

US EPA ARCHIVE DOCUMENT

**New York City
Department of Environmental Protection**

2006 Long-Term Watershed Protection Program

December 2006



Prepared by the Bureau of Water Supply

**Emily Lloyd, Commissioner
Paul Rush, P.E., Deputy Commissioner
Bureau of Water Supply**

Table of Contents

Table of Contents	i
List of Tables	iii
List of Figures	v
1. Introduction.....	1
1.1 Water Quality Conditions and Concerns	5
1.1.1 Phosphorus Load Reduction in the Cannonsville Reservoir Basin	5
1.1.2 Pathogen Monitoring in the New York City Water Supply.....	8
1.1.3 Turbidity	11
1.2 Highlights of the Watershed Protection Program	16
2. Long-Term Watershed Protection Program.....	25
2.1 SWTR Objective Compliance	25
2.2 Environmental Infrastructure	25
2.2.1 Septic Programs	26
2.2.2 New Sewage Treatment Infrastructure Program.....	29
2.2.3 Community Wastewater Management Program.....	29
2.2.4 WWTP Upgrade Program.....	30
2.2.5 Stormwater Programs	33
2.3 Protection & Remediation Programs	34
2.3.1 Waterfowl Management Program.....	34
2.3.2 Land Acquisition.....	35
2.3.3 Land Management	37
2.3.4 Watershed Agricultural Program	38
2.3.5 Watershed Forestry Program	40
2.3.6 Stream Management Program	42
2.3.7 Riparian Buffer Protection Program.....	44
2.3.8 Wetlands Protection Program	45
2.3.9 Nonpoint Source Pollution Strategy for East of Hudson Catskill/Delaware Basins.....	47
2.3.10 Kensico Water Quality Control and Related Programs	50
2.3.11 Catskill Turbidity Control.....	52
2.4 Watershed Monitoring, Modeling and GIS	53
2.4.1 Watershed Monitoring Program	53
2.4.2 Multi-Tiered Water Quality Modeling Program.....	55
2.4.3 GIS Program	56
2.5 Regulatory Programs	57
2.5.1 Watershed Rules and Regulations and Other Enforcement/Project Review	57
2.5.2 WWTP Inspection Program.....	58
2.6 Catskill/Delaware UV Disinfection Facility	60
2.7 In-City Programs	61
2.7.1 Waterborne Disease Risk Assessment Program	61
2.7.2 Cross Connection Control.....	61
2.8 Administration	62
2.9 Education & Outreach	62
2.10 Reporting	64

List of Tables

Table 2.1.	Schedule of West of Hudson WWTP Upgrades.....	31
Table 2.2.	Schedule of East of Hudson WWTP Upgrades.	32
Table 2.3.	List of proposed reports.	65

List of Figures

Figure 1.1	Total phosphorus loads and total volume of WWTP effluent flow to Cannonsville Reservoir in 1994, 1999, and 2004.	6
Figure 1.2	West of Hudson Wastewater Treatment Plant (WWTP) annual phosphorus loads, pre- and post-plant upgrades.	7
Figure 1.3	Total phosphorus and fecal coliform concentrations at stream sampling sites above and below the Walton wastewater treatment plant (upstream site=WSPA, downstream site=WSPB) in the Cannonsville Basin, 1993-2005.	8
Figure 1.4	<i>Cryptosporidium</i> results at watershed keypoint locations.	9
Figure 1.5	<i>Giardia</i> results at watershed keypoint locations.	10
Figure 1.6	This picture of New York City’s Board of Water Supply coagulating plant, taken September 19, 1917, indicates that turbidity was an anticipated water quality concern.	13
Figure 1.7	Photograph of the Catskill Influent Chamber Cove on Kensico Reservoir taken in May 2005 during alum treatment (looking approximately northwest).	14
Figure 1.8	Total annual turbidity loading to Ashokan Reservoir from the Esopus Creek Watershed and the Shandaken Tunnel, 1991-2005	15
Figure 1.9	New York City Water Supply system west of Hudson watershed pre-MOA as of October 1997.	18
Figure 1.10	New York City Water Supply system west of Hudson watershed protection programs as of November 2006.	19
Figure 1.11	Cat/Del: Status of pre-MOA and newly acquired land and CEs as a percentage of and in each basin.	20
Figure 1.12	This wastewater treatment plant serving the Village of Hunter was constructed with funding from the City under the auspices of the New Infrastructure Program.	20
Figure 1.13	Brian McIntosh, operator of the new Bovina Community Septic System, at the control panel, where flow from the settling tanks is directed to twelve leach fields. Photo courtesy of Catskill Watershed Corporation	21



1. Introduction

This report presents New York City's revised Long-Term Watershed Protection Program, submitted to the United States Environmental Protection Agency (EPA) as the City's application for an extension of the 2002-2007 filtration waiver for the Catskill/Delaware systems. Although many of the programs described in this document are intended to form the basis of the next Filtration Avoidance Determination (FAD) for the years 2007-2012, the City anticipates that they will continue beyond 2012, and their institutionalization with community-based partners and local governments will ensure continued filtration waivers for the Catskill/Delaware systems for years to come.

This document should not be reviewed in a vacuum. Since its first filtration waiver was issued by New York State nearly 15 years ago, DEP has produced a multitude of reports detailing program progress and water quality. For specifics about the implementation of watershed protection programs, refer to the Annual Reports prepared pursuant to the FAD for the years 2001 through 2006. For programs not covered by the FAD, specifically Croton watershed programs, the annual reports prepared by the Watershed Protection and Partnership Council contain a section submitted by the City. DEP also produces dozens of quarterly, semi-annual and annual reports on FAD programs, publishes reports on special studies and develops 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 550 billion gallons. They were designed and built with various interconnections to increase flexibility to meet quality and quantity goals and to mitigate the impact of localized droughts. The system supplies drinking water to almost half the population of the State of New York – more than 8.2 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 in 2005 averaged 1.3 billion gallons a day.

The New York City Department of Environmental Protection (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 its infrastructure and 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 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 is supplied by the Croton, although in times of drought the Croton system can provide significantly more.

The City is building a water treatment plant under the Moshulu 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, and Greene Counties. The Catskill system was constructed early in the 20th century, beginning with the Ashokan Reservoir, which went into service in 1915. Water flows southeast from the Schoharie Reservoir via the 18-mile Shandaken Tunnel, emptying into the Esopus Creek at Allaben. From there water continues to flow another 12 miles in the Esopus Creek before entering the west basin of Ashokan Reservoir. Water leaves Ashokan through the 75-mile-long Catskill Aqueduct, which connects to the 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 the Kensico Reservoir. The Delaware system supplies the remaining 50% of the City's daily demand. Because waters from the Catskill and Delaware watershed are comingled 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 to either provide filtration or 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 Surface Water Treatment Rule. To demonstrate a basis for a filtration waiver, DEP advanced a program to assess and address water quality threats in 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 demonstrated that the Catskill/Delaware supply easily complied with the quantitative criteria, since (1) the source water met the turbidity and fecal coliform standards of the SWTR, (2) there were no source-related violations of the Total Coliforms Rule and (3) there were no waterborne disease outbreaks in the City.

The narrative criteria of the SWTR required the City to show, through ownership or agreements with landowners, that it could 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 27% of the land in the Catskill/Delaware watershed was publicly owned – 20% 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 15 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) 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 15 years, a long-term commitment by the City to safeguard and even improve 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 oper-

ational – ensuring the smooth running of the reservoir infrastructure and the delivery of water to the City. Water quality samples were taken not by trained staff but 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 Division of Drinking Water Quality Control now employs approximately 250 professionals who annually perform more than 620,000 analyses from over 40,000 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. The monitoring program's fundamental goals are to help manage the system to provide the best possible water; to develop a database through which water quality trends can be identified; and to 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 NYC 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 the reservoirs; wastewater treatment plants 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 those 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

After 14 months of intense negotiations, in January 1997, 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, the State, EPA, watershed counties, towns, and villages and certain environmental and public interest groups. This unique coalition has come 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 decade, DEP and its partners have focused on several key watershed protection initiatives: the Watershed Agricultural Program; the acquisition of watershed lands; the enforcement of improved 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 wastewater treatment plants.

1.1 Water Quality Conditions and Concerns

DEP has made great strides in reducing sources of water quality concerns in the watershed. The text to follow will bring into focus three important water quality attributes of interest - phosphorus content, pathogen abundance and turbidity “concentration”.

1.1.1 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, the Cannonsville Reservoir was in relatively poor condition compared to other reservoirs in the Catskill and Delaware systems. Nutrient loading, mainly due to agricultural and wastewater runoff, caused large algal blooms in the summertime. These massive blooms of algae consumed a significant portion of available dissolved oxygen and sunlight, 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 primarily used to maintain flow in the Delaware River below the dam.

Subsequent to the enactment of the new, more aggressive watershed protection measures in the early 1990s, water quality began to markedly improve 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 System Rehabilitation 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 is no longer listed as a phosphorus-restricted basin since 2002.

As illustrated in Figure 1.1, phosphorus (as total phosphorus) loads from WWTPs (wastewater treatment plants) 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, Kraft. The substantial additional reductions in phosphorus loads realized after 1999 can be attributed to final upgrades of several plants and diversion of one other.

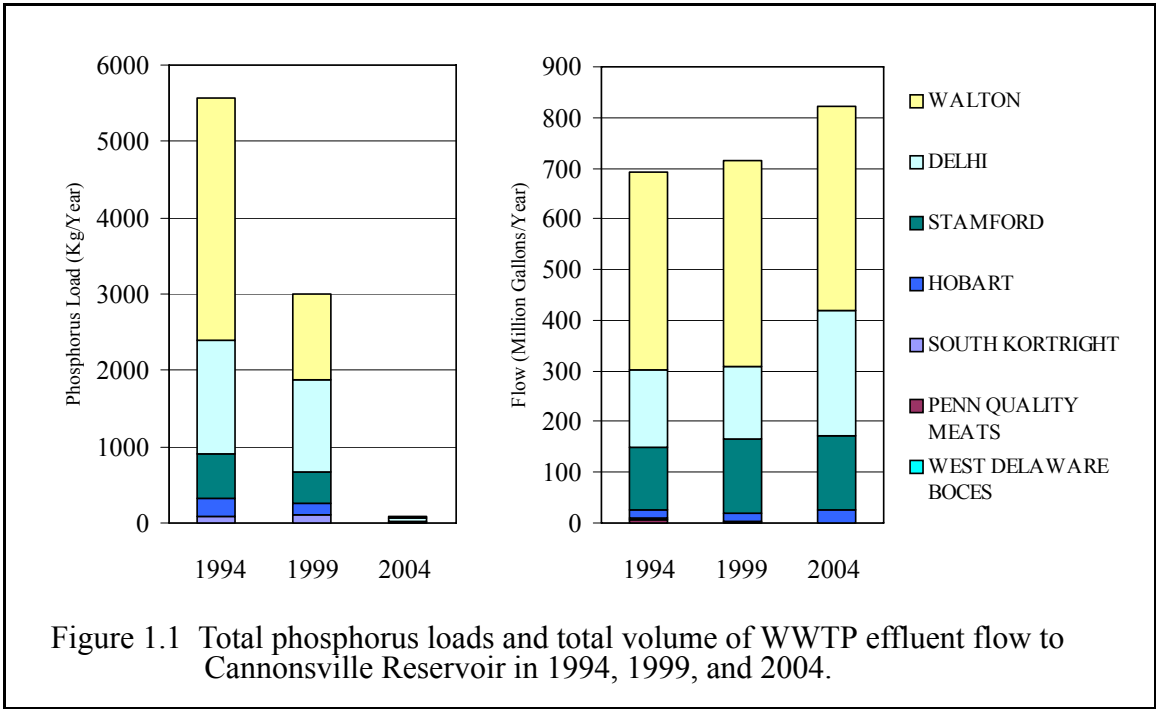


Figure 1.2 on the following page illustrates the locations and relative contributions of phosphorus from WWTPs in the Catskill and Delaware watersheds both before and after plant upgrades. The larger circles show the amount of phosphorus leaving each WWTP before upgrades and the smaller, darker circles indicate current phosphorus contributions following plant upgrades.

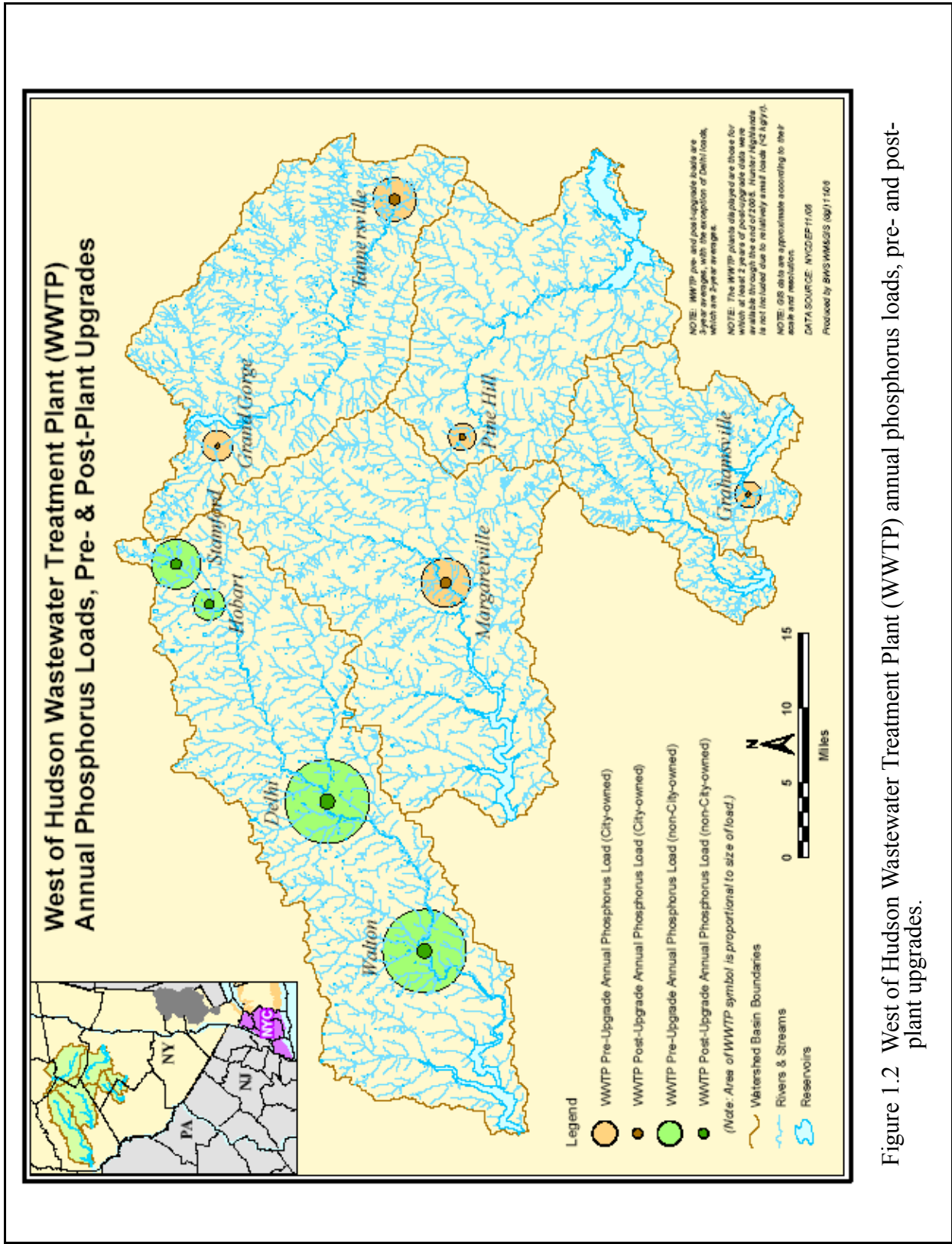
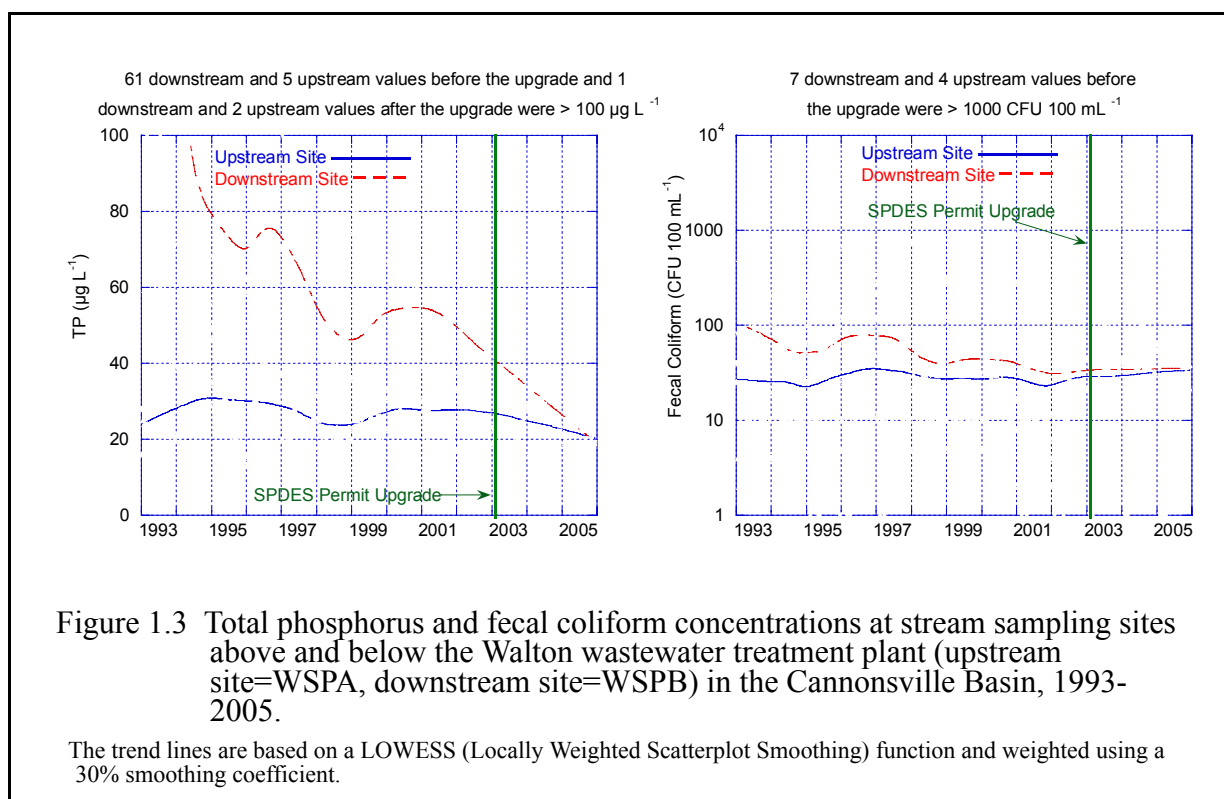


Figure 1.2 West of Hudson Wastewater Treatment Plant (WWTP) annual phosphorus loads, pre- and post-plant upgrades.

A Closer Look: Wastewater Treatment Plant Upgrades and Reduction in Cannonsville Phosphorus Loading

The Walton WWTP is the largest plant in the Cannonsville watershed and is located downstream of the other plants on the West Branch of the Delaware River. Prior to the upgrade of the plant, the total phosphorus concentrations downstream of the plant were much higher than those seen in the creek above the plant (see Figure 1.3). Also, fecal coliform levels downstream of the plant were higher than the upstream levels. The median total phosphorus (TP) and fecal coliform levels in the creek below the plant before the upgraded SPDES permit were $57 \mu\text{g L}^{-1}$ and $30 \text{CFU } 100 \text{mL}^{-1}$, respectively, and were $25 \mu\text{g L}^{-1}$ and $24 \text{CFU } 100 \text{mL}^{-1}$ after the upgrade. Following the plant improvements and the upgraded SPDES permit, the upstream and downstream values for TP and fecal coliform levels were very similar.



1.1.2 Pathogen Monitoring in the New York City Water Supply

As part of its Watershed Protection Program, DEP has made significant investments to ensure the high quality of New York City's water supply for current consumers and for generations to come. As a municipal water supplier, one water quality concern demanding constant vigilance is the potential presence of pathogens. DEP routinely monitors its water for the presence of *Cryptosporidium* and *Giardia*. Pathogen detection rates are at extremely low levels reflective of pristine drinking water supplies.

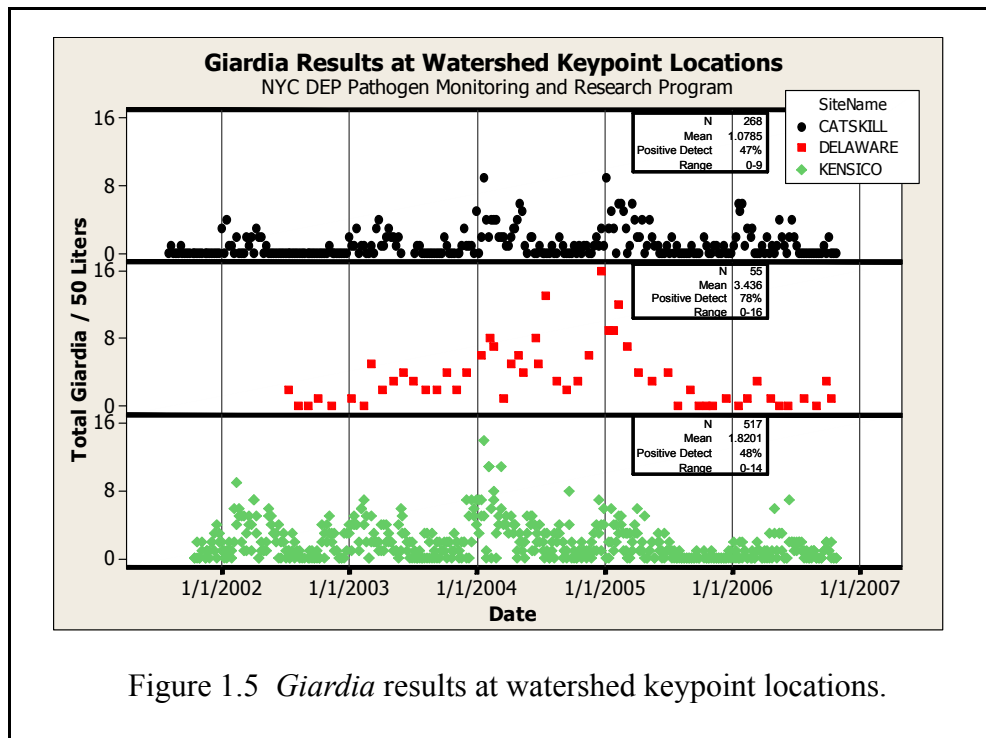


Figure 1.5 *Giardia* results at watershed keypoint locations.

DEP’s protozoan results have been consistently below any level that would require additional treatment by EPA guidelines even considering the extra steps DEP has taken to maximize the recovery of these protozoa. Kensico Reservoir, the blending reservoir for the Catskill and Delaware systems, also consistently meets the turbidity and fecal coliform bacteria criteria required by the Surface Water Treatment Rule for source waters.

As indicated in Figure 1.4, at the Catskill keypoint *Cryptosporidium* detection occurred at a rate of 12 percent from a total of 269 samples over the 2001-2006 period. The vast majority of samples detected zero oocysts and positive samples usually yielded a range of one to three oocysts per 50 liters, with a one-time maximum of four oocysts in 2002. At the Delaware keypoint, *Cryptosporidium* detection occurred at a rate of 13 percent from the total of 55 samples over the 2002-2006 period. Not unlike Catskill keypoint indicators, the vast majority of samples at the Delaware keypoint detected zero oocysts and positive samples usually yielded a range of one to two oocysts per 50 liters, with a one-time maximum of three oocysts in 2004. *Cryptosporidium* occurrence is at 20 percent for the Kensico keypoints from a total 519 samples over the 2001-2006 period. As in the Catskill and Delaware results, the majority of samples yielded zero oocysts; those positive samples generally ranged from one to two organisms, but twice peaked at three oocysts - once in 2003 and again in 2005. Genotyping of *Cryptosporidium* in the watershed indicates that most of oocysts are of wildlife origin and, therefore, suggest no significant public health risk.

As indicated in Figure 1.5, *Giardia* occurrence at the Catskill upstate keypoint is 47 percent with a mean of 1.1 cysts per 50 liters. Overall, *Giardia* has a higher prevalence in the watershed than *Cryptosporidium*. DEP has observed a distinct seasonal variation in *Giardia* concentrations, whereby concentrations are lower in the warmer months and slightly to considerably higher during the colder months of the year. This seasonal cycle is most apparent at the upstate Catskill and the Kensico keypoints. *Giardia* occurrence at the Delaware upstate keypoint is 78 percent with a mean of 3.4 cysts per 50 liters. *Giardia* occurrence at the Kensico effluent keypoints is 48 percent with a mean of 1.8 cysts per 50 liters.

DEP's Watershed Protection Programs and Eliminating Possible Pathogen Sources

DEP has aggressively sought to keep pathogen numbers low through a variety of environmental infrastructure programs - notably, the Septic Rehabilitation and Septic Maintenance Programs, Sewer Extension Program, Wastewater Treatment Plant Upgrade Program, Community Wastewater Management Program, and construction of new wastewater treatment plants under the auspices of the New Sewage Treatment Infrastructure Program. Additionally, the Watershed Agricultural Program supports construction of best management practices (BMPs) on watershed farms to address "non-traditional" agricultural water pollution concerns, especially waterborne pathogens. DEP's Waterfowl Management Program helps eliminate fecal coliform pollution on many of the City's reservoirs by employing avian deterrent and hazing techniques.

Because pathogen detection rates have always been low in the Catskill and Delaware watersheds, it is difficult to quantify the positive effects these programs have had on water quality, however based on how these programs perform, it is beyond dispute that any risk of potential pathogen contamination has been significantly reduced. In implementing its ambitious watershed protection programs, DEP is securing a pristine, unspoiled water supply for consumers both now and in the future. As a final "finishing" step in ensuring that the water delivered to New Yorkers throughout the State is of the highest possible quality, DEP will begin treating Catskill and Delaware waters with ultraviolet light in 2012. Once complete, this facility will treat all water conveyed through Catskill and Delaware aqueducts – effectively providing a final barrier of protection against contamination of waterborne pathogens before water enters the City.

1.1.3 Turbidity

New York City's water supply is recognized the world around for its excellent quality and pristine watersheds. DEP has long believed that the quality of the water it provides to consumers is a reflection of activities occurring in the watershed, whether anthropogenic or natural. One of the most notable examples of how the natural landscape can affect water quality is the challenge posed by the clay-rich soils of the Catskill watershed, which can contribute to occasional periods of elevated turbidity.

The particles giving rise to turbidity can impact water quality and use by affecting the water's color and taste, interfering with chemical and ultra-violet (UV) disinfection, and providing a medium for the growth of potentially harmful bacteria and other microorganisms. Due to these concerns, State and federal agencies have set a limit on the level of nephelometric turbidity allowed in public drinking water. The limit for an unfiltered surface water source is defined in the Surface Water Treatment Rule (40CFR Section 141.71) and in the New York State Sanitary Code (10 NYCRR Section 5-1.1), both of which specify that raw water turbidity immediately prior to the first or only point of disinfection cannot exceed 5 Nephelometric Turbidity Units (NTU).

As has been observed a number of times since the construction of the Catskill system, rushing waters resulting from intense runoff events can destabilize stream banks or even completely move the streambeds, lifting the glacial clays that underlie the streambed armor. Once suspended, this clay can remain so for weeks or even months on end. When the Catskill system was conceived, engineers recognized this potential in their plans, designing both Ashokan and Kensico Reservoirs to provide ample settling. The Ashokan Reservoir was designed and constructed with a dividing weir separating the reservoir into two basins: the upstream West Basin allows for settling of turbidity, while generally less turbid water spills over to the downstream East Basin for delivery to the Catskill Aqueduct. To address the occasional, more extreme storms where turbidity-causing particles remain suspended for longer periods and even enter the Catskill Aqueduct, engineers built a structure to house chemical coagulants to be used to enhance settling once water leaves the aqueduct and enters the Kensico Reservoir. See Figure 1.6.



Figure 1.6 This picture of New York City's Board of Water Supply coagulating plant, taken September 19, 1917, indicates that turbidity was an anticipated water quality concern.

Further historical context is found in the *Catskill Aqueduct Celebration Municipal Engineers Journal, Souvenir Edition*, dated Oct. 12, 13, and 14, 1917:

At a number of places in the Catskill watersheds there are banks of very fine clay-like earth on the hill slopes or along the streams and margins of the reservoirs. Under certain conditions of storm or very rapid run-off of water from the steep surfaces of the hills and mountains, some of this fine earth is carried into the streams and by them into the reservoirs, making the water turbid. Most of this turbidity settles in the reservoirs during the period of storage of the water. At times, however, some of the finest turbidity may be carried into the aqueduct rendering the water unattractive in appearance. To correct this fault whenever it may occur (which will probably be only at long intervals) a coagulating plant has been installed on the aqueduct about two miles north of Kensico Reservoir. This plant is so arranged that it can mix into the water flowing in the aqueduct small quantities of a harmless coagulant which will cause the very fine clay particles to settle out of the water while passing through Kensico Reservoir.

This observation from 1917 reflects essentially the same conditions DEP sees in the Catskill watershed today: during rapid runoff storm events, turbidity-causing particles of a very fine nature enter the supply system. A large quantity of the turbidity settles out in reservoirs as water makes its way down to the City. In rare circumstances, treatment with a coagulant, generally alum, is necessary to help settle out the finest turbid particles as the water leaves the aqueduct and enters Kensico. Before 2005, alum treatment of Catskill system water had been required only four times in the preceding 20 years in response to extreme floods.



Figure 1.7 Photograph of the Catskill Inflow Chamber Cove on Kensico Reservoir taken in May 2005 during alum treatment (looking approximately northwest).

The incoming turbid water can be seen to the north of the chamber (to the right of the photograph) with the suspended material flocculating out very quickly as water moves to the south (to the left of the photograph). Some turbid water that entered the reservoir prior to the treatment can be seen hugging the shoreline to the south of the chamber.

Studies have demonstrated that the vast the majority of turbidity in Ashokan Reservoir comes from high flow events in Ashokan basin streams and not necessarily from turbid water entering from the Schoharie Reservoir via the Esopus Creek. See Figure 1.8.

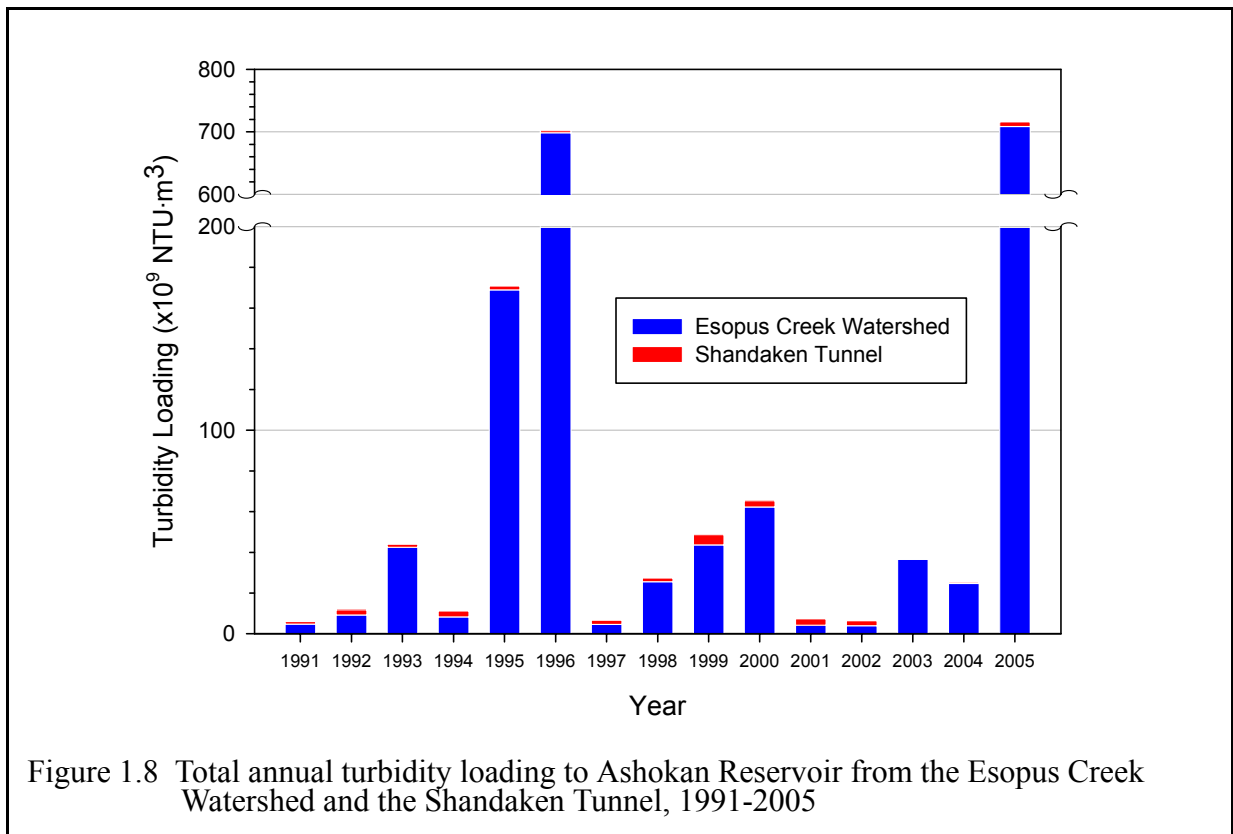


Figure 1.8 Total annual turbidity loading to Ashokan Reservoir from the Esopus Creek Watershed and the Shandaken Tunnel, 1991-2005

Figure 1.8 shows the annual contribution of turbidity to the Ashokan Reservoir from the Shandaken Portal and from the sources in the Esopus Creek watershed itself. The results are based on a water quality model developed by the Upstate Freshwater Institute (UFI) which takes into account the turbidity values and flows from the tunnel and from the streams in the Esopus watershed. For the fifteen years displayed, the Shandaken Tunnel provided an average of 2% of the Ashokan’s annual turbidity load. In drier years, such as 2001 and 2002, the tunnel delivered a greater proportion (approx. 50%) of the annual load, but in these years the total load was much less than in wetter years, such as 1996 or 2005 when the contribution of turbidity from the tunnel to the Ashokan was insignificant. In summary, these results indicate that the influence of the Shandaken Tunnel on turbidity in the Ashokan Reservoir is relatively minor and does not contribute to water quality problems in the reservoir, such as those that might lead to the need for alum treatment.

Controlling Turbidity in the Long Term

DEP is undertaking a comprehensive analysis of potential effective and cost-effective engineering and structural alternatives to reduce turbidity levels in the Catskill system. DEP has engaged the Hazen and Sawyer-Gannett Fleming Joint Venture to conduct the engineering analyses. In addition, working closely with the Joint Venture, the Upstate Freshwater Institute (UFI) is enhancing the existing Schoharie and Ashokan Reservoir models to allow for full assessment of the effectiveness of potential engineering alternatives in reducing turbidity. DEP has developed a two-

phase approach for this study. Phase I, a screening level evaluation to select alternatives that showed the most promise, was completed in 2004. Phase II, which was completed in 2006, further evaluated measures to address turbidity leaving the Schoharie Reservoir that were carried forward from Phase I. Phase III will focus on measures to address turbidity leaving the Ashokan Reservoir and entering the Catskill Aqueduct. The Phase III study will be completed in 2007. More on this subject can be found in section 2.3.9.

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 1.9 and 1.10 illustrates the extent and diversity of watershed protection measures implemented in the Cat/Del (Catskill/Delaware) watersheds since the Memorandum of Agreement was promulgated in 1997.

To realize 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 to protect the waters of the Catskill and Delaware watersheds while supporting the economic vitality of the region. The City's commitment to these efforts is total and complete.

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

- **Land Acquisition** – When the Land Acquisition Program began 10 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 10.9%. As noted earlier, New York State's Catskill Preserve protects an additional 20%.

Figure 1.11 demonstrates the extraordinary achievements of DEP's land acquisition program since its inception, particularly considering its willing seller/ willing buyer philosophy that relies on the volition of local landowners. The City will only pursue land that owners choose to make available.

During the term of the 2002 FAD, DEP has more than doubled the acreage protected in the Catskill/Delaware watershed, increasing lands and easements covered from 33,700 acres to 75,215, purchased from more than 900 landowners.

- **Waterfowl Management Program** – DEP's Waterfowl Management Program (WMP) was established in 1992 to measure the level and impact of pollution – specifically, fecal coliform – by avian wildlife on the City's water supply. 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 SWTR's stringent standards. Bird hazing efforts have been very successful where implemented. Despite a few exceedances due to minor sea-

sonal elevations of both birds and bacteria, DEP has remained in compliance with the federal rule stating values should not exceed 20 CFU (fecal coliform forming unit/100ml water sample) more than 10% over a 6-month running average.

- **Wastewater Treatment Plant (WWTP) Upgrades** – By 2002, DEP had completed the \$240 million upgrades of six City-owned wastewater treatment facilities that account for 40% of the WWTP flow in the west of Hudson watersheds using technologies that include phosphorus removal, sand filtration, back-up power, back-up disinfection, microfiltration or an approved equivalent, flow metering and alarm telemetering. There are 34 non-City-owned WWTPs in the Catskill/Delaware watershed that produce the remaining 60% of the WWTP flow in the west of Hudson watershed. As of mid-September 2006, 96% of the total flow has been upgraded. DEP expects to complete work on these last facilities by the end of 2008.

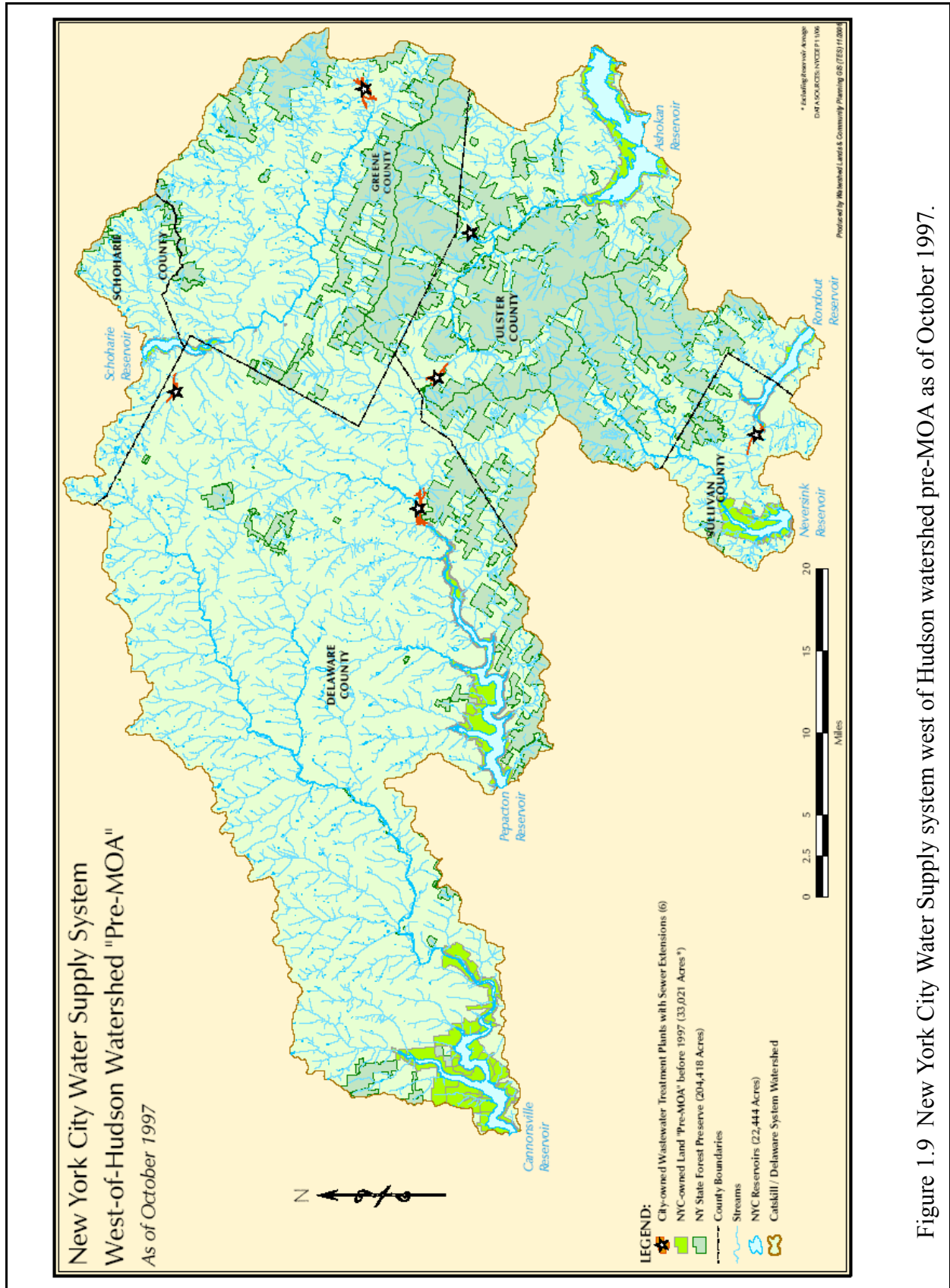


Figure 1.9 New York City Water Supply system west of Hudson watershed pre-MOA as of October 1997.

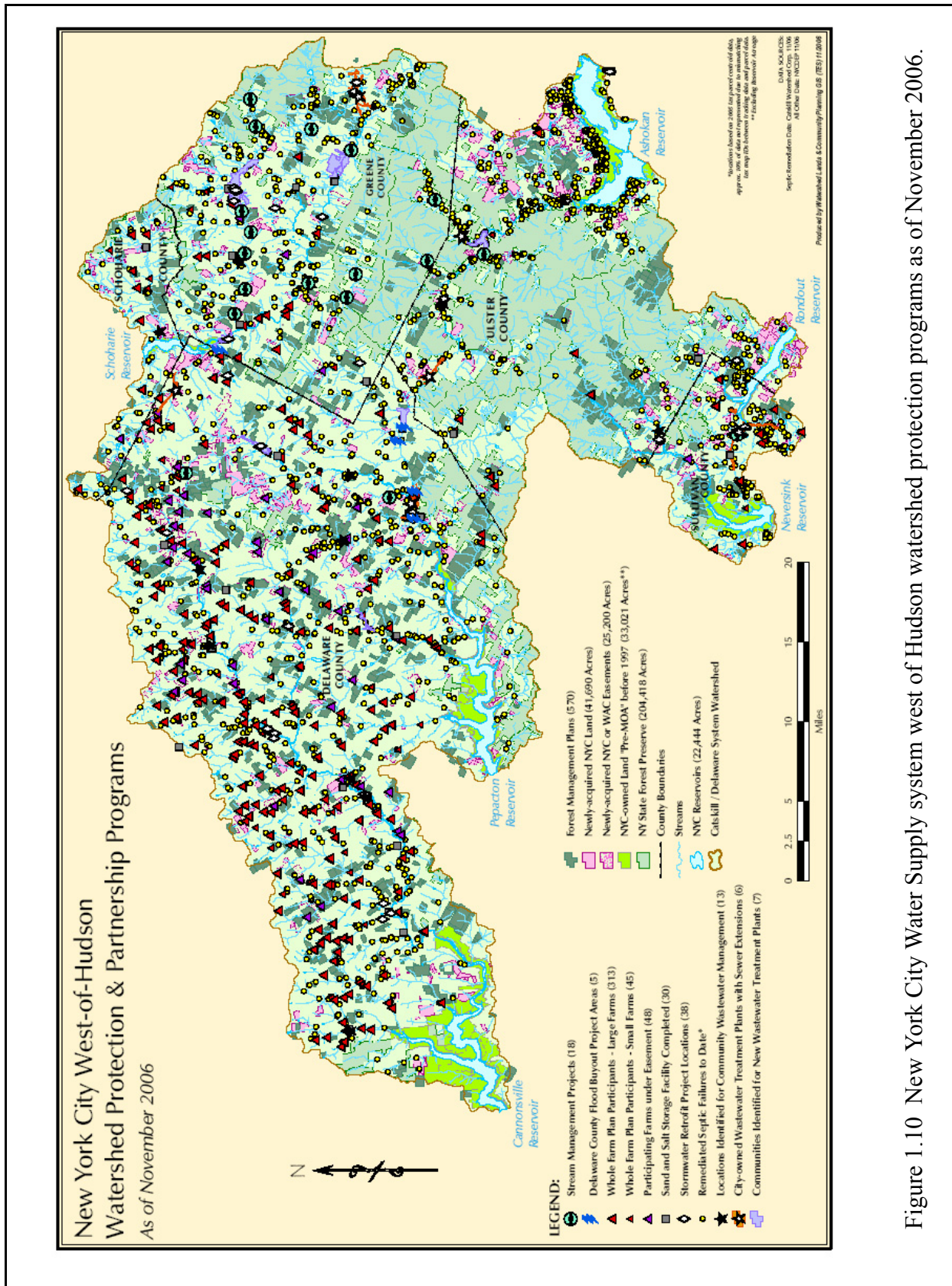


Figure 1.10 New York City Water Supply system west of Hudson watershed protection programs as of November 2006.

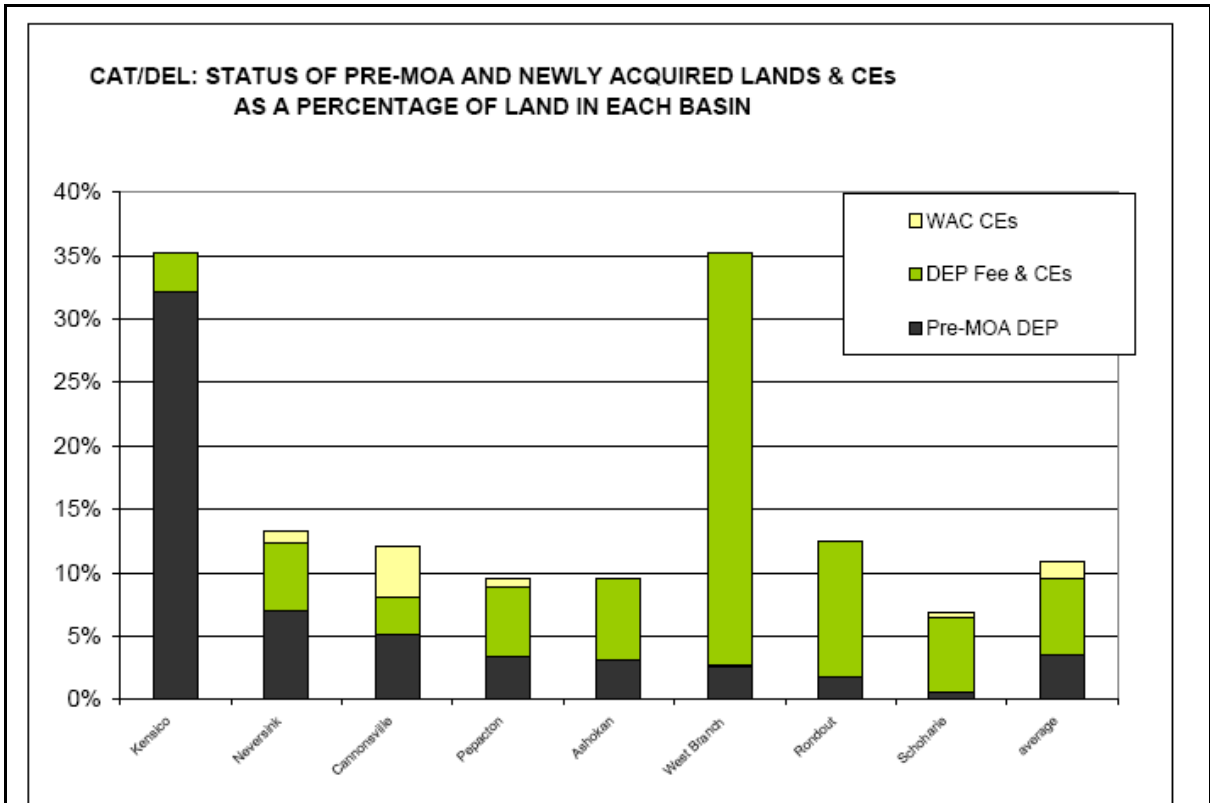


Figure 1.11 Cat/Del: Status of pre-MOA and newly acquired land and CEs as a percentage of and in each basin.



Figure 1.12 This wastewater treatment plant serving the Village of Hunter was constructed with funding from the City under the auspices of the New Infrastructure Program.

- **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 1997, DEP has built 13 stream restoration projects in the watershed. Since the 2002 FAD, the SMP and its partners have completed six Stream Management Plans that cover one-third of the west-of-Hudson watershed. Three additional plans will be completed by 2007, bringing the total area covered by the SMP to 65% of the Catskill/Delaware watershed west of the Hudson. DEP’s partners in the SMP include county Soil and Water Conservation Districts, 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 seven new wastewater treatment plants in seven communities. Four communities have completed WWTPs: Roxbury, Andes, Windham and Hunter (see Figure 1.12). The remaining three, Fleischmanns, Phoenicia and Prattsville are expected to be functioning by late 2008. New York City is committed to pay a significant portion of the operation and maintenance costs of these facilities in perpetuity. 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



Figure 1.13 Brian McIntosh, operator of the new Bovina Community Septic System, at the control panel, where flow from the settling tanks is directed to twelve leach fields. *Photo courtesy of Catskill Watershed Corporation*

Five communities – Bovina, Bloomville, Boiceville, Hamden and Delancey – are the City’s partners in the Community Wastewater Management Program, for which DEP has provided more than \$16 million to date. Each community is working on a wastewater project intended to provide more reliable treatment and eliminate dependence on often failing individual septic systems. Bovina, which opted to construct a community septic system, is the first project to be completed.

Sewer extensions in the Towns of Neversink, Roxbury, Middletown, Shandaken and the Villages of Margaretville and Hunter are expected to be completed by the end of 2010.

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** – The 1997 MOA required the City to explore the use of its newly-acquired lands for recreational purposes. DEP has certainly fulfilled that commitment, launching a far-reaching and growing recreational use program that to date has 102,000 registered Access Permit holders. Working closely with local planning boards and the Sporting Advisory Committees constituted by the MOA, the City has quadrupled the acreage open for recreational activities available on its water supply lands. In 1997, little more than 10,000 acres of City-owned lands were open for deer hunting only. Today, almost 43,000 acres are available for a much enhanced selection of recreational activities including hunting, hiking, birding, snowshoeing and other uses.

Currently, a pilot program for small game, turkey and bear hunting is being implemented on select parcels and, if successful, is expected to be expanded to other City-owned lands. In addition, DEP and two Delaware County snowmobiling clubs have reached agreement to allow snowmobiling on several City-owned parcels that abut State-owned lands. If successful, this initiative, too, may be expanded. To support its recreation programs, DEP produces a twice-yearly newsletter sent to all Access Permit holders and recently began an online system of permit issuance. All of the enhancements to the program are the result of extensive meetings with local residents and other recreational users.

- **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 Watershed Agricultural Council, the City funds development of farm plans and implementation of structural and non-structural best management practices. To date, more than 95% of watershed farms have signed up to participate in the program. In addition, the City has augmented the program with the addition of 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 best management practices critical to water quality protection.

DEP's Long-Term Program

Over the past 15 years of watershed protection, the City has developed and implemented an enhanced, comprehensive long-term program that forms the basis for its application for a continued filtration waiver. DEP's plan for the next five years is outlined in the next section of the document. The proposed program represents the 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 15 years of has been the development of vital, locally-based organizations working with the 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 Catskill Watershed Corporation, the Watershed Agricultural Council, county Soil and Water Conservation Districts, EPA, and the New York State Departments of Health and Environmental Conservation 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.

2. Long-Term Watershed Protection Program

On the following pages are program-by-program write-ups that provide brief summaries and detailed milestone commitments for the next phase of the City's long-term program. DEP has divided the Five-Year Plan into a number of major sections, including SWTR Objective Compliance; Environmental Infrastructure; Protection and Remediation Programs; Watershed Monitoring, Modeling and GIS; Regulatory Programs; Filtration Planning and Enhanced Disinfection; In-City Programs; Administration; Education and Outreach; and Reporting.

2.1 SWTR Objective Compliance

Under the SWTR, in order to qualify for a waiver from the filtration requirement, a water supplier must meet certain objective water quality criteria. The SWTR requires compliance with certain source water criteria (coliforms and turbidity levels) and disinfection standards (inactivation requirements, maintenance of chlorine residual, disinfection system redundancy and other requirements). In addition, a supplier must meet the Total Coliforms Rule (TCR) and the Disinfectant and Disinfection By-products Rule (D/DBPR).

Through the term of the next five years, the City will continue to sample in accordance with applicable rules to demonstrate compliance with the objective criteria. The City will report sampling results monthly, with the exception of trihalomethane results, which are reported quarterly, and cross connection reports that are submitted semi-annually.

Distribution system chlorine residual monitoring results are reported monthly. DEP will continue to monitor chlorine residual results and will inform EPA if appropriate residual levels are not maintained throughout the system and what DEP is doing to remediate the situation.

<i>Activity and Reporting Milestones</i>	<i>Due Date</i>
Continue to meet SWTR Objective Criteria – Provide monthly reports on raw water fecal coliform concentrations, raw water turbidity, raw water disinfection CT values, operational status of Kensico and Hillview disinfection facilities, entry point chlorine residuals, distribution system disinfection residuals and distribution system coliform monitoring	Monthly
Submit reports on trihalomethane monitoring results	Quarterly

2.2 Environmental Infrastructure

DEP will continue supporting core environmental infrastructure programs throughout the Catskill/Delaware watershed during the next five years.

Since the 1997 MOA/FAD, DEP has worked closely with the Catskill Watershed Corporation (CWC) and local communities to develop and implement programs to maintain and enhance core environmental infrastructure in the west of Hudson watershed, including septic systems, waste-

water treatment plants, and stormwater controls. These core environmental infrastructure areas together address some of the most significant anthropogenic sources of pollution in the watershed. Control of the pollution sources in these areas means creation and management of infrastructure systems. DEP's continuing support of these programs fosters tangible on- and in-the-ground results offering long-term pollution prevention.

2.2.1 Septic Programs

Due to the relatively low density of development in the west of Hudson watershed, septic systems are the primary means of sanitary treatment/disposal. There are approximately 22,000 residential septic systems throughout the watershed. Because many of these systems are older and were not designed and installed in accordance with current regulations, and/or are situated on small parcels with poor soils, they are prone to failure, posing a water quality threat.

Pollutant concentrations found in raw sewage are reduced as settling and biological activity occur in septic tanks and are further diminished in the soil absorption system. Properly functioning septic systems reduce the following pollutants of concern: biological oxygen demand, phosphorus, nitrogen, suspended solids, fecal coliform, bacteria, *Giardia lamblia* and viruses.

Septic Rehabilitation and Replacement Program

The 1997 MOA established the Septic Rehabilitation and Replacement Program. The objective of the program was to facilitate identification and remediation of failed or likely to fail septic systems posing the high potential to contaminate the City's drinking water supply. More than 2,300 septic systems have been replaced or repaired under the program to date.

For the term of the Long Term Watershed Protection Plan, DEP is prepared to fund additional activity in the basic Septic Rehabilitation and Replacement Program. Generally, CWC and DEP will continue the approach of focusing on priority areas embodied in CWC's current program rules. The funding level will essentially allow CWC to advance the program to address the historical maximum physical capacity for area system installers, approximately 300 systems per year. DEP will work with CWC to amend program rules to allow funding to be used for needed cluster systems.

<i>Activity and Reporting Milestones</i>	<i>Due Date</i>
Execute contract with CWC in support of the Septic Rehabilitation and Replacement Program that includes funding sufficient to address approximately 300 septic systems per year	11/30/2007
Amend Septic Program contract and/or rules to allow funding to be used for needed cluster systems	11/30/2007
Utilizing existing information from both in-house and watershed partner sources, identify areas/small hamlets, within current septic priority areas, that may be candidates for / in need of cluster systems	12/31/2007
Determine feasibility and install cluster systems as appropriate	On-going

<i>Activity and Reporting Milestones</i>	<i>Due Date</i>
Re-assess the adequacy of program funding to address the identified need	7/1/2009
Report on implementation of the Septic Rehabilitation and Replacement Program including cluster systems	Semi-annually
Report on the number and location of areas/hamlets, within current septic priority areas, that are potential candidates for cluster system	12/31/2007
Report on the adequacy of program funding to address outstanding/remaining cluster system areas	7/1/2009

Septic System Maintenance Program

Proper septic maintenance is important in prolonging the life and optimizing the function of a septic system. A key component to avoiding septic failure is periodic tank pumping. Without periodic pumping, sludge and scum layers become too thick and solid materials may flow from the septic tank into the leach field, clogging the pipes and soils and causing the system to fail. Routine maintenance prevents groundwater pollution and surfacing effluent. While the cost of repairing or replacing a septic system can be expensive, the effort and expense of routine maintenance is relatively minor.

The Septic System Maintenance Program, administered by CWC, is a voluntary program intended to reduce the occurrence of septic system failures through regular pump-outs and maintenance. CWC adopted program rules in October 2003. Under the rules, CWC pays 50% of eligible costs for pump-outs and maintenance. Another component of the program is the development and dissemination of septic system maintenance educational materials.

The Septic System Maintenance Program is intended to encourage homeowners to have their septic systems pumped on a regular basis – every three to five years. In 2005, CWC included Septic System Maintenance Program information in its revised septic programs brochure available for general distribution. An increase in program participation is expected as the date from system repair/ replacement extends from three years to five years.

In the next five years CWC will continue to fund 50% of septic pump-outs to qualified properties in order to enhance the functioning and reduce the incidence of failures of septic systems throughout the west of Hudson watershed. DEP will also work with CWC to establish a mechanism to allow funding to be used for pump-outs for cluster systems.

<i>Activity and Reporting Milestones</i>	<i>Due Date</i>
Work with CWC on continuation of and enhancements to the program	Ongoing
Work with CWC to modify program rules to include pump-outs for septic systems in clusters systems	6/30/07
Report on implementation of Septic Maintenance Program	Semi-annually

Sewer Extension Program

Paragraph 123 of the MOA provides for the design and construction of sewer extensions to service areas of City-owned wastewater treatment plants in the west of Hudson watershed. The purpose of the Sewer Extension Program is to protect the quality of the City’s water supply by connecting existing residences and businesses to the sewer system in areas where onsite septic systems are either failing or are likely to fail.

In the next five years, DEP intends to complete projects at Neversink, Grand Gorge, Margaretville/Middletown and Pine Hill, and new sewer lines in the Village of Hunter’s Showers Road area.

<i>Activity and Reporting Milestones</i>	<i>Due Date</i>
Grand Gorge Sewer Extension – Construction Complete	12/31/07
Neversink Sewer Extensions. – Construction Complete	12/31/08
Margaretville/Middletown Sewer Extensions – Construction Complete	12/31/09
Pine Hill Sewer Extension – Construction Complete	11/30/08
Planned Sewer Extension Along Showers Road in V. of Hunter – Construction Complete	11/30/10
Report on implementation of the Sewer Extension Program	Semi-annually

Alternate Design Septic Program

The purpose of the Alternate Design Septic Program is to assist west of Hudson homeowners to fund eligible incremental compliance costs of the WR&Rs (Watershed Rules and Regulations) septic provisions to the extent they exceed State and federal requirements with available program funding through the FAD term.

<i>Activity and Reporting Milestones</i>	<i>Due Date</i>
Continue funding the eligible incremental compliance costs of the WR&R septic provisions to the extent they exceed State and federal requirements with available program funding through the FAD term	Ongoing
Report on the implementation of program	Annually

Other Septic Programs

East of Hudson, DEP will initiate a septic repair program in the Kensico Reservoir basin based on results of an existing house to house survey. In addition, DEP will assist Putnam County to implement a septic repair program. For more details on these initiatives please refer to sections 2.3.9 and 2.3.10.

2.2.2 New Sewage Treatment Infrastructure Program

The New Sewage Treatment Infrastructure Program, also referred to as the New Infrastructure Program, is described in Paragraph 122 of the MOA. Over the next five year period, the New Sewage Treatment Infrastructure Program will complete projects in Fleischmanns, Phoenicia, Prattsville and Hubble’s Corner.

<i>Activity and Reporting Milestones</i>	<i>Due Date</i>
Execute contract changes with EFC and CWC in support of the program that include funding level sufficient to complete projects at Phoenicia per MOA and contract terms	9/30/07
Construction complete for Prattsville and Fleischmanns	11/30/07
Shandaken executes construction contract for Phoenicia project	4/30/07
Construction complete for Phoenicia	11/30/10
Execute Contract for Hubble’s Corner Project	12/31/07
Design Complete for Hubble’s Corner Project	6/30/09
Construction Complete for Hubble’s Corner Project	12/31/11
Report on implementation of the New Sewage Treatment Infrastructure Program	Semi-annually

2.2.3 Community Wastewater Management Program

The Community Wastewater Management Program (CWMP) provides funding for the design and construction of community septic systems, including related sewerage collection systems, and/or the creation of septic maintenance districts, including septic system replacement, rehabilitation and upgrades as well as operation and maintenance of the district, in up to five identified communities. Additional CWMP funding was provided by DEP in 2006.

CWMP Rules were approved by CWC in February 2004. As spelled out in the program rules, an engineering firm retained by CWC works with each of the participating communities to determine the appropriate wastewater project, develop engineering plans, assist in the formation of septic districts and the adoption of sewer use laws, advertise for bids, manage construction and establish an operation and maintenance plans.

CWC sent out CWMP solicitation letters to five identified communities (Bloomville, Boiceville, Hamden, Delancey, and Bovina Center) in early April 2004. (Bovina Center and Hamden had already begun community wastewater projects with grant funding secured from other sources). By June 2004, all five communities had responded affirmatively regarding their participation in the program and a request for proposals for the CWMP engineering consultant was issued.

In the next five years the CWMP will complete projects at Bloomville, Boiceville, Hamden, Delancey, and Ashland. The City will also initiate and complete design for two additional communities and initiate a third as identified below.

<i>Activity and Reporting Milestones</i>	<i>Due Date</i>
Execute contract changes with CWC in support of the Community Wastewater Management Program that include funding sufficient to complete projects at Bloomville, Boiceville, Hamden, Delancey, Ashland and to complete design in two additional communities	9/30/07
Design complete for Bloomville, Boiceville, Hamden, Delancey	5/31/07
Construction complete for Bloomville, Boiceville, Hamden, Delancey	11/30/09
Study complete for Ashland	12/31/07
Design complete for Ashland	12/31/08
Construction complete for Ashland	6/30/11
Study complete for two additional communities	12/31/09
Design complete for two additional communities	12/31/10
Start construction for two additional communities ¹	6/30/11
Construction complete for two additional communities	6/30/13
Study complete for third additional community	6/30/10
Design complete for third additional community	6/30/11
Start construction for third additional community ¹	12/31/11
Construction complete for third additional community	12/31/13
Report on implementation of the Community Wastewater Management Program	Semi-annually

¹ DEP intends to fund construction of these facilities unless, through the midcourse review process, the primacy agency or DEP concludes that there are substantial impediments to continued filtration avoidance after 2012.

2.2.4 WWTP Upgrade Program

The Wastewater Treatment Plant Upgrade Program has made great progress toward achieving the goals of watershed protection. Efforts of the west of Hudson projects are drawing to a close. As of 2006, only 4% of flow west of Hudson remains to be upgraded. The upgrade of non-City-owned Catskill and Delaware existing WWTPs is divided into two distinct components: Regulatory Upgrades and SPDES Upgrades. Although created under the MOA as two separate programs, the Upgrade Agreements between EFC and the WWTP owners encompass both Regulatory Upgrades and, as applicable, SPDES Upgrades.

The Regulatory Upgrade Program is designed to bring each WWTP into compliance with the Watershed Rules and Regulations. DEP, with the assistance of EFC, administers a program of designing, permitting, constructing and installing Regulatory Upgrades at all non-City-owned WWTPs and disbursing City funds for these activities. Treatment technologies required by the

Regulatory Upgrade Program include, but are not limited to, phosphorus removal, sand filtration, back-up power, back-up disinfection, microfiltration (or approved equivalent), flow metering and alarm telemetering.

The WWTP Upgrade Program also counts as one of its goals completion of the regulatory upgrades of Croton Falls and Cross River Basins WWTPs. 80% of the flow is currently under construction.

DEP will complete WWTP upgrades per the following schedules.

Table 2.1. Schedule of West of Hudson WWTP Upgrades.

<i>WWTP</i>	<i>PUP Approval</i>	<i>FUP Approval</i>	<i>Construction Start Up</i>	<i>M9 Functional Completion</i>	<i>Flow MGD</i>
1. Bataviakill Recreation Area ¹	2 nd Qt 2007	4 th Qt 2007	2 nd Qt 2008	2 nd Qt 2009	0.005
2. Camp Nubar ²	Completed	Completed	Completed	2 nd Qt 2007 4 th Qt 2007	0.0125
3. Camp Oh-Neh-Tah	3 rd Qt 2008	4 th Qt 2008	1 st Qt 2009	2 nd Qt 2010	0.0075
4. Crystal Pond	3 rd Qt 2007	4 th Qt 2007	1 st Qt 2008	1 st Qt 2009	0.036
5. Elka Park	Completed	Completed	Completed	4 th Qt 2007	0.010
6. Mountain View Estates #1 & #2	Completed	Completed	Completed	3 rd Qt 2008	0.013
7. Olive Woods	Completed	1 st Qt 2007	3 rd Qt 2007	4 th Qt 2008	0.0127
8. Onteora Central School Dist. ³					0.027
9. SEVA Institute	4 th Qt 2006	1 st Qt 2007	3 rd Qt 2007	4 th Qt 2008	0.0078
10. Whistle Tree	Completed	Completed	4 th Qt 2006	3 rd Qt 2007	0.0125

¹ This schedule is for a “Stand Alone Upgrade.” If “Hold & Haul” is implemented Functional Completion will be sooner.

² Weather could effect completion date. Camp will not allow construction between June and the end of August; therefore two Functional Completion dates are listed.

³ Project on hold pending approval of the Boiceville wastewater treatment project. In the interim DEP will provide SPDES dollars, if available, to address any sand filter breakouts. This facility will be connected to the Boiceville WWTP within six months after the Boiceville WWTP is operational.

Table 2.2. Schedule of East of Hudson WWTP Upgrades.

<i>WWTP</i>	<i>PUP Approval</i>	<i>FUP Approval</i>	<i>Construction Start Up</i>	<i>M9 Functional Completion</i>	<i>Flow MGD</i>
1. Carmel SD#2 ¹	Completed	Completed	Completed	2 nd Qt 2007 4 th Qt 2007	1.100
2. Fulmar Road Elementary School ²	4 th Qt 2006 1 st Qt 2008	2 nd Qt 2007 2 nd Qt 2008	1 st Qt 2008 4 th Qt 2008	3 rd Qt 2008 3 rd Qt 2010	0.019
3. Lake Plaza & Ralph Morando Building ³	(see below) 1 st Qt 2008	(see below) 2 nd Qt 2008	(see below) 4 th Qt 2008	(see below) 1 st Qt 2010	0.0218
4. Lewisboro Elementary School	2 nd Qt 2007	4 th Qt 2007	2 nd Qt 2008	3 rd Qt 2009	0.010
5. Meadows at Cross River	2 nd Qt 2007	4 th Qt 2007	2 nd Qt 2008	3 rd Qt 2009	0.059
6. Michelle Estates	2 nd Qt 2007	4 th Qt 2007	2 nd Qt 2008	3 rd Qt 2009	0.060
7. The Fairways/Hill & Dale	2 nd Qt 2007	4 th Qt 2007	2 nd Qt 2008	3 rd Qt 2009	0.065
8. Waccabuc Country Club	4 th Qt 2007	2 nd Qt 2008	4 th Qt 2008	2 nd Qt 2010	0.008

¹ 2nd Qt 2007 Functional Completion date is for the Regulatory Upgrade. The 4th Qt 2007 date includes UV installation which is an August 28, 2006 add on. The completion of the UV installation could delay the project engineer from issuing the Functional Completion certification until the 4th Qt 2007.

² Two schedules have been provided: connection to the DEP Mahopac WWTP (earlier dates) and a "Stand Alone Upgrade."

³ Stated schedule is for a "Stand Alone Upgrade." If alternative project (connection to DEP Mahopac WWTP) is selected, the City will coordinate with the Town of Carmel on a sewer extension and shall complete connection no later than the first quarter of 2010.

<i>Activity and Reporting Milestones</i>	<i>Due Date</i>
Complete construction/Functional Completion of remaining Catskill and Delaware WWTPs (see Table 2.1)	Ongoing
Complete construction/Functional Completion of Croton Falls and Cross River Basins WWTPs (see Table 2.2)	Ongoing
WWTP Upgrade Program – Report on all components of program. If a milestone is missed or anticipated to be missed, provide an explanation for the delay or anticipated delay and actions taken or to be taken to bring the facility back on schedule	Quarterly
West of Hudson Wastewater Treatment Plant (WWTP) Upgrade Program Monthly Progress Report	Monthly

2.2.5 Stormwater Programs

Stormwater Cost-Sharing Programs

The Future Stormwater Controls Program pays for the incremental costs of stormwater measures required solely by the New York City Watershed Rules and Regulations above State and federal requirements. It provides funds for the design, construction and maintenance of stormwater measures included in stormwater pollution prevention plans and individual residential stormwater plans for new construction after May 1, 1997.

The Program is administered by CWC and reimburses municipalities and large businesses 100% and small businesses 50% for eligible costs. To date, CWC has funded over \$2.3 million stormwater BMPs and allocated \$103,750 in maintenance funding. CWC has also, pursuant to contract terms, transferred \$9,455,000 to other eligible watershed protection programs. The Future Stormwater Controls Program also funds certain maintenance costs of projects pursuant to terms of the MOA and program contracts.

Paragraph 145 of the MOA establishes a separate program known as The Future Stormwater Controls Paid for by the City (the City program), which provides for payment of design, implementation and maintenance costs required by the WR&Rs beyond the requirements of State and federal law for single family houses, small businesses, and low income housing. This program is administered by the City. In particular, the City program provides full funding for eligible costs for Individual Residential Stormwater Permits (IRSPs) for certain single family homes, and for Stormwater Pollution Prevention Plans (SPPPs) for publicly-subsidized low income housing, and 50% funding for SPPPs for small businesses.

<i>Activity and Reporting Milestones</i>	<i>Due Date</i>
Continue funding the eligible incremental compliance costs of the WR&R stormwater provisions to the extent they exceed State and federal requirements with available Future Stormwater Controls Program funding	Ongoing
Report on the Future Stormwater Controls Program implementation including stormwater controls paid for by the City for single family houses, small businesses, and low income housing program	Annually

Stormwater Retrofit Program

The Stormwater Retrofit Program is administered jointly by CWC and DEP. The goal of the program is to continue funding the installation of stormwater best management practices; community-wide stormwater infrastructure assessment; and planning and the installation of stormwater best management practices throughout the west of Hudson watershed through the FAD term.

CWC currently maintains an open application timetable for construction grant project applications, evaluating each application as it is submitted, but gives funding preference to construction grant project applications where a Planning and Assessment contract has already been success-

fully completed or where a New Infrastructure Program project or Community Wastewater Management Program project is in progress. Required “local share” contribution has been reduced from 25% to 15%. In New Infrastructure and Community Wastewater Management project areas, the local share requirement has been eliminated to promote the synergistic effect.

DEP proposes in the next five years to finance the Stormwater Retrofit Program sufficiently to sustain the historical project activity level in the program.

<i>Activity and Reporting Milestones</i>	<i>Due Date</i>
Continue funding the installation of stormwater best management practices; community-wide stormwater infrastructure assessment and planning; and the installation of stormwater best management practices throughout the west of Hudson watershed through the FAD term. Continue to explore ways of expanding the program	Ongoing
Report on the implementation of stormwater best management practices, the implementation of community-wide stormwater infrastructure assessment and planning program, and efforts to expand the program	Semi-annually

East of Hudson, DEP expects to implement several stormwater projects as well. Details on both these efforts can be found in Section 2.3.9 of this report.

2.3 Protection & Remediation Programs

2.3.1 Waterfowl Management Program

DEP’s Waterfowl Management Program (WMP) was established to quantify and reduce the level of pollutant impact associated with avian wildlife on the New York City water supply. The management of waterbird populations at coliform-restricted reservoirs throughout the New York City water supply is essential to meet stringent water quality regulations as stated in the SWTR.

The WMP was designed to study the relationship between spatial and temporal trends in bird populations on the reservoirs and trends in fecal coliform concentrations both within the reservoir and at the regulatory sampling locations. The monitoring of waterbird populations began in 1992, under the direction of an in-house wildlife biologist. Bird fecal samples and water samples were analyzed by DEP microbiologists and used to identify birds as a significant source of fecal coliform at the Kensico Reservoir. In an attempt to eliminate these waterbird populations from the reservoir system, DEP implemented standard bird population management techniques approved by the United States Department of Agriculture Wildlife Services (USDA) and DEC. Bird dispersal and deterrent techniques began in 1993 resulting in a dramatic reduction in both bird populations and fecal coliform levels, thus maintaining high quality water in compliance with SWTR.

Over the next five years DEP intends to actively continue bird harassment at Kensico Reservoir as well as harassment at West Branch, Rondout, Ashokan, Croton Falls, Cross River and Hillview Reservoirs on an “as needed”* basis. Avian deterrent measures, such as egg depredation at reservoir shoreline areas and the installation of bird exclusion wires and netting at critical intake chambers, will also be implemented.

<i>Activity and Reporting Milestones</i>	<i>Due Date</i>
Active Bird Harassment – Kensico Reservoir	8/1 to 3/31; Annually
“As needed” ¹ Bird Harassment – West Branch, Rondout, Ashokan, Croton Falls, Cross River and Hillview Reservoirs	8/1 to 4/15; Annually
Avian Deterrent Measures – Kensico, West Branch, Rondout, Ashokan, Croton Falls, Cross River, Hillview Reservoirs and other City reservoirs, as needed	Year-round; Annually
Submit annual summary of Waterfowl Management Program activities including contract status, and implementation and analysis of all program elements (including special studies)	7/31; Annually

¹ The term “as needed” refers to active bird harassment measures implemented 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 colony-forming units at reservoir effluent structures coincident with elevated bird populations;
- Recent weather events;
- Operational flow changes within the reservoir (i.e., elevations and flow patterns and amounts);
- Reservoir ice coverage and watershed snow cover; and
- Determination that active bird management measures would be effective in reducing bird populations and fecal coliform bacteria levels.

2.3.2 Land Acquisition

The Land Acquisition Program (LAP) seeks to prevent future degradation of water quality by acquiring sensitive watershed lands. The MOA requires the City to contact landowners of 355,050 acres of eligible watershed land in the most sensitive areas of the Catskill / Delaware system over 10 years ending January 21, 2007. Interested landowners are offered fair market value as determined by independent appraisers hired by the City; either fee or conservation easements may be acquired by the City. Landowner participation in the program is completely voluntary – the City will acquire land under the program only from willing sellers. The City pays property taxes on all real property interests acquired; for conservation easements, taxes are assessed at a level equal to the ratio of the easement to the overall property value as if unimproved.

As of 1997, 36,047 acres of land (3.5%) in the Cat/Del watershed were owned by New York City (an additional 25,743 acres, or 2.5%, are reservoirs, and roughly 212,000 acres are protected by other entities such as DEC). Of the remaining 777,000 acres of privately held land, the City was required to solicit 355,050 acres during the first eight years of the program. Acreage to be solicited was determined by estimating the eligible land and applying the requirements of MOA Para-

graph 65, which reflect different intensities of solicitation according to the importance of each Priority Area. For example, the City was to solicit 95% of all eligible land in Priority 1A/B and 50% of all eligible land in Priority 4. As of December 2004, the solicitation deliverable - contacting the owners of 355,505 acres - was met. As of October 31, 2006, watershed-wide solicitation and resolicitation efforts have resulted in the City securing 63,343 acres in fee simple or conservation easement, with another 14,276 acres of farm easements secured by the Watershed Agricultural Council. This represents a tripling of lands held by the City for watershed protection as of 1997 - the majority of these are considered high quality properties that would have been otherwise threatened with development. The success of the program to date suggests that more properties can be secured, and that land acquisition should continue to play a role in long-term protection of the Cat/Del system.

Over the next five years, DEP intends to ensure the success of the LAP by continuing to solicit new landowners and resoliciting previously contacted landowners.

<i>Activity and Reporting Milestones</i>	<i>Due Date</i>
Reevaluate solicitation ¹ plan for 2007; WAC acreage to be included. Revised plan(s) will include at least 50,000 acres to be solicited annually	1/1/07
Reevaluate solicitation plan for 2008-10; WAC acreage to be included. Revised plan(s) will include at least 50,000 acres to be solicited annually	10/1/07
Reevaluate solicitation plan for 2011-12; WAC acreage to be included. Revised annual plan(s) will include at least 50,000 acres to be solicited annually	10/1/10
Review any monies remaining in the 'Supplementary Fund' (currently \$23m) until depleted; make recommendations to EPA to allocate up to an aggregate total of \$30 million in new funds to support program during period of 2007-2012	Annually in December
Consult with EPA regarding the potential need for any additional monies beyond that already committed overall to Land Acquisition; if such funding is agreed to, sequester the funds	As needed
Request ten-year extension of Water Supply Permit from DEC	1/21/10
Secure \$20 million to be allocated and available for land acquisition under the 2012 Filtration Avoidance Determination ²	1/31/12
Report Semi-annually	Due 8/1 for reporting period 1/1 – 6/30 and due 2/1 for reporting period 7/1 – 12/31

¹ "Solicitation" as used herein includes (1) newly solicited land (contacts with owners of land that was previously unsolicited) as well as (2) resolicited land (contacts with owners of land that has been previously solicited).

² DEP intends to allocate funds for continuation of the Land Acquisition Program, provided that such a program is authorized by a

DEC Water Supply Permit, unless, through the midcourse review process, the primacy agency or DEP concludes that there are substantial impediments to continued filtration avoidance after 2012.

2.3.3 Land Management

In 1998, the City owned 84,000 acres of water supply lands, but by 2012 this landholding is expected to be as many as 150,000 acres in fee and 20,000 acres in easements. An outcome of acquiring tens of thousands of acres of water supply lands is the need for a comprehensive, long-term approach for their care and protection. While it is often assumed that the control of activities harmful to a water supply is best achieved when the water supply operators have direct ownership of contributing lands, this is only the case if those lands are subsequently well-managed. The Land Management Program exists to provide effective and professional management of the City's water supply lands and conservation easements to meet the goals of the City, including filtration avoidance. This management approach has six major areas of concentration:

- *Property Management* – ensuring the protection of the City's water supply lands through regular monitoring and inspection, maintenance of property boundaries, resolution of encroachments, diminishment of hazards, maintenance of access, and addressing inquiries about the properties.
- *Natural Resources* – managing the forests, agricultural fields, soil, water, wildlife, and landscapes on City water supply lands to best protect the water supply and the City's interests.
- *Recreational Use* – sharing the outstanding opportunities on City water supply lands with the general public for fishing, hunting, and hiking through the issuance of access permits, hunting tags, and boat tags to interested users.
- *Land Use Permits* – granting permissions to outside parties for use of the City's water supply lands for specified purposes such as driveways, utilities, landscapes, and developed recreation areas.
- *Land Acquisition Assistance* – advising the Land Acquisition Program on property acquisitions, completing environmental site assessments, preparing sites for closing, communicating information about acquisitions to municipalities, putting together baseline documentation on conservation easements, and reviewing title issues.
- *Conservation Easements* – monitoring the City's watershed conservation easements, promoting water quality protection, and addressing issues with this subset of private watershed landowners.

The goals of the Land Management Section are to:

- Monitor and coordinate the use of the City's water supply lands to meet multiple objectives including water supply infrastructure, forest and soil health, stream protection, and community benefits such as recreational use.
- Bring the power of the City's GIS as decision-support to field level operations in a way that maximizes the effectiveness of the City's lands for filtration avoidance.
- Establish and maintain a goal-driven planning process for optimizing the contributions of the City's forest lands to the protection of water quality and public health.
- Continue to monitor and enforce the growing portfolio of City watershed conservation ease-

ments to ensure the long-term water quality benefits of these protected lands.

- Provide the primacy agency with the opportunity to review and comment on modifications to plans for land management.

<i>Activity and Reporting Milestones</i>	<i>Due Date</i>
Monitor water supply lands	Annually
Monitor and enforce watershed conservation easements	Annually
Maintain a watershed land information system	Annually
Develop a forest management plan	11/30/2010
Provide the primacy agency opportunities to review and comment on modifications to plans for land management	As modifications are made to such plans
Annual report on all aspects of land management	Annually
Reports on modifications to plans for land management	Ongoing

2.3.4 Watershed Agricultural Program

The Watershed Agricultural Program (WAP) has operated since 1992 as a comprehensive effort to develop and implement pollution prevention plans on 85% of the commercial farms in the City’s Catskill/Delaware watershed. The program is a voluntary partnership between the City and farmers in the watershed to manage nonpoint sources of agricultural pollution, with particular emphasis on waterborne pathogens, nutrients, and sediment. In addition, the program incorporates the economic and business concerns of each farm into the development of its Whole Farm Plan in order to fully integrate the principles and goals of pollution prevention into the farm operation.

Funded primarily by DEP, the program is administered by the not-for-profit Watershed Agricultural Council (WAC), whose board consists of farmers, agri-business representatives, forest landowners and the DEP Commissioner. Over time, the City and WAC have been able to leverage generous financial support from other sources to enhance the program, particularly the US Department of Agriculture, EPA, and Army Corps of Engineers. Local, State, and federal agricultural assistance agencies provide planning, technical, educational, engineering, scientific and administrative support for the program under sub-contractual agreements with WAC.

The Watershed Agricultural Program strives to maintain and protect the existing high quality of the water supply system from agricultural nonpoint source pollution through the planning and implementation of BMPs on farms. When possible, the program uses traditional BMPs that are proven to protect and enhance source water quality, and, if necessary, to employ and evaluate innovative BMPs to increase the number of alternatives available to farmers to address "non-traditional" agricultural water pollution concerns, especially waterborne pathogens. Over 85% of large commercial farms participate in the program. An increasing number of “small” farms, many with significant acreage and potential impact on water quality, are volunteering.

Through the next five years, the primary goals of the Watershed Agricultural Program are to:

- Maintain a broad and high level of land and water stewardship by farmers and respond quickly and effectively to correct farm related pollution incidents.
- Maintain participation of actively managed farmland in program.
- Re-enroll expiring Conservation Reserve Enhancement Program (CREP) contracts for additional 10-15 year terms (contingent upon federal reauthorization, funding, re-enrollment policy).
- Solicit 200 new acres in CREP annually.
- Enroll participating farms in federal Conservation Security Program (CSP) with base and enhancement funding to support animal waste, nutrient and sediment management (contingent upon federal reauthorization, selection of Delaware watershed basins, funding).
- Maintain up-to-date Livestock Waste/Nutrient Management Plans on participating farms.
- Continue relationship and support to NYS Cattle Health Assurance Program (NYSCHAP); continue educational and outreach efforts to farmers on pathogen management; help facilitate pathogen research activities for evaluation and program support.
- Work towards the completion and implementation of priority BMPs in all Whole Farm and Nutrient Management Plans.

<i>Activity and Reporting Milestones</i>	<i>Due Date</i>
Support and monitor on-farm maintenance and operation of structural and non-structural BMPs on participating farms, including easement stewardship, and conduct annual status reviews on all farms with substantially implemented Whole Farm Plans	On-going/Annually
Selective, prioritized, cost-shared replacement of old, failed BMPs on participating farms, based on programmatic strategy	On-going/Annually
New/Revised Whole Farm Plans, including CREP (west of Hudson) <ul style="list-style-type: none"> •Pursue new Whole Farm Plans on approximately 12 existing “large” farms (farm income > \$10,000) not currently enrolled in program •Pursue Whole Farm Plans on 10 “small” farms (farm income > \$1,000) not currently enrolled in program. Complete a Small Farms Assessment Report to determine the number, extent and impact of small farms on water quality. 	On-going Annually
New/Revised Whole Farm Plans and Forest Management Plans in east of Hudson Watershed <ul style="list-style-type: none"> •Up to 10 new Whole Farm Plans/year with a minimum of 6 new Whole Farm Plans/year; prioritize for farms in West Branch/Boyd Corners, Kensico, Cross River, and Croton Falls basins •Forest Management (see Forestry Program goals, Section 2.3.5) 	On-going/Annually

<i>Activity and Reporting Milestones</i>	<i>Due Date</i>
Farmer Education and Outreach <ul style="list-style-type: none"> •Educational Program and curriculum to include: •Pathogen Management •Nutrient Management 	On-going/Annually
Farm Easements (see Land Acquisition, Section 2.3.2)	On-going/Annually
Comprehensive Annual Report of program activities and status review/evaluation, including plan for subsequent year, related research activities (City and non-City Funds), update on farm census, and comprehensive evaluation based on evaluation criteria	Annually (due 3/31)
Submit 5-year Plan	1/31/08
Programmatic Strategy for BMP Replacement of aging/ failing BMPs	7/31/08
Complete review of evaluation criteria	12/31/10
Small Farms Assessment Report	7/31/09

2.3.5 Watershed Forestry Program

The Watershed Forestry Program is a pollution prevention and educational partnership that supports well-managed working forests as a beneficial land cover for water quality protection. The program has been administered locally by the Watershed Agricultural Council (WAC) since September 1997.

Forests cover more than three-quarters of the watershed land area, and a similar majority of this land is privately held by thousands of individuals with diverse ownership goals and forest management objectives. However, watershed landowners face significant pressures to sell, parcelize or convert their forests to other, less-desirable land uses. In addition, the long-term ecological health of the watershed forests is increasingly threatened by a growing number of exotic invasive pests, plants and pathogens that are rapidly spreading towards/into the watershed from other parts of the State and region.

Through DEP’s partnership with the WAC, the Watershed Forestry Program helps to empower landowners with knowledge and resources to properly steward their forest resources; train forestry professionals to implement BMPs during forest management operations; and educate upstate/downstate audiences about the role of working watershed forests. Since the Watershed Forestry Program is voluntary, a good measure of success is the ongoing degree of program participation. Approximately 560 landowners have WAC forest management plans covering more than 100,000 watershed acres; approximately 1,500 loggers and foresters have attended more than 150 professional training workshops; and several thousands of people (landowners, local officials, upstate/downstate teachers and students, community groups, etc.) have participated in forestry education programs and outreach events since the program began in 1997.

Through the course of the next five years, the goal of the Watershed Forestry Program is to maintain a healthy working forest landscape by encouraging good forest stewardship practices and behaviors among watershed landowners, foresters, loggers and the forest industry through cost-sharing incentives, professional training, technical assistance, and education. The program intends to fulfill this goal, by actively participating in the following initiatives:

- Assist watershed landowners with developing and implementing long-term forest management plans that include specific recommendations for protecting streams and adjacent riparian areas.
- Assist watershed landowners, loggers and foresters with the installation of forestry BMPs (erosion control devices and temporary stream crossings) before, during and after timber harvesting projects.
- Provide watershed loggers and consulting foresters with ongoing professional training opportunities and water quality protection incentives.
- Continue supporting existing model forests (Lennox and Frost Valley) and establish a viable east of Hudson model forest.
- Conduct watershed forestry education programs for upstate/downstate target audiences (landowners, teachers, youth, local officials, etc.) that promote good forest stewardship and help maintain a healthy working forest landscape
- Collaborate with local, State and federal partners to prevent the spread of exotic invasive forest pests and support early detection efforts.

<i>Activity and Reporting Milestones</i>	<i>Due Date</i>
Forest Management Planning & Stewardship: <ul style="list-style-type: none"> •Continue enrolling eligible watershed landowners in WAC forest management plans (which include specific riparian management recommendations) •Complete and evaluate the Management Assistance Program (MAP) pilot project during 2007-2008 •Expand and implement MAP on a watershed-wide basis (pursuant to pilot evaluation) to eligible landowners having a WAC forest management plan •Continue evaluating the implementation status of 5-year old WAC forest management plans 	Ongoing/Annually 12/31/08 (MAP pilot evaluation complete and watershed-wide expansion underway)
BMP Implementation: <ul style="list-style-type: none"> •Complete road BMP projects, portable bridge projects, and other forestry BMP projects 	Ongoing/Annually
Logger & Forester Training: <ul style="list-style-type: none"> •Conduct forester and logger training workshops •Support/promote the NYS Trained Logger Certification Program throughout the watershed 	Ongoing/Annually

<i>Activity and Reporting Milestones</i>	<i>Due Date</i>
Model Forest Program: <ul style="list-style-type: none"> •Continue research and demonstration projects •Conduct forestry educational events •Establish an east of Hudson model forest 	Ongoing/Annually
Watershed Forestry Education Program: <ul style="list-style-type: none"> •Implement annual Watershed Forestry Institute for Teachers, Green Connections Education Program, and Watershed Forestry Bus Tour Program •Conduct landowner education/outreach programs •Support invasive species education/outreach programs 	Ongoing/Annually
Submit Watershed Forestry Program Annual Report, covering: <ul style="list-style-type: none"> •Forest Management Planning & Stewardship (including riparian buffers) •BMP Implementation •Logger & Forester Training •Model Forest Research and Demonstration Program •Watershed Forestry Education Program 	Annually (due 3/31)
Submit Watershed Forestry Program Evaluation Report, covering: <ul style="list-style-type: none"> •Five-Year Implementation Status of WAC Forest Management Plans, including documenting and assessing the degree to which private landowners follow the forestry management practices recommended in their 10-year management plans. 	Annually (due 1/31)

2.3.6 Stream Management Program

The goal of the Stream Management Program (SMP) is to protect and/or restore achievable levels of stream system stability and ecological integrity by facilitating the long-term stewardship of streams and floodplains. Many pervasive problems experienced by watershed communities – erosion at public and private properties and infrastructure, habitat degradation, and reach-scale water quality degradation – are linked to the physical condition of those streams. Further, actions taken by individuals or agencies can positively or negatively impact those same processes. Ameliorative efforts as part of an overall watershed protection program can serve to protect water quality. Management decisions in this mountainous, glacially influenced, and predominantly privately-owned landscape are especially sensitive, calling for this voluntary program to focus outreach, training, planning and demonstration on the appropriate management of stream corridors.

The program goals and objectives for the SMP as established in 2001 are sound and should remain the basis for program planning and implementation. These goals are:

- Create an approach for stream management in the Catskill Region that is watershed scale, multi-objective, and community-based by promoting and applying the principles of fluvial geomorphology as the scientific basis of the approach.

- Promote a stream stewardship ethic and develop an informed constituency of regional stream managers and community participants.
- Prepare and implement Stream Management Plans in priority sub-basins.
- Implement a range of stream restoration and protection projects demonstrating BMPs in priority sub-basins.
- Develop and distribute regional stream morphology databases to support stream management decisions, stream design specifications, and program evaluation.

The milestones DEP outlined for the term of the Long Term Watershed Protection Plan should enable the agency and its partners to work more adaptively. We have learned that watershed conditions can vary with flood events and that restoration projects can be constrained by unfavorable climatic conditions and landowner cooperation. The adaptive framework proposed will result in annually modified schedules to enable DEP and its partners to adjust to these conditions and respond effectively to the most pressing needs.

<i>Activity and Reporting Milestones</i>	<i>Due Date</i>
Complete 2002 FAD Deliverables: Stream Management Plan for the East Branch Delaware River •Demonstration Project	12/31/07 12/31/07 (weather permitting)
Stream Management Plan for the Schoharie Creek •Demonstration Project	4/30/07 12/31/07 (weather permitting)
Additional restoration project in the Schoharie Basin (Conine)	12/31/07 (weather permitting)
Implement Existing Stream Management Plans: Meet annually with county contracting partners to re-evaluate stream management plan recommendations and priorities and establish a modified schedule for actions to be taken. Submit a biennial "Action Plan" to EPA for implementation of each plan by reservoir basin.	3/1 each year, beginning 2007, where plans are complete
Establish and implement local funding program for enhanced implementation of Stream Management Plan recommendations •Establish program rules •Award and implement projects •In the Ashokan basin, provide at least \$2 million for implementation of stream management plan recommendations, with preference given for grants for local implementation of projects	3/31/08 Annually By close of FAD
Stream Management Plan for the Rondout Creek •Demonstration Project	2/28/10 2/28/11

<i>Activity and Reporting Milestones</i>	<i>Due Date</i>
Stream Management Plan for the Neversink River •Demonstration Project	2/28/11 2/28/12
Provide a coordinated program delivering technical assistance and conservation guidance to riparian landowners	Ongoing
Review and revise, as appropriate, Addendum A of the 1993 MOU between DEC and DEP as it pertains to the review of Article 15 stream disturbance permits to reflect and enhance coordination between the agencies with the goal of ensuring consistency with the recommendations in stream management plans	6/30/09
Work with DEC to develop and distribute updated Flood Insurance Rate Maps for the west of Hudson watershed	Close of FAD
Annual Progress Report, to include progress in restoration project selection	Annually
Biennial submission of basin by basin modified Action Plans (based on the outcomes of Annual “Action Planning” meetings)	5/1
Conine Water Quality Monitoring Report	12/31/12
Semi-Annual Progress Meetings with EPA, NYS DOH, NYS DEC, one meeting of which will provide a forum for discussion of the content and outcome of the annual meetings with county contracting partners	Semi-annually

2.3.7 Riparian Buffer Protection Program

Based on an analysis undertaken as part of the 2002 FAD, DEP believes that riparian buffers in the Catskill/Delaware watersheds are in good condition, are primarily forested, and are generally well protected at this time. DEP's analysis identified and confirmed the value of the existing programs (e.g., the Land Acquisition, Stream Management, Forestry, and Watershed Agricultural programs, and the administration of the Watershed Rules and Regulations, among other things) in terms of protecting, and potentially improving, buffer areas that are currently in private ownership. DEP held a series of facilitated workshops in 2004-2005 with organizations involved in riparian protection to discuss laying out an enhanced direction.

Going forward, DEP intends to continue to advance protection riparian of riparian buffers through a number of existing programs and to initiate selected program enhancements. For example, DEP will continue to use the land acquisition tools available in the watershed to maintain the trend of positive increase in protected riparian buffer areas, including fee simple acquisitions and conservation easements by DEP, agricultural conservation easements by WAC, as well as the CREP program. DEP will strengthen the landowner agreements under the Stream Management Program for restoration projects affecting stream reaches deemed a priority by requiring such agreements, current and future, to protect the riparian zone and restoration project features. DEP will also con-

centrate more on enhancing education and outreach efforts to riparian landowners and will continue coordination amongst the various partners implementing programs within the riparian zone.

In a new initiative, DEP will develop a new program watershed-wide that will provide technical assistance and other resources to streamside landowners. This streamside assistance program will focus on riparian landowners who are not covered by the other riparian protection programs currently being implemented by the City and its partners

<i>Activity and Reporting Milestones</i>	<i>Due Date</i>
Continue existing programs that are protective of riparian buffers including, but not limited to, regulations, farm and forest programs, land acquisition, stream management, and land management.	Ongoing
Evaluate the CREP program in the watershed, including recommendations for enhancements for cropland, application and relation to Whole Farm Planning, better distribution of CREP throughout the watershed, and the addition of permanent CREP.	12/31/09
Continue implementation of the CREP Program.	Ongoing
Develop a streamside assistance program throughout the watershed to provide technical assistance to non-agricultural streamside landowners. Program elements will include: <ul style="list-style-type: none"> • Ongoing coordination with Riparian Buffers Working Group and local partners • Prioritization of potential areas for program activity using Stream Management Plans and other existing resources • Streamside management guidance including design and planting plans for prioritized areas • Exploration of native plants material supply and demand for project implementation • Development of communications materials supporting the program 	12/31/08
Require enhanced management agreements (voluntary 10-year or purchased perpetual) for all current and future stream restoration projects.	Ongoing
Develop an enhanced education, outreach, and marketing strategy for riparian landowners.	12/31/09
Report on all implementation of all elements of the Riparian Buffer Protection Programs	Annually

2.3.8 Wetlands Protection Program

The purpose of the Wetlands Protection Program is to protect wetlands throughout the New York City water supply watershed by integrating regulatory and non-regulatory strategies with wetland mapping and research programs. The Wetlands Protection Strategy was first implemented in

1996 and then updated in 2001. The strategy includes research and mapping programs such as the National Wetlands Inventory (NWI), wetland status and trends, wetland monitoring and functional assessment, and efforts to support protection programs such as wetland permit review, acquisition, and watershed agricultural programs. Accomplishments in all of these programs have provided the foundation for future efforts. Through the course of the Long Term Watershed Protection Plan, DEP intends to achieve the following goals:

- Continue monitoring of west of Hudson reference wetlands to obtain long-term data to assess wetland functions and conditions to provide support regulatory to and non-regulatory wetland protection programs.
- Continue review of federal, State, and municipal wetland permit applications to ensure that wetland impacts in the watershed are avoided, minimized, or appropriately mitigated to preserve wetland water quality functions to the maximum extent practicable.
- A status and trends study is proposed for west of Hudson using the 1990s and 2005 NWI data as the endpoints. Status and trends analysis was done for east of Hudson and doing the same west of Hudson will provide similar levels of information. Status and trends analysis will help enable a cumulative assessment of wetland protection programs. East of Hudson and west of Hudson status and trends studies should then be conducted on a regular interval, as the NWI is updated.
- Update and produce the color educational pamphlet that was first produced in 1996 upon completion of the NWI. An updated version of this educational tool will include the most current NWI data as well as findings from other programs such as Wetland Monitoring, Functional Assessment, and Status and Trends.
- DEP will continue the Land Acquisition, Stream Management, and Watershed Agricultural Programs, and administration of the Watershed Rules and Regulations, which benefit wetland management and protection (see Sections 2.3.3, 2.3.4 and 2.3.6).
- Review and revise, as appropriate, Addendum A of the 1993 MOU between DEC and DEP as it pertains to the review of Article 24 Freshwater wetland permits to enhance coordination between the agencies with the goal of minimizing wetland impacts in the watershed.
- Revise Wetlands Protection Strategy to reflect the above proposed programmatic changes and continuations.

<i>Activity and Reporting Milestones</i>	<i>Due Date</i>
Continue reference wetland monitoring	Ongoing
Continue permit review program	Ongoing
Revise Wetlands Protection Strategy	12/31/07
West of Hudson Status and Trends	12/31/08
Revisit Addendum A of MOU	6/30/09
Update, produce and distribute color pamphlet	12/31/09
Annual Report on Wetlands Strategy. This report includes updates on mapping/ trends and monitoring projects, the number and types of wetland permits reviewed and tracked, wetland-related components of land acquisition, stream management, agricultural programs and associated partnerships and education programs.	Annually

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

DEP has developed a comprehensive plan to address nonpoint source pollution in the Catskill/Delaware basins located east of Hudson. The plan, based upon watershed surveys, water quality monitoring, and the Croton Watershed Strategy (CWS), was designed to reduce known nonpoint sources of pollution and identify and eliminate other sources of nonpoint pollution. DEP will continue the east of Hudson Nonpoint Source Program (EOHNPS) to 1) ensure that the projects implemented to date will achieve the intended goals, 2) acquire additional sources of data to guide future decision-making and 3) implement new programs to continue the mitigation of nonpoint sources of pollution.

In order to achieve the goals of continuing the reduction of nonpoint source pollution to the east of Hudson Cat/Del reservoirs, the EOHNPS will target the following:

- Long-Term Operation and Maintenance – DEP will continue to regularly inspect stormwater management facilities and identify the maintenance needs of each identified facility in order to ensure that the performance requirements and design removal efficiencies are achieved;
- Stormwater Data Collection – DEP will complete the mapping and inspection of stormwater conveyance systems in order to improve maintenance, and eliminate all illicit inputs. Beyond inspection and mapping, DEP will conduct an infrastructure treatment capacity assessment of the existing stormwater conveyance systems to predict the current level of treatment that existing local and regional infrastructure provides. This assessment will examine stormwater flow paths in subbasins of each watershed and identify opportunities to enhance components of the system. The information gathered through this and other DEP programs can also be used to assist the counties and municipalities in complying with the Phase II MS4 requirements (e.g. locating and sizing stormwater retrofits, identifying illicit connections). In addition, DEP will assess the potential value of initiating a pilot study that would evaluate the impacts of implementing small stormwater improvements on stream corridors;
- Assessment and Prioritization Criteria – As one of the largest landowners in the watershed, DEP recognizes the value of controlling and treating stormwater on-site. In order to maximize the watershed protection value of DEP-owned lands, DEP will conduct an assessment that will assist the agency's ability to locate, design and construct stormwater management facilities on City property. This comprehensive assessment will result in the development of a list of future pollution control features and the criteria to prioritize their implementation; and
- Reduce the Potential Pathogen Risk – DEP will complete the mapping and inspection of the sanitary sewer collection systems in order to identify potential system defects. Upon completion, DEP will contact municipalities and/or infrastructure operators to discuss remediation alternatives. In partnership with Putnam County, the EOHNPS will also continue to reduce loading from improperly functioning subsurface disposal systems through implementation of a Septic Repair Program (SRP). The goal of the SRP is to remediate the failing septic systems in the areas where it is most likely to maximize the reduction of nutrient and pathogenic loading to the watershed.

<i>Activity and Reporting Milestones</i>	<i>Due Date</i>
East of Hudson Stormwater Facility Maintenance for constructed facilities	Ongoing
Stormwater Remediation Projects: <ul style="list-style-type: none"> • BC-1 (Kent, Putnam County) <ul style="list-style-type: none"> • Cleanout of sediment/debris and stabilize embankment along the stream channel • Install forebays with a drainage ditch • WB-1 (Kent, Putnam County) <ul style="list-style-type: none"> • Install drainage structures and outlet protection • WB-2 (Carmel, Putnam County) <ul style="list-style-type: none"> • Install porous pavers • Cleanout sediment/debris buildup • CF-1 (Carmel, Putnam County) <ul style="list-style-type: none"> • Stream channel embankment stabilization • Michael Brook/Hughson Road Improvements • CR-1 (Bedford, Westchester County) <ul style="list-style-type: none"> • Construct drainage ditch, culverts, outlet protections, and stabilize steep slopes • Install porous pavers and vegetation 	Award Contract: 12/31/07 Completion: 12/31/08
Stormwater Retrofit Projects: <ul style="list-style-type: none"> • Hemlock Dam – Croton Falls • Design and construct retrofit Magnetic Mine Road – Croton Falls <ul style="list-style-type: none"> • Design and construct retrofit 	Award Contract: 9/30/08 Completion: 12/31/09
Stormwater Remediation Small Projects Program: <ul style="list-style-type: none"> • Complete design and construction of stormwater management practices • Assess effectiveness of program 	Completion: 9/30/08
East of Hudson Stormwater Mapping and Inspection <ul style="list-style-type: none"> • Complete digital mapping and stormwater inspection of Boyd Corners and West Branch basins • Review results and coordinate with counties to remediate illicit connections in Boyd Corners and West Branch basins 	Completion: 12/31/07
Stormwater infrastructure capacity evaluation	Completion: 12/31/10
East of Hudson Stormwater Prioritization Assessment (DEP Properties) <ul style="list-style-type: none"> • Determine prioritization criteria • Determine location of potential future stormwater projects to be implemented by DEP 	3/31/09
Develop a schedule for implementation of selected practices	9/30/09

<i>Activity and Reporting Milestones</i>	<i>Due Date</i>
<p>Establish a \$4.5 Million program to provide grants to stormwater districts or municipalities for projects that will reduce stormwater pollutant loading to the Croton Falls and Cross River Basins.</p> <ul style="list-style-type: none"> •Develop program rules and model contract, including provision for local match of at least 50% •Solicit applications from interested parties •Convene inter-agency technical panel (EPA, DEC, DOH and DEP) to evaluate and select projects <p>Completed projects may be used by the awarded district or municipality toward their efforts to comply with the requirements of the NYSDEC SPDES General Permit (GP-02-02), Stormwater Discharges from Municipal Separate Storm Sewer Systems (MS4) and the NYSDEC Heightened Permit Requirements For MS4's In The East Of Hudson Watershed. It is understood that the MS4 Requirements are requirements of federal and State law and that responsibility for meeting those requirements rests with the East of Hudson watershed communities and not with the City.</p>	<p>12/31/07¹</p> <p>4/30/08</p> <p>11/30/08</p>
<p>Sanitary Infrastructure Mapping/Inspection</p> <ul style="list-style-type: none"> •Complete inspection and mapping •Prepare report identifying defects •Coordinate with responsible entities to remediate identified deficiencies 	<p>6/30/09</p>
<p>Septic Program East of Hudson</p> <ul style="list-style-type: none"> • Coordinate with county in prioritizing the program target areas • Review and approve designs from program participants 	<p>Ongoing</p>
<p>East of Hudson Nonpoint Source Program Annual Report – Report discussing all program elements</p> <ul style="list-style-type: none"> • Ongoing stormwater facility maintenance • Stormwater Retrofit and Small Projects Program • Stormwater Mapping and Inspection • Sanitary Infrastructure Mapping/Inspection • East of Hudson Septic Program • Stormwater Capacity evaluation and prioritization assessment 	<p>Annually</p>
<p>East of Hudson Nonpoint Source Program Semi-Annual Report – Brief report discussing material events in east of Hudson program implementation</p>	<p>Semi-annually</p>

¹Completion dates were calculated based on the anticipated dates for DEC's promulgation of Final Heightened Permit Requirements For MS4's In The East Of Hudson Watershed. If promulgation of these requirements occurs after the issuance of the FAD, the completion dates of the tasks listed above would be rescheduled accordingly

2.3.10 Kensico Water Quality Control and Related Programs

The Kensico Reservoir is the terminal reservoir for the City’s Catskill/Delaware water supply system. Because it provides the last impoundment prior to Catskill/Delaware water entering the City’s distribution system, this reservoir is of critical importance. Since the early 1990s DEP has prioritized watershed protection in the Kensico Basin. The 2002 FAD and the 2001 Watershed Protection Program Report laid out the framework for DEP’s expanded Kensico pollution prevention and remediation programs. During the next FAD term, DEP will institute programs that ensure the continued success of past efforts as well as develop new source water protection initiatives that target both stormwater and wastewater.

To achieve the broad goals of reducing nonpoint source pollution to the Kensico Reservoir, DEP will focus on:

- Long-Term Operation and Maintenance – 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.
- Complete Assessment of Kensico – Through the Kensico Action Plan (KAP), DEP will generate the information required to make better strategic decisions on future stormwater and dredging projects. Key elements of the program include mapping Kensico sub-basins based on 2-foot contour topographic coverages, evaluating and modeling stormwater discharges from the catchments, and assessing the need for effluent chamber dredging.
- Reduce the Potential Pathogen Risk – Implementation of a Septic Repair Program, construction of an early warning sanitary sewer overflow protection system and the annual visual inspection of sanitary sewers will increase DEP’s ability to prevent possible discharges of wastewater to Kensico.

<i>Activity and Reporting Milestones</i>	<i>Due Date</i>
Maintain Nonpoint Management Facilities within the Kensico Reservoir Basin <ul style="list-style-type: none"> • Inspect and maintain stormwater management facilities, turbidity curtain and spill containment measures • Update the computer assisted facilities management system (CAFM) to track, document and manage the Kensico watershed protection programs 	Ongoing
Stormwater BMP Monitoring <ul style="list-style-type: none"> • Sample selected BMPs through 2007 	Report findings in 2009 FAD Annual
Submit draft Kensico Action Plan (KAP) for review and comment by EPA, DOH and DEC. Review period will not exceed one month. Draft report will include: <ul style="list-style-type: none"> • Recommendations for up to 4 pollution remediation practices under the KAP • Recommendations for up to 4 water quality risk assessments under the KAP 	5/15/07

<i>Activity and Reporting Milestones</i>	<i>Due Date</i>
<p>Complete Kensico Action Plan – The Final KAP will include:</p> <ul style="list-style-type: none"> •Mapping of Kensico sub-basins based on 2-foot contour topographic coverages •Evaluation, based on modeling, of stormwater discharges from the Kensico catchments •Recommendations for up to 4 pollution remediation practices •Recommendations for up to 4 water quality risk assessments •Summary of work performed under separate contract that evaluates the need for effluent chamber dredging 	<p>KAP Completion 8/15/07</p>
<p>Evaluate KAP’s pollution remediation recommendation and develop a schedule for implementation of selected practices. Schedule is to be subject to approval by EPA, DOH and DEC.</p>	<p>Complete Schedule 12/15/07</p>
<p>Septic Repair Program</p> <ul style="list-style-type: none"> •Submit survey results and proposed program to EPA, DOH and DEC for review and comment. Review period will not exceed one month. •Initiate contract for septic repair program based on results of existing house to house survey. 	<p>10/31/07 Contract Start: 11/30/08</p>
<p>Propose to Westchester County DEP’s installation of a Sanitary Sewer Remote Monitoring System at West Lake Sewer Extension (Early Warning)</p> <ul style="list-style-type: none"> •Secure agreement from county to install system •Update sewer system protocol with county •Coordinate with county to implement maintenance, monitoring and response plan for system •Update regulatory agencies on status of coordination with Westchester County 	<p>Ongoing</p>
<p>Visually Inspect West Lake Sewer Extension</p> <ul style="list-style-type: none"> •Review and coordinate with county to remediate any identified deficiencies 	<p>Annually</p>
<p>Video Sanitary Sewer Inspection Program</p> <ul style="list-style-type: none"> •Inspection of targeted areas every 5 years 	<p>9/30/10</p>
<p>Continue Westchester County Airport Coordination</p> <ul style="list-style-type: none"> •Coordinate with county and remain an active stakeholder as projects are proposed 	<p>Ongoing</p>
<p>Continue Route 120 Corridor Coordination</p> <ul style="list-style-type: none"> •Coordinate with DOT and remain an active stakeholder 	<p>Ongoing</p>
<p>Conduct wind-induced turbidity assessment. Evaluate assessment recommendations. As appropriate, develop a schedule for implementation of selected practices.</p>	<p>8/31/07</p>

<i>Activity and Reporting Milestones</i>	<i>Due Date</i>
Submit Kensico Programs Annual Report – An integrated report including the following: <ul style="list-style-type: none"> •Discuss progress in implementing Kensico protection programs including: <ul style="list-style-type: none"> •Ongoing stormwater facility maintenance •Stormwater BMP monitoring •Septic Repair Program •Kensico Action Plan •Assessment of alum dredging (interval to be based on SPDES permit) •Remote Monitoring System at West Lake Sewer •Sewer inspections • Presentation, discussion and analysis of monitoring data (e.g. keypoint, reservoir, stream, BMPs); and • Status and application of the Kensico reservoir model 	Annually
Submit Kensico Programs Semi-Annual Report – Brief report discussing material events in Kensico Program implementation.	Semi-annually
Submit Final Kensico Action Plan	8/15/07
Submit KAP Implementation Schedule	12/31/07
Depending on the findings of the Kensico Action Plan, provide a short report evaluating the need, and/or plan, for maintenance dredging of intake channels at Delaware Shaft 18 and Catskill Upper Effluent Chamber, as appropriate	Include in annual report for 2010

2.3.11 Catskill Turbidity Control

The Catskill Turbidity Program under the 2002 FAD focused on “a comprehensive analysis of engineering and structural alternatives at Schoharie Reservoir that may reduce turbidity levels entering Esopus Creek.” Through the Phase I engineering analysis, DEP has determined that contributions from the Esopus watershed to turbidity in the Catskill system as a whole, particularly at times when the turbidity in the Catskill system reaches levels of concern, are much more significant than contributions from the Schoharie Reservoir. Accordingly, while the program under the 2007 FAD will include implementation of certain measures based on the Phase II engineering analysis, it focuses on development and evaluation of potential modifications at Ashokan Reservoir including: (1) an in-reservoir baffle in the East Basin, (2) a release structure from the West Basin, (3) a new East Basin intake; and (4) increased storage capacity in the West Basin. Performance evaluation of an in-reservoir baffle in the East Basin requires a three-dimensional water quality model, similar to that used for the Schoharie baffle in Phase I.

Through the course of the next FAD, DEP will work closely with the Hazen and Sawyer/ Gannett Fleming Joint Venture to develop recommendations and an implementation plan for any feasible, effective and cost-effective measures to reduce turbidity leaving Ashokan Reservoir and entering the Catskill Aqueduct as well as entering the Esopus Creek from the Shandaken Tunnel.

<i>Activity and Reporting Milestones</i>	<i>Due Date</i>
Complete dredging of the Schoharie Reservoir intake channel	12/31/07
Complete implementation of Phase II Schoharie Reservoir recommendations in accordance with the 12/31/06 Phase II Implementation Plan Report as approved by EPA, DOH, and DEC	TBD
Conduct a comprehensive analysis of engineering and structural alternatives at the Ashokan Reservoir that may reduce turbidity levels entering the Catskill Aqueduct	Ongoing
Submit final report upon completion of Phase III of study, including detailed conceptual designs and associated cost information for recommended alternatives. Report will identify any interim measures that emerge during the course of study	12/31/07
Develop a plan, subject to EPA, DOH and DEC approval, with appropriate milestones for implementing any feasible, cost effective measures identified by the comprehensive engineering analysis	3/31/08
Convene meetings with EPA, DOH and DEC to review progress on all Catskill turbidity control efforts	Semi-annually (one meeting shortly before submission of annual report)
Report on the implementation of all elements of the Catskill Turbidity Control Program	Annually

2.4 Watershed Monitoring, Modeling and GIS

New York City's watershed monitoring, modeling and science programs form the basis for the City's ongoing assessment of watershed conditions, changes in water quality and ultimately any modifications to the strategies and management of the watershed protection program. Through the course of the next five years, DEP will continue to support and enhance these programs.

2.4.1 Watershed Monitoring Program

DEP conducts extensive water quality monitoring throughout the watershed. The framework of DEP's monitoring efforts is defined by the Drinking Water Quality Control (DWQC) Integrated Monitoring Plan (IMP). The IMP is periodically assessed and revised to address the changing needs of the monitoring program. Water quality results from the routine monitoring programs (i.e., hydrology, limnology, pathogens, and laboratory) are described yearly in the Watershed Water Quality Annual Report. A more rigorous evaluation of the routine monitoring data, including the appraisal of current water quality status and long-term water quality trends, clearly dem-

onstrates 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.

Over the next five years the goals of DEP’s Watershed Monitoring Program are as follows:

- Provide an up-to-date, objective-based monitoring plan for the routine watershed water quality monitoring programs, including keypoint, stream, reservoir, and pathogens.
- Provide routine water quality results for keypoint, stream, reservoir, and pathogens programs to assess compliance and provide comparisons with established benchmarks. Describe ongoing research activities.
- Provide mid-term results from routine watershed (e.g., stream and WWTP) pathogen monitoring.
- Use water quality data to evaluate the source and fate of pollutants, and the effectiveness of watershed protection efforts at controlling pollutants. 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.
- Provide after action reports on all chemical treatment activities and other significant or unusual events.
- 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 on reducing pathogen concentrations; and identifying additional monitoring and/or research needs.

<i>Activity and Reporting Milestones</i>	<i>Due Date</i>
Participation in educational seminars on watershed monitoring	Annually (September)
Coordinate technical Pathogen Working Group meeting	Annually (March)
Discuss draft contents of Integrated Monitoring Plan with DOH, EPA and DEC	2/28/08
Submit updated Integrated Monitoring Plan	10/31/08
Submit Watershed Water Quality Annual Report (including comprehensive chapters on pathogens and ongoing research)	Annually (July)
Submit mid-term report on watershed surveillance results (i.e., supplement to FAD monthly) consistent with the Integrated Monitoring Plan for pathogens for WWTPs, upstream source waters and Kensico Reservoir perennial streams	Annually (January)
Submit Watershed Protection Program Summary and Assessment Report	3/31/11
Submit after-action reports following chemical treatments, or significant unusual incidents and /or monitoring	Upon completion as specified for each action

2.4.2 Multi-Tiered Water Quality Modeling Program

DEP’s Modeling Program develops and applies simulation models for understanding and quantifying the effects of watershed management, reservoir operations, and climate (floods and drought) on the quality and reliability of the water supply system. The models encapsulate the key processes and interactions that control generation and transport of water, sediment and nutrients from the land surface, throughout the watersheds and within the reservoirs. A wide variety of data are integrated, including land cover, land use, soils, topography, population, wastewater treatment, stream flow, stream water chemistry, reservoir bathymetry, reservoir operations, and reservoir chemistry and thermal structure. The models are useful for predicting the effects of changing land use, population, watershed management, and reservoir operations on water supply quantity and quality.

The Modeling Program’s primary goals are to continue development and application of models to support watershed management, reservoir operations, and long-term water supply planning.

These goals include:

- Modeling applications and analyses to evaluate the effectiveness of watershed management programs to control eutrophication in the Delaware System
- Use of models to predict turbidity transport in the Catskill System and Kensico Reservoir, and to provide guidance for reservoir operations to minimize the impact of turbidity events
- Provide modeling support for DEP's Climate Change Task Force studies on the potential effects of climate change on water supply.

<i>Activity and Reporting Milestones</i>	<i>Due Date</i>
Continue model improvements based on ongoing data analyses and research results	Ongoing
Continue model testing as additional data from DEP’s ongoing monitoring programs becomes available	Ongoing
Update land use, watershed programs, and time series data (meteorological, stream flow and chemistry, reservoir chemistry) to support modeling	Ongoing
Continue development of data analysis tools for modeling, and software for model connectivity	Ongoing
Continue model applications to support watershed management, reservoir operations, and long-term planning	Ongoing
Continue testing and improvements to 1-D reservoir eutrophication models (including Phytoplankton Functional Group Model Application to Cannonsville Reservoir)	Ongoing
Provide modeling support to the Catskill Turbidity Control Program	Ongoing
Provide technical support to assist DEC in its evaluation of nutrient criteria for reservoirs used for drinking water supply	Ongoing

<i>Activity and Reporting Milestones</i>	<i>Due Date</i>
Use reservoir turbidity models to support operational decisions in response to unfavorable turbidity conditions	Ongoing
Submit Annual Status Report. This report will include updates on the Activities above.	Annually (October)
Report on Modeling Analysis of FAD Programs in the Watershed Protection Program Summary and Assessment Report	3/31/11
Report on Phytoplankton Functional Group Model Application to Cannonsville Reservoir	7/31/08
Complete expansion of Nutrient Management Eutrophication Modeling System capabilities for Neversink, Rondout, and Schoharie Reservoirs	7/31/07

2.4.3 GIS Program

DEP's upstate Geographic Information System (GIS) is designed for natural resource management applications of GIS and remote sensing, in particular, watershed management. The GIS is used to manipulate spatial data and create databases in support of existing program objectives and future evaluation of watershed protection programs. The GIS is also used to support terrestrial and reservoir modeling of water quantity and quality in the watersheds. GIS staff generate an average of over 500 maps per month from the large format plotters and support requests for water supply specific data, as needed, from the City Mayor's Office, the DEP Commissioner's Office, and the Bureau of Water Supply Deputy Commissioner's Office. GIS staff also provide extensive training of staff, interns, and local government agents in the use of GPS for project specific data gathering efforts (i.e. stewardship forest inventory, sewer extensions, baseline documentation of conservation easements, etc.). Remote sensing support is also provided for projects and users, such as the analysis of imagery for land use mapping, forest inventory, wetland tracking and conservation easement monitoring.

The mission of the GIS program is to support protection of water supply and quality by providing a means of evaluating water quality information and watershed protection programs in a unique spatial and temporal context. Geographic information is used to display and evaluate the potential magnitude of pollutant sources through mapping and queries. The GIS program will continue to be a useful tool in three primary areas:

- Perform analysis of land use to map wetlands, urban, agricultural, and forested areas;
- Provide estimation of the effects of watershed management programs (e.g., WAP, WWTP upgrades, nonpoint source programs, etc.) on long-term water quality;
- Support terrestrial and reservoir modeling of water quantity and quality in the watersheds.

<i>Activity and Reporting Milestones</i>	<i>Due Date</i>
Continue to maintain and utilize GIS capabilities to support watershed protection efforts	Ongoing
Report annually on: <ul style="list-style-type: none"> •Progress in using GIS for watershed management applications •Completion of new data layers •Incorporation of data layers into the modeling database •Data dissemination to stakeholders and the public as appropriate, including notification of data availability to communities and requests for data •GIS infrastructure maintenance and improvement. 	Annually (March)

2.5 Regulatory Programs

2.5.1 Watershed Rules and Regulations and Other Enforcement/Project Review

The Watershed Rules and Regulations give DEP regulatory authority over activities that, if improperly carried out, could threaten to add nutrients, pathogens, and other contaminants into the water supply. The WR&Rs are directed primarily toward controlling sewage collection and treatment, stormwater discharges and impervious surfaces, but also govern such activities as petroleum storage, winter highway sand and salt storage facilities, and solid waste management and disposal. In general, they require that persons proposing to engage in a regulated activity in the watershed meet stringent standards set out in the regulations and, in many cases, obtain prior DEP review and approval before undertaking the activity.

By expanding DEP's regulatory role in the watershed, the WR&Rs have also changed the manner in which local communities and developers address DEP's concerns. In particular, DEP is now consistently recognized as a regulatory authority and as an involved agency for purposes of environmental review under SEQRA, and DEP's attendance at planning board meetings has become generally accepted. To assist communities and developers in understanding what the WR&Rs require, DEP encourages pre-application conferences and generally makes staff available to the regulated community and local governments, including Planning Board members.

<i>Activity and Reporting Milestones</i>	<i>Due Date</i>
Enforce the requirements of the WR&Rs and other applicable regulations	Ongoing
Review BMP monitoring data and BMP performance and effectiveness in the field and, where appropriate, make revisions to Stormwater Pollution Prevention Plan (SPPP) guidance. These revisions may include: <ul style="list-style-type: none"> •refinements of BMP assumptions, •creation of performance-based benchmarks, •emphasizing the importance of non-structural SMPs and buffers, and •promotion of innovative site design to meet SPPP requirements 	Ongoing
Work with DEC in accordance with Addendum S of the DEP/DEC MOU to improve coordination of stormwater enforcement actions between agencies and with the State Attorney General’s office. Stormwater Enforcement Coordination meetings with involved agencies are held twice per year or as needed.	Ongoing
Report on project review activities with respect to ongoing and proposed projects that may affect water quality, including variance activities and the review of new/remediated septic systems in the Cat/Del watershed basins as well as Croton Falls and Cross River basins. The report should include a summary table (inventory) of all development projects proposed and their SEQRA status in addition to projects under construction, by basin, with corresponding maps. An up-to-date summary table with corresponding maps will also be made available on DEP’s website.	Semi-annually, April and October
Report on the status of DEP regulatory enforcement actions in the Cat/Del watershed basins and Croton Falls and Cross River basins	Semi-annually, April and October
Conduct a roundtable discussion with EPA, DOH and DEC regarding progress of proposed changes to WR&Rs. Develop a timeline for completing proposed changes.	Within four months after the 2007 FAD is issued
Report on progress of proposed changes to WR&Rs.	Semi-annually, April and October, until adopted

2.5.2 WWTP Inspection Program

At each surface discharging WWTP that operates on a year-round basis, DEP conducts one inspection during each calendar quarter. At minimum, two inspections per year are conducted at seasonal surface discharging facilities during the facility’s operating season. Similarly, at least two inspections per year are conducted at non-contact cooling water discharges to surface waters. Treated industrial waste discharges to groundwater, via surface application, are inspected four times per year.

<i>Activity and Reporting Milestones</i>	<i>Due Date</i>
<p>Continue to take timely and appropriate enforcement action against WWTP non-compliance with the WR&Rs and SPDES discharge permit requirements in accordance with the WECC enforcement coordination protocol of the DEC/DEP MOU.</p> <p>Assist in the training of small facility operators</p>	<p>Ongoing, plus quarterly reported at WECC meetings</p>
<p>Perform sample monitoring at all City-owned WWTPs in accordance with their SPDES permits and grab sample monitoring twice per month at all non-City-owned WWTPs discharging in the Catskill/Delaware Watersheds. At least once annually, samples shall be collected and analyzed in accordance with the monitoring requirements of the SPDES permit. If deemed beneficial for enforcement purposes, samples shall be collected and analyzed more frequently, including weekend sampling and split sampling with the facility when possible, in accordance with the monitoring requirements of the SPDES permit. Submit results to EPA and DEC.</p>	<p>Quarterly with WWTP inspection reports</p>
<p>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</p> <p>Submit summary reports including sample monitoring data and inspection reports</p>	<p>Quarterly Inspections with annual reporting</p>
<p>Report on activities of DEP's Technical Support Plan (Circuit Rider) to assist WWTP owners in the training, certification, and proper operation and maintenance of their facilities</p>	<p>Annually</p>
<p>Report on phosphorus-restricted and coliform-restricted analyses</p>	<p>Annually - July (in Water Quality Report)</p>

2.6 Catskill/Delaware UV Disinfection Facility

In 1993 EPA issued two Filtration Avoidance Determinations for the Catskill and Delaware Supplies 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 Filtration Avoidance Determination added deliverables for Final Design and the completion of a Final Environmental Impact Statement (FEIS), 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 and Delaware water supplies appeared likely to meet federal water quality standards for the foreseeable future.

The commitment to update the preliminary filtration designs every two years was memorialized in the 2002 FAD. With respect to UV disinfection, based on the results of the feasibility studies DEP conducted in connection with relief from the final design and environmental review milestones in the 1997 FAD, DEP included a commitment to design and construct a UV disinfection facility in its 2001 Long-Term Watershed Protection Program, and the milestones were incorporated into the 2002 FAD.

The schedule for completion of the UV Disinfection Facility will be incorporated into an Administrative Order on Consent (AO) between EPA and the City. The AO will include a schedule with enforceable milestones. The schedule, which will also be incorporated into the 2007 FAD, will provide for treatment to commence upon functional completion of the first two quadrants, enabling treatment of all Catskill/ Delaware flow by August 31, 2012.

<i>Activity and Reporting Milestones</i>	<i>Due Date</i>
UV Disinfection Facility	
Advertise UV Structures Contract	12/31/06
Order to Commence	10/31/07
Commence Installation of Underslab Steel Pipe	10/31/08
Complete Underslab Piping in 2 nd Quadrant	7/1/09
Complete UV Base Slab	12/31/09
Complete Concrete Slab at El 334'	6/1/10
Enclose UV Building	3/30/11
Complete Installation of Electrical Substation	3/17/12
Commence Operation of First Quadrant	8/3/12
Commence Operation of Second Quadrant	8/31/12
Commence Full Operation	10/29/12

2.7 In-City Programs

2.7.1 Waterborne Disease Risk Assessment Program

New York City’s Waterborne Disease Risk Assessment Program (WDRAP) was established in 1993. The objectives and components of the program have evolved over time, in response to updated information and updated priorities. Key program components include: (a) active disease surveillance and case interviews, and (b) syndromic surveillance utilizing a variety of systems to track indicators of gastrointestinal illness. In addition, some special projects and assessments have been conducted. Two city agencies are involved in this effort, DEP and the New York City Department of Health and Mental Hygiene (NYCDOHMH).

Through the next five years, the goals of WDRAP are:

- To continue to obtain public health data relevant to ensuring that New York City water customers are adequately protected against waterborne disease.
- To continue to collect data on giardiasis and cryptosporidiosis in New York City through active disease surveillance, case interviews, and review of medical charts as appropriate, in order to determine disease rates, and to evaluate demographic and risk factor information.
- To continue to operate syndromic surveillance systems in order to be better able to detect a citywide outbreak of waterborne disease.

<i>Activity and Reporting Milestones</i>	<i>Due Date</i>
Continue to operate Waterborne Disease Risk Assessment Program (WDRAP)	Ongoing
Implement Cryptosporidium Action Plan	Event based
In relation to any water quality “event” involving NYC water supply (e.g., increased turbidity levels, pathogen findings, an operational disruption, or other such event), NYC will provide syndromic surveillance system information (for example, signals and trend data), as requested by either DOH or EPA. Information request will be coordinated through DEP.	Event based
Notify DOH and EPA, whenever DEP is notified by NYCDOHMH, of any significant signs of community gastrointestinal illness in which public drinking water supply appears to be the source of infection	Event based
Cooperate with DOH and EPA on a turbidity action plan	Ongoing
Submit Annual Report (on program and program findings, implementation and analysis)	March 31
Submit Interim Report (mid-year brief interim report on program and program findings and implementation)	August 31

2.7.2 Cross Connection Control

The goal of the Cross Connection Control Program is to prevent backflow into the NYC Water Supply System by requiring owners of property with certain types of facilities to install cross connection control containment devices and to test them annually.

Through the course of the next five years, the Program will proceed with inspection of all premises which may require cross connection control containment devices, as needed, and will also install or cause the installation of containment devices in premises which require such devices.

<i>Activity and Reporting Milestones</i>	<i>Due Date/ Frequency</i>
Respond to cross connection control complaints	1-2 per year
Perform full inspection of potentially hazardous premises	450 per year
Initiate enforcement for non-compliant hazardous premises	225 per year
Backflow preventer plans approved	400 per year
Backflow preventer plans accepted with self certification	To Be Determined
Notices of Violation issued for failure to test annually	200 per year
Review requests for exemption from cross connection control requirements	400 per year
Submit Cross Connection Control Semi-Annual report, include Notice of Violation Table which will include information on high hazard buildings	Semi-annually
Report on implementation of the Cross Connection Control Program and progress in meeting all associated milestones. Also report on high hazard buildings.	Annually

2.8 Administration

Beginning in the early 1990s, to support its comprehensive watershed protection program, DEP hired literally hundreds of professionals in a variety of fields, including hydrology, limnology, engineering, wastewater treatment, project management and administration. The efforts of this dedicated staff have allowed the City to successfully implement the elements of the overall protection effort.

DEP is committed to maintaining the level of staffing, funding and expertise necessary to support all elements of the watershed protection program and to meet all associated milestones. This will be achieved through in-house staffing and use of contractors.

2.9 Education & Outreach

Public education and outreach efforts have been a component of the City’s watershed protection strategy since the expansion of the protection program in the early 1990s. DEP’s activities are built on the principle that an informed base of watershed residents and water consumers facilitates development and implementation of protection strategies. An effective outreach program enhances consumer confidence in the safety and quality of the water supply, while teaching watershed residents and consumers alike the importance of watershed protection and conservation.

Since promoting watershed stewardship is generally accomplished through ongoing programs and partnerships, DEP's educational efforts are tailored to address key target audiences. Examples of key target audiences include watershed landowners, watershed professionals, local community leaders and decision makers, school groups, tourists and recreational users, and downstate consumers of the New York City water supply.

The foundation of DEP's watershed education and outreach programs is the unifying message that a well-managed watershed landscape provides multiple benefits: clean water, clean air, rural character, economic values and opportunities (including jobs), open space, local products (food, fiber, art, culture, specialty items, etc.) and a protected legacy for future generations. It is important that watershed audiences understand the impacts of their land management practices and their personal responsibilities as environmental stewards, whereas downstate audiences need to understand the value of a healthy watershed and its relationship to their safe, clean water supply. Both audiences benefit from ongoing stewardship education programs that demonstrate and reinforce their shared connections. In addition to its own initiatives, DEP recognizes and works in partnership with watershed communities to support locally based educational efforts that promote watershed stewardship.

Over the course of the next five years, DEP will work with partner agencies and organizations to continue program-specific education efforts. Education will continue to be a component of the Watershed Agricultural Program, the Forestry Program, the Stream Management Program, certain CWC-administered programs and the Kensico protection programs, among others.

DEP will assess the watershed stewardship training/educational needs of local officials and, where appropriate, will make use of existing, or develop additional, training programs to help meet these needs. This will be a collaborative process to promote the merits and principles of land use planning, stream corridor and stormwater management on a local level. It will focus on demonstrating how these general principles can be translated into regular practices. One goal will be to collaborate with local and regional highway officials to provide training/education programs that promote the integration of stream corridor and stormwater management principles with road maintenance practices.

School-based education efforts have long been a component of DEP's outreach programs. DEP will continue to conduct teacher training and workshops in the City; make class visits and presentations; work with schools on environmental curriculum development; sponsor an annual water conservation art and poetry contest; and offer internships and mentor programs to high school and college students.

DEP will continue to produce a wide range of publications to provide general and program-specific information. When applicable, DEP will also recognize and incorporate local initiative programs that exemplify the principles of watershed stewardship. DEP will produce program

brochures, the annual Consumer Confidence Report, special papers and scientific reports, and other publications. In addition, DEP will create and publish a periodic watershed newsletter to be sent to watershed residents, libraries, town halls, et al., and posted on DEP website.

DEP’s website (www.nyc.gov/dep) provides Internet users access to a wide range of information and data about the water supply system, water quality, watershed protection program content and status. The goal is to give users current system and program information while also presenting topics that DEP considers critical to understanding developing watershed issues. DEP will continue to update the website with current information, including certain FAD reports.

<i>Activity and Reporting Milestones</i>	<i>Due Date</i>
Continue Education and Outreach initiatives, including: <ul style="list-style-type: none"> • Program Specific Education Efforts: <ul style="list-style-type: none"> • WAP/Forestry • Stream management • CWC • KEEP/KWIC • School-Based Education Efforts • General Outreach: <ul style="list-style-type: none"> • Fairs, exhibits and local events • Publications • Website • Regulatory and local government outreach 	Ongoing
Report on implementation of the Education and Outreach Program	Annually

2.10 Reporting

Through the years, DEP has provided numerous comprehensive reports to EPA, DOH and interested parties on all aspects of its watershed protection efforts. These reports are designed to give regulatory oversight agencies and watershed stakeholders the information they need to assess the progress of the watershed protection program. At times, these reports have been too detailed or cumbersome, and important information may have been buried in the stacks of documents. In addition, the heavy reporting burden has diverted City resources from other important tasks.

For the next phase of the watershed protection effort, DEP is proposing a modified schedule of reports as well as modifications to the content and organization of certain reports. This revised and streamlined schedule is designed to provide vital, timely, and accessible information to interested parties.

Table 2.3. List of proposed reports.

<i>Activity and Reporting Milestones</i>	<i>Due Date</i>
Objective Compliance Report	Monthly
WWTP Upgrade Report	Quarterly
WWTP Monitoring Report	Quarterly
WWTP Inspection Report	Quarterly
Trihalomethane Monitoring Report	Quarterly
Project Review Report	Semi-annually, 4/30, 8/31
Enforcement Report	Semi-annually, 4/30, 8/31
Septic Rehabilitation and Replacement Program Report	Semi-annually
Septic Maintenance Program Report	Semi-annually
Sewer Extension Program Report	Semi-annually
New Sewage Treatment Infrastructure Program Report	Semi-annually
Community Wastewater Management Program Report	Semi-annually
West of Hudson Stormwater Retrofits Report	Semi-annually
East of Hudson Nonpoint Source Program Report	Semi-annually
Kensico Programs Report	Semi-annually
UV Facility Status Report	Semi-annually
Land Acquisition Status Report	Semi-annually
Cross Connections Control Program Report	Semi-annually
GIS Status Report	Annually, 3/31
Waterborne Disease Surveillance Program Annual Report	Annually, 3/31
Waterborne Disease Surveillance Program Interim Report	Annually, 8/31
Watershed Forestry Program Evaluation Report	Annually, 3/31
Modeling Status Report	Annually, 10/31
Watershed Agricultural Program Report	Annually, 3/31
Pathogen Program Status Report	Annually
Stream Management Program Report	Annually
Technical Support Plan (Circuit Rider) Report	Annually
Filtration Avoidance Determination Report	Annually, 3/31
Research Objectives Report	Annually
Watershed Water Quality Report	Annually
Waterfowl Program Report	Annually
Wetlands Strategy Report	Annually
Stream Management Basin Action Plan	Biennially

Annually means submittal of reports for the previous calendar year due no later than March 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 January 31 and July 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 April 30, July 31, October 31 and January 31.

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

