward program goals. The SMP will continue to require 10-year easements for any stream restoration project.

#### Program Goals

The overall goal of the Riparian Buffer Protection Program is to continue regional collaboration and coordination with all stakeholders in the many facets of riparian buffer management. The goals of the CSBI are described in Section 2.3.6. The goal of the pilot riparian buffer easement program in the Schoharie watershed is to demonstrate and evaluate the feasibility of securing perpetual easements along high priority riparian buffers. Together with enhanced regional coordination, these efforts will advance riparian buffer programming during the 2012-2017 period.

Table 2.32. Riparian Buffer Protection Program planned activities/milestones (2012-2017).

Activity/Milestones	Due Date
Continue existing programs that are protective of riparian buffers including, but not limited to, watershed regulations, farm and forest programs, land acquisition, stream management, and land management.	Ongoing

Table 2.32. (Cont.) Riparian Buffer Protection Program planned activities/milestones (2012-2017).

Activity/Milestones	Due Date
Continue implementation of the CREP Program.	Ongoing
Through the SMP, continue the CSBI. (For specific activities/milestones, see Table 2.30.)	See Table 2.30
Continue to require enhanced management agreements (voluntary 10-year or purchased perpetual) for all current and future stream restoration projects.	Ongoing
Pilot a Riparian Buffer Program through the LAP (milestones based on WSP commitments).	
•DEP will provide a written recommendation to NYSDOH, EPA, and NYS-DEC regarding the implementation of the RBP.	3/24/12
•DEP will commence implementation of the RBP through a local land trust, or if a suitable land trust is not found, will commence implementation itself. The RBP will be a minimum 3 years in length.	6/24/12
•DEP will submit an evaluation report to NYSDOH, EPA, and NYSDEC.	12/24/14

Table 2.33. Riparian Buffer Protection Program reporting milestones (2012-2017).

Report Description	Due Date
The RBP annual report will reference other component programs where the complete program details will be described.	3/31

### **2.3.8 Wetlands Protection Program**

The 2007 FAD requires that DEP implement the Wetlands Protection Strategy in accordance with Section 2.3.8 of the City's Long-Term Watershed Protection Program. The objective of the Wetlands Protection Strategy is to inform wetland protection and management with data collected through mapping and monitoring programs. DEP, in partnership with the U.S. Fish and Wildlife Service, has completed watershed-wide wetland mapping projects such as the National Wetlands Inventory Mapping (NWI), Wetlands Status and Trends, and Wetland Characterization and Preliminary Functional Assessment. DEP also monitors reference wetlands to obtain information on the characteristics and functions of watershed wetlands. Continuation of the Wetlands Program is necessary to provide current data on the status, trends, distribution, characteristics, and functions of watershed wetlands to support protection of wetlands and their associated water quality functions through the regulatory review, land acquisition, agricultural, stream, and forest management programs.

#### **Program Goals**

Wetlands Program goals for the 2012-2017 period are to continue to improve upon wetland mapping methodology and to assimilate data from the reference wetlands monitoring program to ensure that current, region-specific baseline data are available to support wetlands protection under the regulatory review and land management programs.

FAD program goals for the 2012-2017 period include:

- Continued review of federal, state, and municipal wetland permit applications in the New York City Watershed to ensure that regulated wetland impacts are appropriately avoided, minimized, and mitigated.
- Continued monitoring of reference wetlands and establishment of reference standards. Reference wetland standards are conditions exhibited by reference wetlands that can be used to guide wetland assessment and set performance standards for mitigation sites. Data from DEP's ongoing vegetation, hydrologic, and soil sampling will be assimilated to establish reference wetland standards to guide wetland assessment and mitigation efforts. Reference wetlands monitoring also provides an important long-term dataset for assessing wetland function and ground-truthing the NWI mapping efforts.
- Conduct a small-scale wetland mapping project to ascertain the utility of 2009 Light Detection and Ranging (LIDAR)-derived data to improve NWI mapping in the New York City Watershed. This project will explore how LIDAR may improve not only wetland detection but also the assessment of wetland connectivity and function on a watershed scale. This project will determine the applications of LIDAR technology to advance wetlands mapping in support of protection and management programs.
- Update the Wetlands Protection Strategy to reflect accomplishments and programmatic changes embodied in the 2012-2017 period.

Table 2.34. Wetlands Protection Program planned activities/milestones (2012-2017).

Activity/Milestones	Due Date
Update Wetlands Protection Strategy to reflect programmatic changes.	12/31/12
Analyze reference wetlands data and provide reference standards.	7/31/14
Complete small-scale LIDAR wetland mapping project and submit report.	7/31/15
Review federal, state, municipal wetland permit applications in the watershed.	Ongoing
Monitor reference wetlands.	Ongoing

Table 2.35. Wetlands Protection Program reporting milestones (2012-2017).

Report Description	Due Date
Report as part of FAD Annual Report, including updates on permit review, wetland monitoring program, wetland components of land acquisition, stream management, agricultural programs, and associated partnership and education programs.	3/31

### 2.3.9 Nonpoint Source Pollution Strategy for East of Hudson Catskill/Delaware Basins

DEP developed a nonpoint source program for the West Branch, Boyd Corners, Croton Falls, and Cross River Reservoir basins located east of the Hudson River. DEP addresses concerns in these EOH watershed basins through the continued implementation of the WRR, involvement in project reviews, and inspection and maintenance of existing stormwater management facilities, as well as through a grant program to reduce stormwater pollution through the construction of stormwater retrofits.

#### Program Goals

Continue the reduction of nonpoint source pollution to the EOH Catskill/Delaware reservoirs. The initiatives implemented to achieve that goal are:

- Long-Term O&M. Regularly inspect the existing stormwater management facilities and identify maintenance needs in order to achieve the designed removal efficiencies.
- Reduce the Potential Pathogen Risk. Periodic inspection of sanitary sewers and technical assistance for county septic programs will assist in preventing possible discharges of pathogens to the water supply.
- Reduce the Potential Pollutant Load. Reduce pollutant loads through the implementation of a grant program to assist regional stormwater entities design and construct new stormwater retrofits in EOH Catskill/Delaware basins.

Table 2.36. Nonpoint Source Pollution Strategy for East of Hudson Catskill/Delaware Basins Program planned activities/milestones (2012-2017).

Activity/Milestones	Due Date
Maintenance for EOH Stormwater Facilities	Ongoing
EOH Stormwater Retrofits	
<ul style="list-style-type: none"> <li>• Complete construction of five stormwater retrofits:               <ul style="list-style-type: none"> <li>Maple Avenue (Cross River)</li> <li>Drewville Road (Croton Falls)</li> <li>Michael Brook (Croton Falls)</li> <li>Sycamore Park (West Branch)</li> <li>Nemarest Club (Boyd Corners)</li> </ul> </li> </ul>	10/31/13
<ul style="list-style-type: none"> <li>• New Stormwater Retrofits</li> </ul> <p>DEP will support the EOH watershed communities' efforts to design and construct stormwater retrofits, in recognition of the elevated levels of impervious surface found in these communities. To do this, DEP will support the use of \$18.2 million in EOH Water Quality Investment Program funds that it provided Putnam and Westchester Counties under the 1997 MOA, and up to \$15.5 million<sup>1</sup> in funds that it will provide directly to the EOH communities.</p>	Ongoing



Table 2.36. (Cont.) Nonpoint Source Pollution Strategy for East of Hudson Catskill/Delaware Basins Program planned activities/milestones (2012-2017).

Activity/Milestones	Due Date
<ul style="list-style-type: none"> <li>•DEP will make City lands available for stormwater retrofit projects constructed by EOH watershed communities so long as DEP determines that the projects will not pose a threat to water quality or DEP operations related to the water supply.</li> </ul>	Ongoing
<ul style="list-style-type: none"> <li>•Stormwater Grant Program Continue to make available \$4.5 million in grant funding to implement stormwater retrofits that will reduce stormwater pollutant loading in the Croton Falls, Cross River, and upstream/hydrologically connected basins. This effort includes a local funding match of at least 50%.</li> </ul>	Ongoing
<p>Sanitary Infrastructure Inspection Complete inspection of targeted areas, identify potential defects, coordinate with entities responsible for the remediation of identified deficiencies.</p>	Report findings in the 2015 Annual Report
Continue to provide technical assistance in support of EOH county septic management programs.	Ongoing

<sup>1</sup>DEP will make \$10 million available to the EOH watershed communities and will make the remaining \$5.5 million available within six months of receiving written notification that the first \$10 million have been committed via binding agreements.

Table 2.37. Nonpoint Source Pollution Strategy for East of Hudson Catskill/Delaware Basins Program reporting milestones (2012-2017).

Report Description	Due Date
Report annually on program implementation.	3/31

### 2.3.10 Kensico Water Quality Control and Related Programs

Kensico Reservoir, located in Westchester County, is the terminal reservoir for the City’s Catskill/Delaware water supply system. Because it provides the last impoundment of Catskill/Delaware water prior to entering the City’s distribution system, protection of this reservoir is critically important to maintaining water quality for the City. The program reduces nonpoint source pollution in Kensico Reservoir through various stormwater and wastewater projects.

#### Program Goals

- Long-Term O&M. DEP will continue to regularly inspect the existing stormwater management facilities and identify maintenance needs through the life span of each identified facility in order to maximize its removal efficiency.
- Reduce the Potential Pathogen Risk. Implementation of a Septic Repair Reimbursement Program and installation of an early warning sanitary sewer overflow protection system to reduce possible discharges of wastewater.
- Reduce the Potential Risk of Turbidity at Effluent Chambers. Review timeline for assessing and/or dredging effluent chambers to prevent possible resuspension of sediment. Assess sediment accumulation at Shaft 18 every 10 years following the last assessment in 2010.

Table 2.38. Kensico Water Quality Control and Related Programs planned activities/milestones (2012-2017).

Activity/Milestones	Due Date
Inspect and maintain nonpoint source management facilities within the Kensico Reservoir basin <ul style="list-style-type: none"> <li>•Stormwater management facilities</li> <li>•Turbidity curtain</li> <li>•Spill containment measures</li> </ul>	Ongoing
Complete installation of nonpoint source reduction projects identified in the Kensico Action Plan (KAP) <ul style="list-style-type: none"> <li>•Drainage improvements in the N-1 catchment</li> <li>•Pipeline system for N7 sub-basin</li> <li>•Extended detention basin for the N12 sub-basin</li> <li>•Whippoorwill Creek stream stabilization</li> </ul>	10/31/13
CATUEC shoreline stabilization project <ul style="list-style-type: none"> <li>•Report on DEP’s assessment of the feasibility and need for the shoreline stabilization project and the proposed future use and location of CATUEC annually.</li> </ul>	Ongoing
Work with Westchester County to complete construction of the remote monitoring system at Westlake Sewer Extension.	10/31/12

Table 2.38. (Cont.) Kensico Water Quality Control and Related Programs planned activities/ milestones (2012-2017).

Activity/Milestones	Due Date
Effluent chambers	
•Submit progress report on the development of draft schedule for dredging at CATUEC.	6/30/17
•Assess sediment accumulation at CATUEC after completion of CATUEC dredging.	Based on schedule
Continue to implement Septic Repair Reimbursement Program.	Ongoing
Video Sanitary Sewer Inspection Program	Report findings in the 2015 Annual Report
•Complete inspection of targeted areas.	
•Identify potential defects.	
•Coordinate with entities responsible for remediation of identified deficiencies.	

Table 2.39. Kensico Water Quality Control and Related Programs reporting milestones (2012-2017).

Report Description	Due Date
Submit Kensico Programs Annual Report, an integrated report on the progress implementing the Kensico Water Quality Control Program, including:	3/31
•O&M of nonpoint source management facilities	
•KAP implementation	
•Westlake monitoring program	
•Shoreline stabilization	
•Septic Repair Reimbursement Program	
•Westchester County Airport and Route 120 Corridor projects, as needed	

### **2.3.11 Catskill Turbidity Control**

Due to the nature of its underlying geology, the Catskill watershed is prone to elevated levels of turbidity in streams and reservoirs. High turbidity levels are associated with high flow events, which can destabilize streambanks, mobilize stream beds, and suspend the glacial clays that underlie the streambed armor. The design of the Catskill System takes into account the local geology, and provides for settling within Schoharie Reservoir, Ashokan West Basin, Ashokan East Basin, and the upper reaches of Kensico Reservoir. Under normal circumstances, the extended detention time in these reservoirs is sufficient to allow the turbidity-causing clay solids to settle out, and the system easily meets turbidity standards at the Kensico effluent. Periodically, however, the City has had to use chemical treatment to control high turbidity levels.

Over the past several years, DEP has executed a comprehensive program to identify and implement operational strategies and infrastructure improvements that improve the system's resilience during naturally-occurring turbidity events and reduce the frequency of alum treatment events.

#### **Catskill Turbidity Control Study**

DEP initiated the Catskill Turbidity Control Study to provide a comprehensive analysis of engineering and structural alternatives to reduce turbidity levels in the Catskill System and reduce the frequency of alum treatment events. The study has been conducted in three phases.

The *Phase I* study, completed in December 2004, provided a preliminary screening-level assessment of turbidity control alternatives at Schoharie and Ashokan Reservoirs, and identified potentially feasible, effective, and cost-effective measures for subsequent detailed evaluation.

The *Phase II* study, completed in September 2006, consisted of a detailed conceptual design, cost estimation, and performance evaluation of three alternatives for improving turbidity and temperature control in diversions from Schoharie Reservoir: a Multi-Level Intake, In-Reservoir Baffle, and Modification of Reservoir Operations. The performance evaluation relied on development and application of an integrated modeling framework that linked the OASIS water supply model of the entire NYC reservoir system and Delaware Basin with the W2 water quality model of Schoharie Reservoir. Schoharie water quality model development was supported by detailed routine and event-based in-reservoir and in-stream monitoring efforts and process studies, as detailed in annual FAD reports.

DEP selected Modification of Reservoir Operations as the most feasible, effective, and cost-effective alternative for improving turbidity and temperature control at Schoharie Reservoir, and proposed in the December 2006 Phase II Implementation Plan to develop a system-wide Operations Support Tool (OST) to support implementation of this alternative. The Modification of Reservoir Operations/OST plan was conditionally approved by regulatory agencies in August

2008, pending completion of additional sensitivity analyses. These analyses plus an array of model updates were presented in the July 2009 report, “Phase II Implementation Plan: Updates and Supporting Analyses”.

The *Phase III* study, completed in December 2007, focused on alternatives at Ashokan Reservoir that could reduce turbidity levels entering Kensico Reservoir, including a West Basin Outlet Structure, Dividing Weir Crest Gates, East Basin Diversion Wall, Upper Gate Chamber Modifications, a new East Basin Intake, and Catskill Aqueduct Improvements/Modified Operations. The performance evaluation relied on an updated version of the OASIS-W2 model, which included water quality models of Kensico Reservoir and the West and East Basins of Ashokan Reservoir. Ashokan and Kensico water quality model development was supported by detailed routine and event-based in-reservoir and in-stream monitoring efforts and process studies, as detailed in annual FAD reports.

The *Phase III* evaluation indicated that, when turbidity levels rise, taking the Catskill System offline (or operating the Catskill Aqueduct at the minimum flow rate needed to satisfy demands) is the most effective way to reduce the turbidity load transferred from Ashokan to Kensico and reduce the frequency of alum treatment events. Releasing water from the West Basin via the Ashokan Release prior to and during a storm event was also found to provide significant reductions in turbidity loading to the East Basin, and hence to Kensico Reservoir.

DEP selected Catskill Aqueduct Improvements and Modified Operations as the most feasible, effective, and cost-effective alternative for reducing turbidity levels entering Kensico Reservoir, and proposed implementation of this alternative in the July 2008 Phase III Implementation Plan. The Phase III Implementation Plan also presented the results of extensive model sensitivity and uncertainty testing undertaken by DEP.

### **Catskill Turbidity Control Program**

The Catskill Turbidity Control Program consists of three components:

- Modified reservoir operations guided by OST
- Catskill and Delaware Aqueduct connection at Shaft 4
- Improvement to Catskill Aqueduct Stop Shutters

Having completed the study phases, DEP over the next five years will be implementing the resulting recommendations to achieve effective turbidity control for the Catskill System.

This suite of measures offers an effective approach to controlling turbidity by providing the means to reduce flow in the Catskill Aqueduct and delivery of turbid water to Kensico Reservoir during high-flow events, thereby maintaining turbidity well below standards for TSS, maintaining flow to communities along the Catskill Aqueduct, and minimizing the need for chemical treatment.

### ***Operations Support Tool***

OST is a state-of-the-art decision support system for the NYC water supply system. OST will integrate multiple sources of critical near-real-time operations data—streamflow data, in-reservoir water quality data, SCADA data, and current infrastructure information—into an advanced version of DEP’s existing OASIS-W2 water supply/water quality model.

OST will combine current system data with inflow forecast data and system operating rules to project the likely range of reservoir levels and water quality over the coming weeks and months. This look-ahead capability will provide system analysts, operators, and managers with information to support decisions concerning reservoir diversions and releases, and will allow operators to test the risk/reliability of actual operations decisions “on paper” before implementing them. Examples of operating practices supported by OST include reducing diversions from Schoharie Reservoir to conserve cold water, reducing diversions from Ashokan Reservoir subsequent to storm events, operation of the Ashokan Release prior to or during storm events, and identifying when, and how much, additional water might be available for release from Delaware basin reservoirs to support spill reduction and meet down-basin environmental objectives.

In February 2011, DEP convened an expert panel workshop to provide technical expertise to ensure that the science behind the OST is sound and to offer guidance for future use.

### ***Shaft 4 Connection***

The Shaft 4 Connection will be a new engineered connection between the Catskill and Delaware Aqueducts at the Delaware Aqueduct’s Shaft 4 location where the two aqueducts cross. This connection will allow DEP to divert Delaware System water into the Catskill Aqueduct, thereby allowing DEP to reduce the flow of water from Ashokan Reservoir when turbidity is elevated while still maintaining sufficient flow to provide service to outside communities and meet overall demand. This increases operational flexibility, reduces turbidity levels entering Kensico (by blending Catskill diversions with low turbidity Delaware water), and improves water quality for outside communities. Preliminary design of the Shaft 4 Connection and a Value Engineering (VE) workshop were completed in 2010. Design of the preferred VE option is expected to be complete by Spring 2012.

### ***Catskill Aqueduct Stop Shutter Improvements***

To avoid service interruptions at outside community connections when reducing aqueduct flow below a 275 MGD threshold, DEP currently installs stop shutters at five of the six stop shutter locations along the Catskill Aqueduct. The installation and removal of these stop shutters is labor intensive and time consuming. DEP needs to run the Catskill Aqueduct at a minimum of 50 MGD to sustain the pools of water behind each shutter at sufficient elevation to keep the outside community taps wetted.



Improvements to the stop shutter installation process consist of fabricating new light-weight aluminum stop shutters and building hoist system improvements that will allow DEP operations staff to install and remove stop shutters more quickly; the new shutters will also seal more effectively. The improved stop shutter facilities will continue to require service personnel to operate on-site equipment and coordinate the timing of shutter installation and removal. The improved stop shutters will enable DEP to decrease the minimum flow in the Catskill Aqueduct to approximately 25 MGD.

## **Program Goals**

### ***Operations Support Tool***

OST is being developed and deployed via a four-year, phased approach, with new functionality being made available for testing and usage every several months. A complete beta version, with full functionality, will be deployed by 10/31/12. The fourth year of the project will provide testing, technical support, minor additional customization, and training to DEP operations staff. The final version of OST is expected to come online by 10/31/13.

As the development of OST progresses, DEP has begun to utilize components, such as reservoir models and forecasting tools, to modify operations at Ashokan Reservoir to better control turbidity events.

### ***Shaft 4 Connection***

The project is currently in design, with final design documents anticipated to be complete in early 2012. Major design elements have been selected, including connection layout, flow control valves, and water quality monitoring. After design is complete a construction contract will be procured. It is anticipated that construction will be functionally complete by early 2015.

### ***Catskill Aqueduct Stop Shutters Improvements***

The project is currently in design. Bid documents (construction contract drawings and specifications) are expected to be completed by mid-2012. After design is complete, a construction contract will be let out for bids, a contractor will be selected, and the construction contract registered. It is anticipated that construction will be functionally complete by late 2014.

Table 2.40. Catskill Turbidity Control Program planned activities/milestones (2012-2017).

Activity/Milestones	Due Date
Continue to develop and deploy OST.	Ongoing
Refine version of Graphical User Interface (GUI).	02/28/12
Deployment of OST full beta version.	10/31/12
Shaft 4 functionally complete.	3/31/15

Table 2.40. (Cont.) Catskill Turbidity Control Program planned activities/milestones (2012-

Activity/Milestones	Due Date
Catskill Aqueduct Stop Shutter Improvements construction functionally complete.	12/31/14
Convene, on an annual basis, a progress meeting with NYSDOH, EPA, and NYSDEC, providing a forum for discussion of the status of the Catskill Turbidity Control Program, management of turbidity events reported in the March Annual Report, and responses to any significant events that have concluded subsequent to those reported in the March Annual Report.	9/30
Submit Catskill Turbidity Control General Management Plan, including consideration of maintaining water quality during Delaware Aqueduct repair and shutdown.	2/28/17

Table 2.41. Catskill Turbidity Control Program reporting milestones (2012-2017).

Report Description	Due Date
Report on progress of Catskill Turbidity Control Program components in Annual Report.	3/31

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

### **2.4.1 Watershed Monitoring Program**

DEP conducts extensive water quality monitoring throughout the watershed. The watershed monitoring conducted by the Water Quality Directorate is defined in the 2009 Watershed Water Quality Monitoring Plan (WWQMP). The WWQMP is designed to produce the appropriate data for reports related to regulatory compliance, FAD Program evaluation, modeling, and surveillance. The WWQMP is amended through the use of addenda, to address and track changes in the monitoring program as they occur. Significant changes to the monitoring plan are reviewed and approved by the New York State Department of Health in advance of implementation. Water quality results from the routine monitoring programs are stored in a database for reservoirs, streams, and aqueducts throughout the watershed.

The water quality database serves both short-term and long-term objectives. Daily results are used for regulatory compliance and operational guidance. Upon completion of a year of data collection, results are described in the Watershed Water Quality Annual Report. Over the longer term, a more comprehensive evaluation of the routine monitoring data is conducted to appraise water quality status and long-term trends, as well as demonstrate the effectiveness of ongoing watershed protection efforts. This evaluation is described in the Watershed Protection Program Summary and Assessment Report produced every five years by DEP.

#### **Program Goals**

The goals of DEP's Watershed Monitoring Program are as follows:

- Provide water quality results for keypoints (i.e., aqueduct locations), streams, and reservoirs collected through routine programs to guide operations, assess compliance, and provide comparisons with established benchmarks. Describe these results and ongoing research activities in Watershed Water Quality Annual Reports.
- Use water quality data to evaluate the source and fate of pollutants and assess the effectiveness of watershed protection efforts. Provide a comprehensive evaluation of watershed water quality status and trends, and other research activities, to support assessment of the effectiveness of watershed protection programs.
- Actively participate in forums (e.g., seminars, discussion groups) for the exchange of information between DEP and outside agencies regarding watershed research activities and pathogen investigative work.
- Coordinate a technical working group on pathogen studies to discuss the latest research on pathogen sources, transport, and fate in the environment; effectiveness of management practices in reducing pathogen concentrations; and identifying additional monitoring and/or research needs.
- Provide after-action reports on all chemical treatment activities and other significant or unusual events.

Based on current New York State policies, gas drilling using high volume hydraulic fracturing will not be allowed in the New York City Watershed. However, as a contingency in the event New York State policies change and gas drilling is authorized in the New York City Watershed, DEP will work with regulatory partners to develop parameters to revise/enhance its monitoring plan to include sampling for indicator pollutants.

Table 2.42. Watershed Monitoring Program planned activities/milestones (2012-2017).

Activity/Milestones	Due Date
Annual participation in educational seminars on watershed monitoring.	9/30
Coordinate annual technical Pathogen Working Group meeting.	5/31
Submit after-action reports following chemical treatments or significant unusual incidents.	Upon completion as specified for each action

Table 2.43. Watershed Monitoring Program reporting milestones (2012-2017).

Report Description	Due Date
Submit Watershed Water Quality Annual Report (including comprehensive chapters on pathogens and ongoing research).	7/31
Submit Watershed Protection Program Summary and Assessment Report.	3/31/16

## **2.4.2 Multi-Tiered Water Quality Modeling Program**

DEP's Modeling Program develops and applies simulation models to evaluate effects of land use change, watershed management, reservoir operations, ecosystem health, and climate on water supply quantity and quality. These models fall into four general classes:

1. Models that simulate watershed hydrology and stream water quality, including models that simulate agriculture, urban, and forest ecosystem processes and the consequent effects on evapotranspiration and biogeochemistry.
2. Watershed models that simulate watershed sediment loss and transport, including the processes that affect soil erosion and transport, stream channel erosion and transport, and the relationships between stream water suspended solids and turbidity.
3. Reservoir models that simulate the effects of watershed nutrient inputs on reservoir nutrient and chlorophyll concentrations, and reservoir models that simulate the transport and gradient of turbidity within the reservoirs.
4. System operation models which simulate the demands, storage, and transfer of water throughout the entire NYC reservoir system.

The models encapsulate the key processes and interactions that control generation and transport of water, sediment, and nutrients from the land surface, through the watersheds, and within the reservoirs.

Research and development is an integral component of the group's mission, and an ongoing activity that leads to improvements to existing models, adaptation of new models, and development of model applications. Results of these applications, often published in the peer reviewed literature, have distinguished DEP as a leader in the use of models to support water supply management by evaluating the impacts of changing management programs, climate, land use, population, and reservoir operations. Past accomplishments of the Modeling Program include the development and application of watershed and reservoir models to show the importance of FAD/Memorandum of Agreement (MOA) programs in reducing nutrient loading and eutrophication, initial implementation and development of the Bureau's Geographic Information System (GIS), and development of the models and model applications that are a part of the core components of the Operations Support Tool (OST).

Ongoing support for this work is by contract (currently with the City University of New York) to provide on-site data and model development and applications. The combined scientific expertise of the DEP scientific staff and the contractual support ensures that needed levels of research and development, as well as practical model applications, can be produced in a timely and effective manner. As requested, the Modeling Program is also available to provide support to local watershed protection efforts.

### **Program Goals**

The Modeling Program's primary goals are to continue development and application of models to:

- Predict turbidity transport in the Catskill System and Kensico Reservoir, and provide guidance for reservoir operations to minimize the impact of turbidity events, including continued application and testing of models that are used as part of OST and providing for improved efficacy of model results.
- Provide support and understanding of the effects of FAD/MOA programs on the maintenance and improvement of water system water quality through evaluation of the effectiveness of watershed management programs to control eutrophication in the Delaware System.
- Provide modeling support for continued studies on the potential effects of climate change on the water supply, thus ensuring the long-term ability of the water system to reliably supply an adequate quantity of high quality water.

Table 2.44. Multi-Tiered Water Quality Modeling Program planned activities/milestones (2012-2017).

Activity/Milestones	Due Date
Continue model testing and development based on ongoing model simulations, data analyses, and research results, as necessary.	Ongoing
Update land use, watershed programs, and time-series data (meteorological, stream flow and chemistry, reservoir chemistry) to support modeling, as necessary.	Ongoing
Continue development of data analysis tools for modeling, and software for model connectivity, as necessary.	Ongoing
Use reservoir turbidity models to support operational decisions in response to unfavorable turbidity conditions.	Ongoing
Develop and improve model applications to support watershed management and long-term planning.	Ongoing
Develop model applications that simulate the impacts of future climate change on reservoir water quality and quantity.	Ongoing
Update future climate scenarios that can be used as inputs to DEP reservoir and watershed models.	Ongoing

Table 2.45. Multi-Tiered Water Quality Modeling Program reporting milestones (2012-2017).

Report Description	Due Date
Submit Annual Status Report. This report will include updates on the modeling activities described above.	3/31



### **2.4.3 GIS Program**

DEP's Geographic Information System (GIS) is used not only to manage the City's interests in the lands and facilities of the upstate water supply system, but also to display and evaluate the potential efficacy of watershed protection programs through maps, queries, and spatial analyses. The GIS is also used to support watershed and reservoir modeling of water quantity and quality, as well as modeling of water supply system operation.

Since 1997, the GIS Program has provided technical support and data development for a variety of protection programs and modeling applications in such areas as:

- State Environmental Quality Review Act (SEQRA) review and regulatory mapping
- land acquisition prioritization
- open space mapping
- infrastructure mapping
- forestry management
- water quality compliance monitoring
- reservoir morphometry (bathymetry)
- land cover and impervious surface mapping and tracking
- stream assessment
- modeling evaluation of watershed management programs
- land use, soil, and meteorological inputs for modeling
- climate change impact assessment

GIS staff routinely:

- acquire, update, or develop new GIS data and metadata
- perform GIS analysis and research
- produce maps and statistical reports
- fulfill requests for Bureau-specific data from other agencies and watershed stakeholders
- train and support other DEP staff, interns, and local government agents in the use of Global Positioning Systems (GPS) for project-specific data gathering efforts
- provide support in the acquisition, management, and analysis of remotely-sensed data such as satellite or aerial imagery for watershed-wide land use and topographical (terrain) mapping.

### **Program Goals**

The mission of the GIS is to support DEP in protecting water supply and water quality. The GIS provides visualization and analysis tools that assist in the design, implementation, and evaluation of water quality monitoring and watershed protection programs in a unique spatial and temporal context. The GIS will continue to be a useful tool to:

- inventory and track water supply lands and facilities
- perform analysis of land use and terrain to map development, agriculture, forest, and hydrography
- provide estimation of the effects of watershed management programs on long-term water quality
- support watershed and reservoir modeling of water quantity and quality, and modeling of system operations.

Table 2.46. GIS Program planned activities/milestones (2012-2017).

Activity/Milestones	Due Date
Continue to provide GIS technical support for protection programs, monitoring programs, and modeling applications.	Ongoing
Continue to develop and update GIS data and metadata, including acquisition of high-resolution aerial data and their derived products as needed.	Ongoing
Continue to improve and maintain GIS infrastructure to evolve with changing technology and growing database needs.	Ongoing
Continue to fulfill requests for Bureau-specific GIS data from other agencies and watershed stakeholders.	Ongoing

Table 2.47. GIS Program reporting milestones (2012-2017).

Report Description	Due Date
FAD Annual Report, documenting: <ul style="list-style-type: none"> <li>•GIS technical support for protection programs, monitoring programs, and modeling applications</li> <li>•Completion or acquisition of new GIS data layers and aerial products in the GIS spatial data libraries</li> <li>•GIS infrastructure improvement</li> <li>•GIS data dissemination summaries</li> </ul>	3/31

## **2.5 Regulatory Programs**

### **2.5.1 Watershed Rules and Regulations and Other Enforcement/Project Review**

DEP's Watershed Regulatory Program consists of two primary components:

- Project Review
- Regulatory Enforcement

DEP's overall watershed protection strategy is the enforcement of applicable environmental regulations, which include the Rules and Regulations for the Protection from Contamination, Degradation, and Pollution of the New York City Water Supply and Its Sources (Watershed Regulations (WRR)), including the regulations and standards incorporated by reference in the WRR; the federal Clean Water Act (CWA National Pollutant Discharge Elimination System (NPDES) Program); and the State Environmental Quality Review Act (SEQRA). The primary mechanism for protection of the water supply against development and other land use activities that pose a threat to water quality is the WRR. DEP's enforcement efforts are focused on the review and approval of projects within the watershed and environmental law enforcement.

Each project proposed in the watershed, including those designed or sponsored by DEP, is reviewed to ensure compliance with the WRR as well as federal, state, and local laws. Projects that require DEP review and approval include all wastewater treatment systems (including construction of wastewater treatment plants (WWTPs), subsurface sewage treatment systems (SSTs), and sewer collection systems), the preparation of stormwater pollution prevention plans (SWPPPs), and the construction of certain impervious surfaces. In addition, DEP reviews and issues permits for Individual Residential Stormwater Plans (IRSPs) and for impervious surfaces associated with stream diversions or piped watercourses. DEP also ensures that during and after construction, projects are built in accordance with the approvals issued by DEP, and that those that require SWPPPs or IRSPs properly site and maintain temporary erosion controls and have the necessary stormwater management practices installed.

DEP is required under both Section 1104 of the New York State Public Health Law (PHL) and the 1997 Watershed Memorandum of Agreement (MOA) to pay for certain costs associated with WWTPs in the watershed. DEP must pay for design, installation, operation, and maintenance of "Watershed Equipment and Methods" for WWTPs that either (or both) (1) are "public" within the meaning of PHL §1104, or (2) were operating, or were permitted and under construction, as of 11/22/95. Watershed Equipment and Methods are WWTP components and methods of operation that are required solely as a result of the WRR and not otherwise required by federal or state law. DEP's commitment to pay for Watershed Equipment and Methods at WWTPs in the two categories described above includes capital replacement of such Watershed Equipment and Methods. The City is also obligated to pay certain incremental costs associated with SWPPPs and IRSPs under MOA paragraph 145.

## Program Goals

Continue the current program, including:

- Facilitate optional Pre-Application meeting requests, receive applications for approval of regulated activities, perform review of SEQRA notices through the SEQRA Group within the Regulatory Enforcement Program, perform project reviews in accordance with the WRR, and monitor construction activity. The entire project history is recorded in a database to ensure that land development projects undertaken within the New York City Watershed have received the necessary DEP approvals for wastewater, stormwater, or other regulated activities.
- Investigate possible violations of the WRR, Environmental Conservation Law (ECL), and CWA. Document failures, issue Notices of Violation, and review proposed plans for corrective actions for any and all violations. Observe and document remediation efforts and perform close out actions. Document DEP Police involvement in the enforcement of environmental and public health laws, including spills in the watershed, hazardous and solid waste dumping, and illegal discharges in the watershed. These activities are recorded in a database to track all enforcement actions.
- Evaluate the effectiveness of approved SWPPs and stormwater management practices in particular detention basins. Continue to administer the contract and guide the consultant in evaluating the performance of stable, functioning detention basins, obtain as-built surveys, assess maintenance activities, and perform observations and monitoring of sites during storm events. Where appropriate, make revisions to DEP’s stormwater pollution prevention plan program and guidance materials.

Table 2.48. Watershed Rules and Regulations and Other Enforcement/Project Review Programs planned activities/milestones (2012-2017).

Activity/Milestones	Due Date
Enforce the WRR and other applicable regulations. Continue to promote guidance to applicants seeking WRR approvals, through: <ul style="list-style-type: none"> <li>•Pre-Application conferences</li> <li>•Guidance documents</li> </ul>	Ongoing
Review best management practice (BMP) monitoring data and BMP performance and effectiveness in the field and, where appropriate, make revisions to SWPPP guidance. These revisions may include but are not limited to: <ul style="list-style-type: none"> <li>•refinements of BMP assumptions</li> <li>•creation of performance-based benchmarks</li> <li>•emphasizing the importance of non-structural BMPs and buffers</li> <li>•promotion of innovative site design to meet SWPPP requirements</li> </ul>	Ongoing

Table 2.48. (Cont.) Watershed Rules and Regulations and Other Enforcement/Project Review Programs planned activities/milestones (2012-2017).

Activity/Milestones	Due Date
Work with NYSDEC, in accordance with Addendum S of the DEP/NYSDEC Memorandum of Understanding (MOU), to improve coordination of stormwater enforcement and compliance activities between agencies and with the NYS Attorney General’s Office. Such enforcement and compliance coordination will apply, but not be limited to, all effective NYSDEC general permits for construction activity. Stormwater Enforcement Coordination Committee meetings with involved agencies will be held at least twice per year or more as needed.	Ongoing

Table 2.49. Watershed Rules and Regulations and Other Enforcement/Project Review Programs reporting milestones (2012-2017).

Report Description	Due Date
<p>Submit semi-annual report consisting of:</p> <ul style="list-style-type: none"> <li>•Summary table, with corresponding maps, of new project activities that may affect water quality, including variance activities and review of new/remediated septic systems in the Catskill/Delaware watershed basins, as well as the Croton Falls and Cross River basins east of the Hudson River</li> <li>•Summary table (inventory) of all development projects proposed and their SEQRA status, with corresponding maps</li> <li>•Summary table of projects under construction, by basin, with corresponding maps</li> </ul> <p>The semi-annual report will also be available on DEP’s website.</p>	4/30 and 10/31
Submit semi-annual report on the status of DEP regulatory enforcement actions in the Catskill/Delaware watershed basins, including the Croton Falls and Cross River basins.	4/30 and 10/31
Report on the analyses used to determine the phosphorus-restricted and coliform-restricted status of each reservoir, as part of the Watershed Water Quality Annual Report.	7/31

## 2.5.2 WWTP Compliance and Inspection Program

To protect against the threat of contamination from WWTPs, DEP has taken a leadership role in ensuring compliance, troubleshooting, and encouraging WWTP owners to properly operate and maintain WWTPs in the watershed. Preventing the degradation and contamination of the source waters and reservoirs includes continual monitoring and a periodic comprehensive review of the WWTPs located within the watershed and their associated collection systems.

### Program Goals

To ensure that these plants are being operated and maintained in accordance with the limits and conditions established in their State Pollutant Discharge Elimination System (SPDES) permits, DEP has developed and will continue to implement an ambitious program. The Wastewater Treatment Plant Compliance and Inspection (WWTPCI) Group performs onsite inspections, compliance monitoring and assistance, troubleshooting, and enforcement (as needed) at all WWTPs within the New York City Watershed. In addition, the DEP Water Quality sampling program regularly monitors the effluent of all treatment plants in the watershed. DEP utilizes the results of the sampling to assist plant operators, or to initiate enforcement activities as necessary. The WWTPCI Group also enforces the WRR and coordinates with NYSDEC on enforcement of the SPDES permits for all non-City-owned WWTPs discharging in the New York City Watershed. The WWTPCI Group also investigates possible violations of the ECL and the CWA. The program is coordinated through an EPA-approved MOU between NYSDEC and DEP. The MOU established the Watershed Enforcement Coordination Committee (WECC), which meets regularly as required by the MOU to address noncompliance through formal enforcement and/or compliance assistance under specific inter-agency protocols. The WECC process is designed to address instances of significant noncompliance in a timely and appropriate manner.

Table 2.50. WWTP Compliance and Inspection Program planned activities/milestones (2012-2017).

Activity/Milestones	Due Date
Perform weekly sample monitoring at all New York City-owned WWTPs in accordance with their SPDES permits, and grab sample monitoring monthly at all non-City-owned WWTPs discharging in the Catskill/Delaware watershed. At least once annually, for the non-City-owned WWTPs, samples shall be collected and analyzed in accordance with the monitoring requirements of each facility's SPDES permit. Continue to provide assistance to owner/operators of non-City-owned WWTPs as needed.	Ongoing
Continue to take timely and appropriate enforcement action against non-City-owned WWTPs for noncompliance with the WRR and SPDES discharge permit requirements, in accordance with the WECC enforcement coordination protocol of the NYSDEC/DEP MOU.	Ongoing

Table 2.50. (Cont.) WWTP Compliance and Inspection Program planned activities/milestones (2012-2017).

Activity/Milestones	Due Date
Conduct at least four on-site inspections for 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.	Ongoing

Table 2.51. WWTP Compliance and Inspection Program reporting milestones (2012-2017).

Report Description	Due Date
Report semi-annually on the Wastewater Treatment Plant Compliance and Inspection Program, including: <ul style="list-style-type: none"> <li>•WWTP Inspection Summary Reports</li> <li>•Enforcement Actions</li> <li>•Regulatory Upgrade Program Status</li> </ul>	2/28 and 8/31
Report by email to the New York State Department of Health all sewage spills exceeding 500 gallons within 24 hours of DEP becoming aware of the spill	Ongoing
WWTP Water Quality Sampling Monitoring Report	2/28 and 8/31



## 2.6 Catskill/Delaware Filtration and UV Disinfection Facilities

### 2.6.1 Catskill/Delaware Filtration Plant Design Update

In 1993 EPA issued two FADs for the Catskill/Delaware water supply that required the City to proceed with conceptual and preliminary design of a water filtration facility that could be built in the event that filtration was someday deemed necessary. The 1997 FAD added deliverables for Final Design and the completion of a Final Environmental Impact Statement, but included a provision for the City to seek relief from these deliverables if the remaining conditions of the FAD were being adequately addressed and the Catskill/Delaware water supply appeared likely to meet federal water quality standards for the foreseeable future.

Having addressed the milestones and conditions of the FAD, and given the long-term outlook for meeting water quality standards, the commitment to update the preliminary filtration designs every two years was memorialized in the 2002 and 2007 FADs.

#### Program Goals

Updates every two years to the preliminary design for the Catskill/Delaware filtration plant will ensure that the existing design documents do not become obsolete, thereby minimizing the overall time to commence filtration in the event that DEP or the primacy agency later determines that filtration is necessary.

Table 2.52. Catskill/Delaware Filtration Plant Design Update Program planned activities/milestones (2012-2017).

Activity/Milestones	Due Date
Biennially, DEP will update the preliminary design for the Catskill/Delaware filtration facilities.	Beginning 9/30/13
At the request of EPA or the NYSDOH, DEP will host a presentation highlighting the changes to the preliminary design.	As requested

Table 2.53. Catskill/Delaware Filtration Plant Design Update Program reporting milestones (2012-2017).

Report Description	Due Date
DEP will issue a report biennially updating the preliminary design for the Catskill/Delaware filtration facilities. This report will discuss the analysis and redesign work performed, and contain the necessary change pages to the final preliminary design, including revisions to drawings.	Beginning 9/30/13

**2.6.2 Catskill/Delaware UV Disinfection Facility**

As a condition of relief from completing final design deliverables for the Catskill/Delaware filtration planning process, the 2002 FAD required that the City move forward with design and construction of an Ultraviolet (UV) Light Disinfection Facility for the Catskill/Delaware water supply.

Addition of UV disinfection to the Catskill/Delaware water supply will provide an additional disinfection barrier enhancing the City’s water supply protection efforts. The UV Facility will also satisfy the *Cryptosporidium* inactivation treatment requirements under the Long Term 2 Enhanced Surface Water Treatment Rule, 40 CFR Part 141, Subpart W. Once the UV Facility is online, DEP will report monthly on its operations in accordance with that rule.

The facility is located at the Eastview site in Valhalla, NY, and is designed to treat up to 2 billion GPD to provide 99.9% inactivation of *Cryptosporidium*. Construction began in 2006 and is scheduled to be completed by the Fall of 2012. The related construction contracts currently total \$1.5 billion.

**Program Goals**

To place the Catskill/Delaware UV Facility into service in order to provide additional treatment of the Catskill/Delaware water supply for *Cryptosporidium*.

Table 2.54. Catskill/Delaware UV Disinfection Facility Program planned activities/milestones (2012-2017).

Activity/Milestones	Due Date
Complete installation of electrical substation.	3/17/12
Staff UV Facility adequately with Certified Operators as defined by the New York State Department of Health’s (NYSDOH) Operator Certification Regulation (10 NYCRR Subpart 5-4).	7/31/12
Commence operation of First Quadrant.	8/03/12
Complete Catskill Connection Chamber including its associated conveyance piping, commence operation of Second Quadrant, and provide UV treatment to all water delivered from the Catskill/Delaware water supply.	8/31/12
Commence full operation.	10/29/12

Table 2.55. Catskill/Delaware UV Disinfection Facility Program reporting milestones (2012-2017).

Report Description	Due Date
Monthly progress reports to regulators	Monthly to project completion
Provide letter to confirm to NYSDOH and EPA that the UV Facility is adequately staffed by Certified Operators as defined by NYSDOH's Operator Certification Regulation (10 NYCRR Subpart 5-4).	7/31/12

## 2.7 In-City Programs

### 2.7.1 Waterborne Disease Risk Assessment Program

In order to continue to operate under a Filtration Avoidance Determination, NYC must continue to demonstrate that water consumers served by the NYC water supply are adequately protected against waterborne disease. In particular, the City must be able to sufficiently demonstrate that there are no waterborne outbreaks of giardiasis or cryptosporidiosis. The Waterborne Disease Risk Assessment Program (WDRAP) satisfies this requirement.

#### Program Goals

NYC’s overall program goal is to continue to obtain public health data in the City relevant to ensuring that NYC water customers are adequately protected against waterborne disease.

Plans are to continue:

- Disease Surveillance. Collect data on giardiasis and cryptosporidiosis, including disease rates and demographics, and also risk factor information as appropriate. Data collection is by means of disease surveillance and case interviews (and review of medical charts, as needed).
- Syndromic Surveillance. Operate syndromic surveillance systems in order to better be able to detect any citywide outbreak of waterborne disease.

In addition, WDRAP staff will continue to track developments regarding drinking water and health (including review of scientific/health literature).

NYC is also proposing to continue to respond to source water pathogen monitoring results as outlined in the *Cryptosporidium* Action Plan (CAP) until the Ultraviolet (UV) Light Disinfection Facility is online and fully operational. Once the plant is online, any *Cryptosporidium* oocysts should be inactivated by UV treatment, so there will be no continuing need to implement the CAP.

Table 2.56. Waterborne Disease Risk Assessment Program planned activities/milestones (2012-2017).

Activity/Milestones	Due Date
Continue to operate the WDRAP.	Ongoing
Continue to implement the CAP.	Event based until UV plant is fully operational
Continue to implement the Turbidity Action Plan (TAP).	Event based

Table 2.56. (Cont.) Waterborne Disease Risk Assessment Program planned activities/milestones (2012-2017).

Activity/Milestones	Due Date
Review and modify the TAP, in consultation with the New York State Department of Health (NYSDOH) and EPA, to take into account the operation of the Catskill/Delaware UV Disinfection Facility and to accommodate the loss of possible elements contained in the CAP, which will be discontinued once the UV Facility is fully operational.	Prior to UV plant being fully operational
In relation to any water quality “event” involving the NYC water supply (e.g., increased turbidity levels, pathogen findings, an operational disruption), the City will provide syndromic surveillance system information (e.g., signals and trend data), as requested by either NYSDOH or EPA. Information requests will be coordinated through NYCDEP.	Event based
Notify NYSDOH and EPA whenever DEP is notified by the New York City Department of Health and Mental Hygiene of any significant signs of community gastrointestinal illness in which the public drinking water supply appears to be the source of infection.	Event based

Table 2.57. Waterborne Disease Risk Assessment Program reporting milestones (2012-2017).

Report Description	Due Date
Submit Annual Report on program and program findings, implementation, and analysis.	3/31

### **2.7.2 Cross Connection Control**

DEP’s Cross Connection Control Program is an integral part of an effective drinking water supply protection plan. There are many businesses and facilities operating in the City that are classified by the state as hazardous and that could potentially contain a cross connection condition or experience a backflow condition. If the water service to the property is not properly protected from backflow with an approved device, there is a risk to the integrity of the drinking water system. Investigating and eliminating possible cross connections or backflow conditions, responding to complaints, confirming the proper and legal installation of approved backflow devices, and providing a mechanism for swift and effective enforcement are essential to the protection of the City’s drinking water supply.

#### **Program Goals**

The protection of the City’s drinking water supply through an extensive cross connection control program includes:

- inspection of facilities classified as posing a risk of contamination because they contain either a hazardous or aesthetically objectionable operation or business
- review of plans for the installation of approved backflow prevention devices
- taking enforcement action against noncompliant facilities
- review and acceptance of Initial and Annual test reports
- public education on laws, requirements, and potential hazards of backflow
- responding to and investigating reports of water quality anomalies or complaints suspected of being caused by a cross connection or backflow condition.

Table 2.58. Cross Connection Control Program planned activities/milestones (2012-2017).

Activity/Milestones	Due Date
Respond to cross connection control complaints	As needed
Initiate enforcement for noncompliant hazardous premises	Anticipated 225/year
Backflow preventer plans approved	Anticipated 400/year
Backflow preventer plans accepted with self-certification	TBD
Notices of Violation issued for failure to test annually	Anticipated 200/year
Review requests for exemption from cross connection control requirements	Anticipated 400/year
Perform full inspection of potentially hazardous premises	300 to 450 per year

Table 2.59. Cross Connection Control Program reporting milestones (2012-2017).

Report Description	Due Date
Annual FAD report on cross connection control	3/31



## 2.8 Administration

Beginning in the early 1990s, DEP hired hundreds of professionals in a variety of fields to support its comprehensive watershed protection program. The efforts of this dedicated staff allow the City to successfully implement the elements of the overall protection effort.

### Program Goals

DEP is committed to maintaining the level of staffing, funding, and expertise necessary to support all elements of the City’s Long-Term Watershed Protection Program and to meet all associated milestones.

Table 2.60. Administration Program planned activities/milestones (2012-2017).

Activity/Milestones	Due Date
DEP, in consultation with the New York City Office of Management and Budget, will make a presentation to the New York State Department of Health/EPA/NYSDEC on the amount of money appropriated and spent for watershed protection programs and its adequacy to meet program objectives and FAD requirements.	Within 60 days of annual report

Table 2.61. Administration Program reporting milestones (2012-2017).

Report Description	Due Date
Report annually on 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. Contractor support staff will be noted.	9/30
Report on the City budget for the upcoming fiscal year, specifically the amount (capital and expense) spent during the previous year, the amount appropriated for watershed protection programs for the current year, and the amount planned for the year thereafter. The amount spent, appropriated, and planned will be broken down by program, to the extent practicable. The report will also include costs for technical consultant contracts identified in the FAD.	9/30

## 2.9 Education and Outreach

Implementing a comprehensive Watershed Education and Outreach Program is part of DEP's Long-Term Watershed Protection Strategy, as well as a component of the 1997 NYC Memorandum of Agreement (MOA) and a mandate pursuant to the 2007 and all prior FADs.

Many of DEP's watershed education and outreach accomplishments are achieved through existing watershed protection programs tailored to key target audiences. These audiences comprise both upstate and downstate constituents such as landowners, homeowners, businesses, professionals, community leaders, local officials, school groups, tourists, recreationalists, and water consumers. Specific watershed partnership programs that target these audiences include those that are administered regionally by the Watershed Agricultural Council (WAC) and the Catskill Watershed Corporation (CWC), those that are administered locally (at the county, stream, or reservoir basin scale) by Cornell Cooperative Extension (CCE) and Soil and Water Conservation Districts (SWCDs), and those that are administered directly by DEP in both the watershed and within NYC.

### Objectives and Principles

DEP's Watershed Education and Outreach Program is truly a collaborative effort that involves numerous partners working to educate, inform, teach, promote, and raise awareness about the importance of the water supply, source water protection, water conservation, environmental stewardship, and sustainability. Watershed education and outreach is based on the principle that creating an informed base of upstate watershed residents and downstate water consumers will facilitate and strengthen DEP's Long-Term Watershed Protection Strategy.

On a year-round basis, DEP supports and participates in dozens of community events throughout the watershed and within NYC, including county fairs, festivals, conferences, workshops, and other public outreach venues where staff disseminate informational publications and directly explain DEP's role as a watershed partner. These community events allow DEP to communicate to thousands of stakeholders annually about watershed protection programs, water conservation, the relationship between environmental protection and public health, and the importance of environmental stewardship and sustainability practices.

DEP also supports school-based watershed education programs while conducting regular professional training opportunities for teachers, environmental educators, watershed landowners, local government officials, and watershed professionals. Common topics covered by these programs include land use planning, stream corridor protection, farm and forest management, septic system maintenance, riparian buffers, invasive species, and stormwater management.

**Program Enhancements**

During the period 2012-2017, DEP anticipates continuing the core activities of the Watershed Education and Outreach Program while striving to improve coordination among the various program components as they progress in the future.

**Program Goals**

- Continue working with WAC, CWC, CCE, SWCDs, and other partner agencies and organizations to support and implement program-specific education and outreach programs (e.g., agriculture, forestry, wastewater, stormwater, stream management) that focus on target audiences in a manner that complements and facilitates DEP’s Long-Term Watershed Protection Strategy.
- Continue to support various upstate/downstate school-based education programs that include professional development for teachers and educators, as well as classroom instruction, watershed field trips, student mentoring, and internship opportunities. These school-based programs will focus on educating the next generation of watershed residents and water consumers about the importance of protecting and conserving the NYC water supply as well as the connections between environmental protection and public health.
- Continue to produce written information about the NYC water supply system and DEP’s watershed protection programs. Examples include the annual Consumer Confidence Report, program brochures, scientific papers, fact sheets, newsletters, press releases, and other forms of publication.
- Continue to utilize, maintain, and update the DEP website ([www.nyc.gov/dep](http://www.nyc.gov/dep)) and other forms of social media as tools for disseminating timely information about the NYC water supply system, promoting DEP’s watershed protection and conservation efforts, and publicizing various watershed recreation opportunities on City-owned water supply lands and reservoirs.

Table 2.62. Education and Outreach Program planned activities/milestones (2012-2017).

Activity/Milestones	Due Date
Continue to support and implement targeted education and outreach programs for specific audiences through the Watershed Agricultural Program, Watershed Forestry Program, Stream Management Program, and Natural Resource Management Program (including Watershed Recreation and Invasive Species Programs).	Ongoing
Continue to fund the CWC Public Education Grants Program and support other community outreach activities in relation to CWC watershed protection programs.	Ongoing
Continue to support upstate/downstate school-based education and training programs.	Ongoing

Table 2.62. (Cont.) Education and Outreach Program planned activities/milestones (2012-

Activity/Milestones	Due Date
Continue to participate in a range of community/public outreach events in both the watershed and NYC.	Ongoing
Utilize publications, the DEP website, and social media tools to disseminate information about watershed protection and conservation to upstate/downstate constituents.	Ongoing

Table 2.63. Education and Outreach Program reporting milestones (2012-2017).

Report Description	Due Date
Watershed Education and Outreach Annual Report	3/31

## 2.10 Reporting

Table 2.64. List of proposed reports.

Reporting Milestones	Due Date
Objective Compliance Report	Monthly
UV Facility Status Report	Monthly
Trihalomethane Monitoring Report	Quarterly
Septic Maintenance Program Report	Semi-annually
Land Acquisition Program Status Report	Semi-annually
WWTP Monitoring Report	Semi-annually, 2/28, 8/31
WWTP Inspection Report	Semi-annually, 2/28, 8/31
Watershed Regulations Project Review Report	Semi-annually, 4/30, 10/31
Watershed Regulations Enforcement Report	Semi-annually, 4/30, 10/31
Septic Remediation and Replacement Program Report	Annually
Sewer Extension Program Report	Annually
Alternate Design Septic Program Report	Annually
New Infrastructure Program Report	Annually
Community Wastewater Management Program Report	Annually
Stormwater Program Report	Annually
Stormwater Retrofit Program Report	Annually
East of Hudson Nonpoint Source Program Report	Annually
Kensico Programs Report	Annually
Catskill Turbidity Control Program Report	Annually
Land Acquisition Program Report	Annually
Land Management Program Report	Annually
Cross Connections Control Program Report	Annually
GIS Status Report	Annually
Waterborne Disease Surveillance Program Report	Annually
Watershed Forestry Program Report	Annually
Modeling Status Report	Annually
Watershed Agricultural Program Report	Annually
Stream Management Program Report	Annually
Riparian Buffer Program Report	Annually
Filtration Avoidance Determination Report	Annually
Wetlands Strategy Report	Annually
Education and Outreach Program Report	Annually

Table 2.64. (Cont.) List of proposed reports.

Reporting Milestones	Due Date
Stream Management Program Basin Action Plan	Annually, 5/31
Watershed Water Quality Report	Annually, 7/31
Waterfowl Management Program Report	Annually, 9/30
Administration Program Report	Annually, 9/30
Catskill/Delaware Filtration Plant Design Update Report	Biennially, starting 9/30/13

Annually means submittal of reports for the previous calendar year due no later than 3/31, unless otherwise stated.

Semi-annually means submittal of reports for the six-month period ending the last day of the month prior to the due date, due no later than 1/31 and 7/31, unless otherwise stated.

Quarterly means submittal of reports for the three-month period ending the last day of the month prior to the due date, due no later than 4/30, 7/31, 10/31, and 1/31.

Monthly means submittal of reports for the preceding month, due no later than 10 days after the end of that month.