New York City
Department of Environmental Protection

Filtration Avoidance Annual Report
For the period January 1 through December 31, 2006

March 2007

Prepared in accordance with the November 2002 EPA Filtration Avoidance Determination

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1. Introduction

In 2006 New York City celebrated its fifteenth year of watershed protection. The City first applied for its first waiver for the Catskill/Delaware system from the filtration requirements of the Surface Water Treatment Rule in 1991. Since then New York City, under the auspices of the Department of Environmental Protection, has committed hundreds of millions of dollars and thousands of staff hours to preserving the pristine quality of the source waters of the Catskill and Delaware water supply system. DEP's multi-faceted watershed protection program is based on exhaustive research by DEP scientists into existing and prospective sources of water contamination.

As part of DEP's source water monitoring program, tens of thousands samples are collected and throughout the watershed annually. Each year, DEP performs hundreds of thousands of laboratory analyses. Based upon the information collected through its monitoring and research efforts, DEP has crafted a comprehensive watershed protection strategy, which focuses on implementing both protective (antidegradation) and remedial (specific actions taken to reduce pollution generated from identified sources) initiatives.

DEP's early assessment efforts pointed to several key potential sources of pollutants: waterfowl on the reservoirs; wastewater treatment plants discharging into watershed streams; failing septic systems; farms located throughout the watershed; and stormwater runoff from development. DEP's protection strategy targets and has had significant success targeting and controlling these primary pollution sources as well as a number of secondary ones.

In 2006, DEP set forth the framework to continue its efforts in sustaining the high quality of New York City's Catskill/Delaware water supplies with the publication of its Long-Term Watershed Protection Program document. This document outlines the City's programmatic commitments to continued watershed protection for the next five years and serves as the framework upon which the 2007 Filtration Avoidance Determination is based.

Other noteworthy strides in protecting the quality if New York City water supply in 2006 include completion of Phase II of the Catskill Turbidity Control Study; completion of the Tannersville Wastewater Treatment Plant in the town of Hunter; completion of the Esopus Creek Stream Management Plan, a draft of which was submitted to EPA on January 31, 2007; implementation of the Ashland Connector stream restoration project in the Batavia Kill watershed; and continued success and participation of watershed residents in various waste- and stormwater programs, land acquisition, and the Watershed Agricultural Program. Details of programmatic activities that took place during 2006 are found in the sections to follow.

2. Federal and State Objective Water Quality Compliance

During 2006, DEP continued its comprehensive water quality monitoring efforts. Both in the City distribution system and in the watershed, DEP collects literally tens of thousands of samples each year. In 2006, DEP staff collected approximately 50,500 samples and conducted roughly 532,470 analyses. The City's sampling program continues to be much more extensive than is required by federal or State law. Almost 28,665 samples were collected in-City and approximately 346,450 analyses were completed. As in previous years, the results are impressive. Of the 9,754 in-City compliance samples analyzed pursuant to the Total Coliform Rule in 2006, only 0.4% were total coliform positive, of which one sample was also *E. coli* positive. All resamples were negative for total coliform with the exception of one site where three of the four resamples were total coliform positive and one site where all four resamples were total coliform positive. In both resample cases low, but measurable, free chlorine residuals were noted. Regulator valve adjustments and flushing at the first site, and flushing at the second site, resulted in significantly higher residuals and total coliform negative results were achieved in the second round of resampling. Since November 1994, DEP has collected more than 131,525 Compliance samples and only twelve of those samples have tested positive for *E. coli.*

Federal and State Objective Water Quality Criteria

On the tenth of every month, DEP provides both EPA and DOH with the results of its enhanced monitoring program, developed to comply with the requirements of the Surface Water Treatment Rule (SWTR), the Total Coliform Rule and other federal regulations that went into effect in 1991. The City, as an unfiltered surface drinking water supplier, must meet these objective criteria. The information provided below summarizes compliance monitoring conducted during the year.

2.1 SWTR Monitoring and Reporting

Raw water monitoring for fecal coliform concentrations and disinfection/CT values, entry point monitoring for chlorine residuals, distribution system monitoring for chlorine residuals and coliform bacteria levels, and quarterly monitoring in the distribution system for trihalomethanes and haloacetic acids, all complied with federal water quality requirements. Raw water monitoring for turbidity in March exceeded the 5 Nephelometric Turbidity Unit (NTU) SWTR maximum allowable limit in the Catskill Aqueduct effluent, resulting in a Tier 2 Treatment Technique violation requiring public notification.

2.1.1 Raw Water Fecal Coliform Concentrations (40 CFR Section 141.71 (a)(1))

Both the Catskill and Delaware Aqueduct effluent from Kensico Reservoir exhibited fecal coliform concentrations in water prior to disinfection at levels less than or equal to 20 CFU/100 mL in at least 90% of the samples collected during the year for six month running percentages. In fact, the running percentages of samples for the Catskill and Delaware Systems never dipped below 97.22% and 98.33%, respectively.

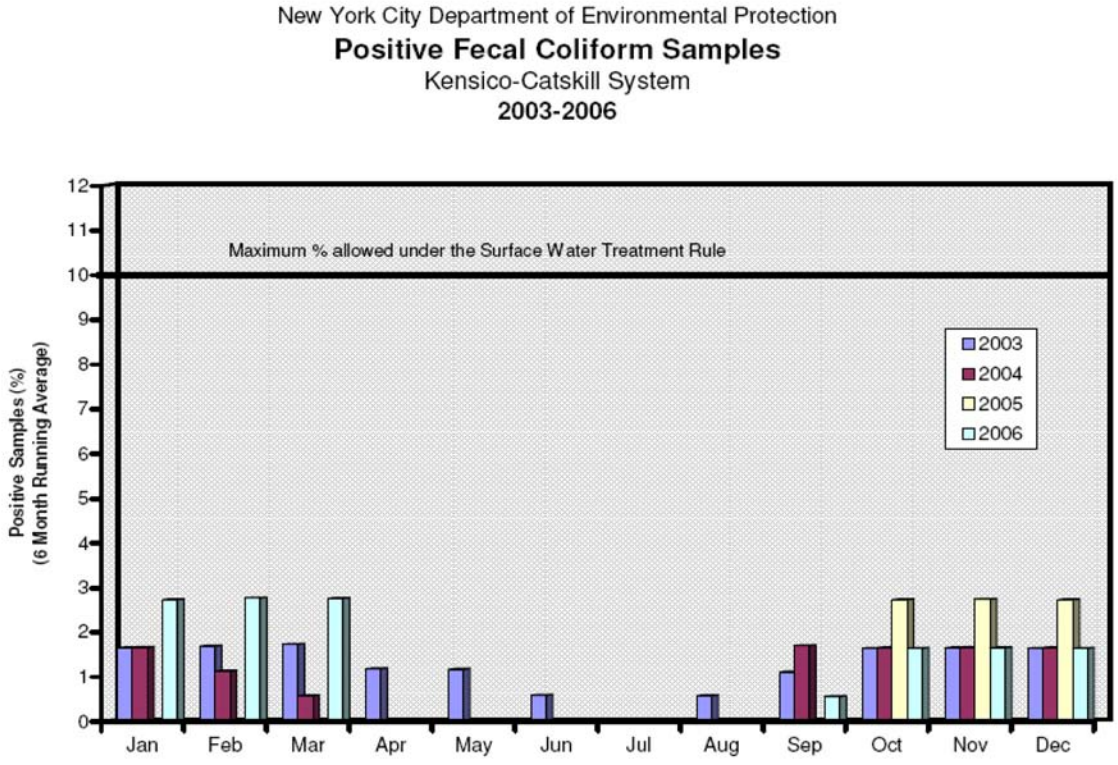

Figure 2.1. Positive fecal coliform samples, Kensico Reservoir, Catskill System, 2003-2006.

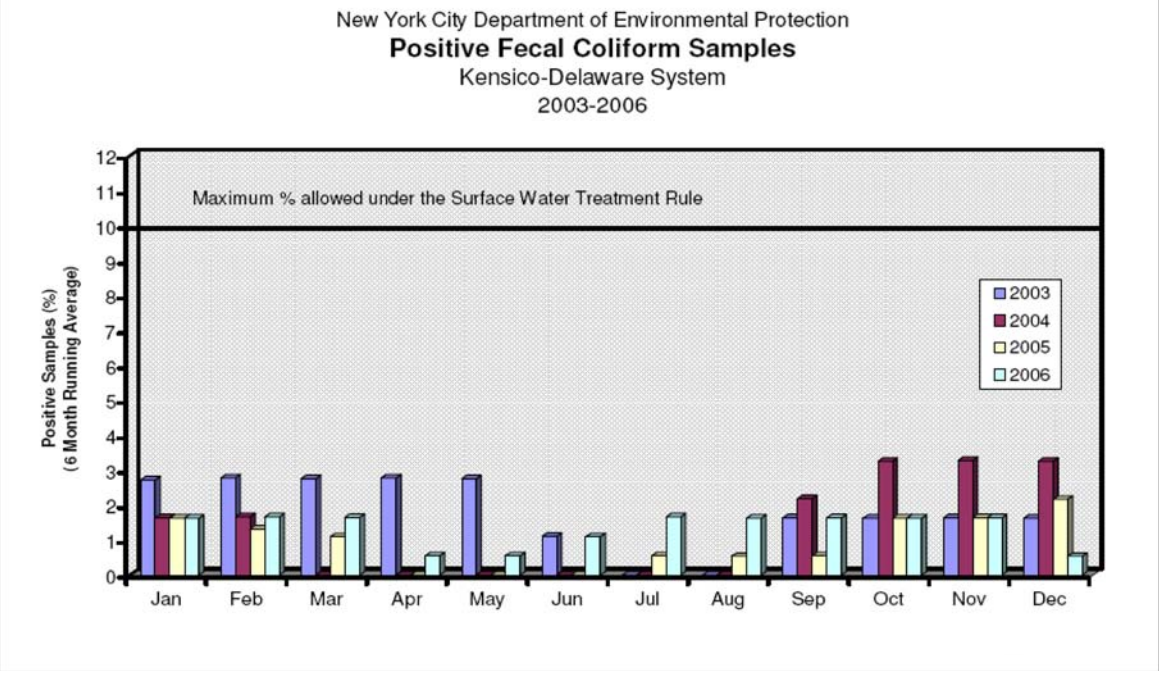

Figure 2.2. Positive fecal coliform samples, Kensico Reservoir, Delaware System, 2003-2006.

2.1.2 Raw Water Turbidity (40 CFR Section 141.71(a)(2))

Both the Catskill and Delaware Aqueduct effluent from Kensico Reservoir exhibited turbidity levels less than or equal to 5 NTU in water prior to disinfection with one exception. On March 23, the turbidity of the Catskill Aqueduct effluent exceeded 5 NTU at approximately 7:40 p.m. and remained above 5 NTU for about 20 minutes. The highest recorded turbidity value was 19 NTU. This rise in turbidity was caused by the start-up of the Catskill Aqueduct following repairs to the chlorine injection system. This constituted a Tier 2 Treatment Technique violation requiring public notification within 30 days. With this one exception, turbidity values did not exceed 4.7 NTU for the Catskill System and 2.7 NTU for the Delaware System.

Beginning January 17, an intense 2 day rain/wind event occurred at the Kensico Reservoir and resulted in localized highly turbid water entering the Catskill Aqueduct at the Catskill Upper Influent Chamber. The turbidity in the Catskill Aqueduct exceeded 1.5 NTU at approximately 4:45 am and continued to rise as the storm continued. As a result of the increase in turbidity, the aqueduct was shut down from 9:25 am on January 18, until 1:00 pm on January 19.

On October 20, a brief intense storm caused a power outage at the Catskill Lower Effluent Chamber (Key point location CATLEFF). This necessitated collection of a drop sample through the building floor and transport of the sample to Delaware Shaft 18 for turbidity analysis. The CATLEFF sample was inadvertently collected twelve minutes prior to the 16:00 four-hour time

moment and had a measured turbidity of 3.3 NTU. NYSDOH acknowledged that the timing of the sample was outside the +/- 5 minute window stated in the SOP but did not issue a Tier 3 Monitoring violation. Since the elevated turbidity was not reflected in readings at the downstream treated sites (CATEV and BX1), the elevated reading at CATLEFF is believed to be due to a sampling anomaly.

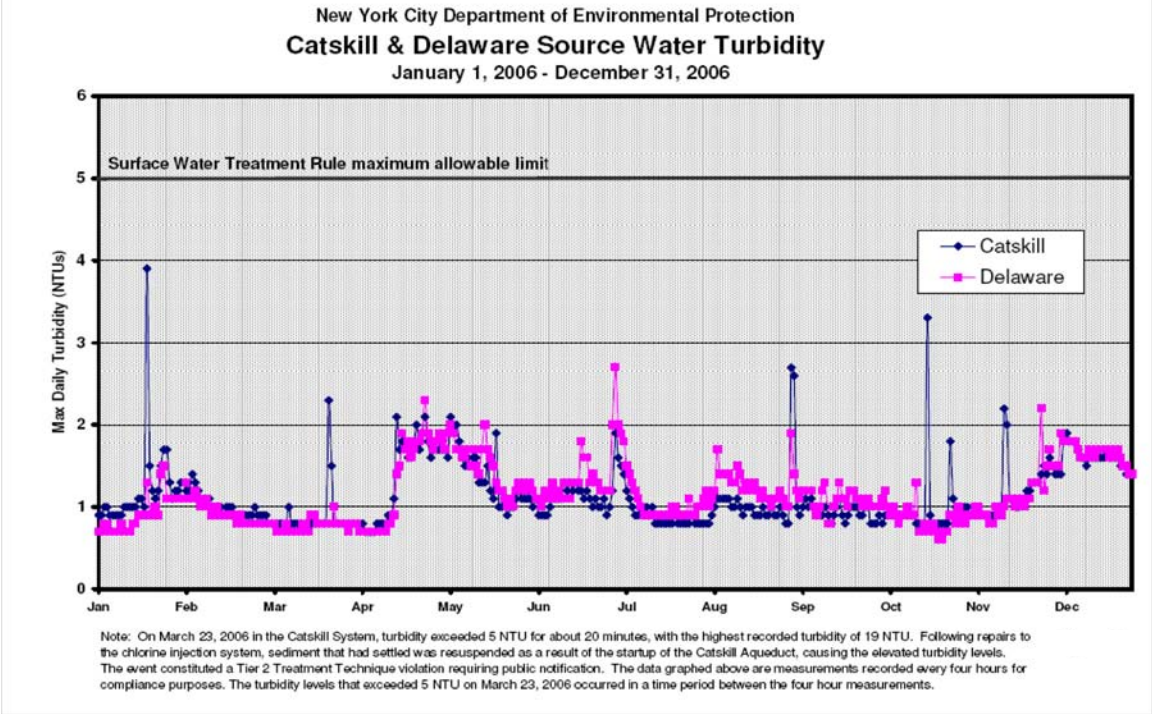

Figure 2.3. Catskill and Delaware source water turbidity, 1/1/06-12/31/06.

2.1.3 Raw Water Disinfection/CT Values (40 CFR Section 141.71(b)(1)(i) and 141.72(a)(1))

CT values recorded each day during the year for the Catskill and Delaware Systems produced net inactivation ratios greater than or equal to 1.0 at all times. The actual lowest net inactivation ratio was 1.9 for the Catskill System and 1.1 for the Delaware System.

2.1.4 Entry Point Chlorine Residual (40 CFR Section 141.71(b)(1)(iii) and 141.72(a)(3))

Chlorine residuals were maintained at concentrations at or above 0.20 mg/l at all Catskill/Delaware entry points during the year. The lowest chlorine residual measured at an entry point was 0.27 mg/l.

2.1.5 Distribution System Disinfection Residuals (40 CFR Section 141.71(b)(1)(iv) and 141.72(a)(4))

All free chlorine residuals measured at compliance sites within the distribution system during the year were greater than or equal to 0.01 mg/l, i.e., free chlorine residual concentrations were measurable/detectable during each sampling event.

Two surveillance samples had 0.0 mg/l free chlorine residuals. Surveillance sites are located on mains that do not have direct service connections to consumers and are not used for compliance purposes. Surveillance samples supplement compliance sites and are collected to gather additional water quality data in the distribution system. Surveillance samples make it possible to optimize process control, assess water quality, facilitate water quality management, and to determine the source and extent of physical and/or biological quality changes, such as high turbidity, color, or coliform occurrences.

2.1.6 Trihalomethane Monitoring (40 CFR Section 141.71(b)(6)) and HAA5 Monitoring (40 CFR Section 141.171)

The analysis for trihalomethanes, performed on a quarterly basis, resulted in a maximum total trihalomethane (TTHM) level of 64 µg/l in the Catskill/Delaware distribution area. The analysis for haloacetic acids, also performed on a quarterly basis, resulted in a maximum haloacetic acid five (HAA5) level of 60 µg/l in the Catskill/Delaware distribution area.

The highest TTHM quarterly running average during the year was 38 µg/l for the Catskill/Delaware distribution area, recorded during the third and fourth quarters, and below the regulated level of 80 µg/l. The highest HAA5 quarterly running average during the year was 43 µg/l for the Catskill/Delaware distribution area, recorded during the first quarter, and below the regulated level of 60 µg/l.

2.2 Total Coliform Monitoring

2.2.1 Monthly Coliform Monitoring (40 CFR Section 141.71(b)(5))

Within the distribution system, coliform monitoring indicated monthly levels below the 5% maximum of the Total Coliform Rule. The number of compliance samples analyzed for total coliform was 9,754. Of these compliance samples, 36 samples were total coliform positive of which one sample was also *E. coli* positive. All resamples, except those of two sites, were negative for total coliform. The actual percentage of compliance samples that were total coliform positive was 0.4%.

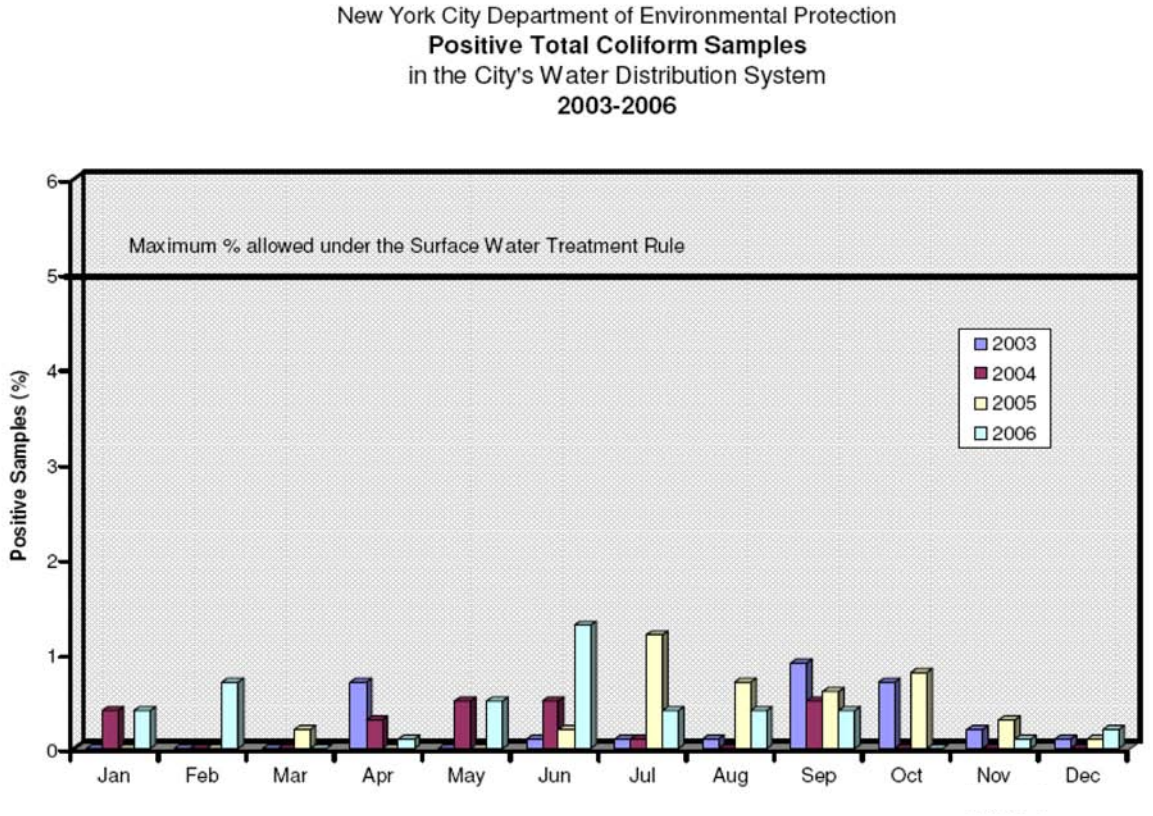

Figure 2.4. Positive total coliform samples in the City's water distribution system.

2.2.2 Chlorine Residual Maintenance in the Distribution System

During the year DEP has continued a number of programs to ensure adequate levels of chlorine throughout the distribution system. These have included: 1) maintaining chlorination levels at the distribution system's four entry points, 2) conducting spot flushing when necessary, and 3) providing local chlorination booster stations at remote locations. Three permanent local chlorination booster stations have been continuously operating to improve the chlorine residual levels at the Fort Tilden, Roxbury and Breezy Point areas (Rockaway Peninsula in Queens), City Island in the Bronx and Floyd Bennett Field in Brooklyn.

As a result of these steps taken by DEP, chlorine residuals were continuously maintained throughout the distribution system during the year. Free chlorine residuals were measurable/ detectable in all 9,754 compliance samples analyzed pursuant to the Total Coliform Rule.

3. Environmental Infrastructure

3.1 Wastewater Treatment Programs

3.1.1 New Sewage Treatment Infrastructure Program

The New Sewage Treatment Infrastructure Program (NIP) funds the study, design and construction of new wastewater projects in seven communities: Andes, Roxbury, Hunter, Windham, Fleischmanns, Phoenicia, and Prattsville.

The Andes WWTP project is complete and project closeout occurred in 2005.

The Roxbury pump station and force main from the Hamlet of Roxbury to the Grand Gorge WWTP are complete. Eighty-seven percent of lateral connections were completed by the end of 2006 (209/241).

The Hunter WWTP and collection system have been constructed. By the end of 2006 approximately 90% of lateral connections were complete.

The Windham WWTP and collection system have been constructed. The three regulatory upgrade-eligible facilities have been connected and are discharging to the sewage treatment plant (Ski Windham, Frog House and Thompson House). Approximately 50% of lateral connections had been made by the end of 2006.

The Fleischmanns WWTP and collection system were substantially completed in 2006.

The Prattsville WWTP and collection systems were substantially completed in 2006.

The Phoenicia WWTP and collection system completed designs and specifications were approved in 2006. Construction bids for the WWTP and collection system were also awarded. On February 3, 2007 Phoenicia residents voted against the project. DEP and stakeholders will be evaluating alternatives in the coming months.

3.1.2 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 and operation and maintenance of the district.

The Bovina community septic system was completed in 2006 and is operational.

Preliminary engineering reports were issued in 2006 for the communities of Bloomville, Boiceville, Hamden, and DeLancey in 2006. The one-year pre-construction phase for the participating communities commenced on May 11, 2006 with the approval of projects and block grant amounts.

In Bloomville, the recommended project is a community septic system with shallow cut-and-fill beds preceded by a sand filter. Sewer district formation was completed in 2006. DEP has received the 65% design submittal on the sewage collection system plans and specifications.

A WWTP was decided upon as the preferred project for Boiceville. Additionally, it was agreed to expand the approved service area to include the Onteora School District and Bread Alone. DEP has received the 65% design submittal on sewage collection system plans and specifications.

The recommended project for Hamden is a community septic system with shallow cut-and-fill beds preceded by a sand filter. Sewer district formation was completed in 2006. DEP has received the 65% design submittal on the sewage collection system plans and specifications received.

In DeLancey, the recommended project is a Septic Maintenance District. The town has created a Septic Maintenance District (SMD). Septic tank pump-outs and facility inspections are complete. Soils testing and data collection have been completed. DEP has received the Facility Plan. The Facility Plan presents a discussion of each property and proposed system.

Change Order #1 for $6,000,000 following the February 2006 EPA Filtration Avoidance Determination Modification was registered by the NYC Comptroller Office on September 20, 2006. This change order provides additional funding necessary for design and construction of a wastewater treatment plant for the Hamlet of Boiceville and for the study, design and construction phases of a community wastewater management project in the next highest priority community on the list.

3.1.3 Sewer Extension Program

The implementation of the MOA Sewer Extension Program continued to move forward during the 2006 calendar year. The main successes of the past year included completing construction of the sewer extensions in the town of Hunter and the signing of an agreement to implement the program in the town of Shandaken by moving forward with plans to construct an extension along NYS Rt. 28 just south of the hamlet of Pine Hill that will provide central sewer service to approximately 20 properties.

The following represents the program's highlights during the past year for each of the communities participating in the program.

Town of Hunter (Tannersville Wastewater Treatment Plant):

The town of Hunter and its engineering consultant, Brinnier & Larios, spent the past year addressing and completing a number of "punch list" items to complete the project. The most notable outstanding items that needed to be addressed included rewiring the control panels on each of the planned pump stations; removing beavers and deconstructing a beaver dam from a pond adjacent to one of the pump stations that caused it to be flooded during major storms; inserting a manhole riser and sealing the storage tank at the pump station affected by flooding; and sealing several manholes along one of the extensions.

On October 17, 2006 DEP staff inspected the work done by the town in addressing the final outstanding items and found that they all were addressed in a satisfactory manner. As a result, on October 30th DEP certified that the project was now complete. Subsequently, on December 29th, DEP assumed the ownership and operation of the extensions from the town. This project is complete.

Town of Roxbury (Grand Gorge Wastewater Treatment Plant):

During the first several months of 2006, DEP staff conducted a background check of the contractor who submitted the lowest bid to construct the planned sewer extension along NYS Rt. 23 just west of the hamlet of Grand Gorge. On May 17th DEP awarded the bid to the above-noted firm and set a construction start date of June 26th. However, due to higher than anticipated inflationary costs during the period between when DEP received bids (November 2005) and the date that DEP awarded the bid, the contractor withdrew its bid.

Following the announcement of the contractor withdrawing its bid, DEP staff worked on preparing documentation for rebidding the project early in 2007. It is now expected that construction of the planned sewer extension will commence in the summer of 2007.

Town of Neversink (Grahamsville Wastewater Treatment Plant):

Significant progress was made in implementing the program in Neversink during the past year. The most important milestone was that the town of Neversink's adoption of a new Sewer Use Law in August 2006.

Also in May 2006, DEP approved the design plans and specifications for the planned sewer extensions. The town let bids for the construction of the extensions in July. Unfortunately, for a variety of reasons, the Town Board was compelled to reject all of the bids and re-bid the project. Subsequently, the project was re-bid and a contract award is expected in the 1st quarter of 2007.

It is now anticipated that construction of the planned extensions will commence in the Spring 2007.

Village of Margaretville & Town of Middletown (Margaretville Wastewater Treatment Plant):

Both Margaretville and Middletown moved forward with two significant activities during 2006 related to advancing the program – development of a new Sewer Use Law and procurement of priority easements the City needs in order to further advance the design and construction of the planned extensions.

The town submitted a draft Sewer Use Law to DEP for review in May 2006. DEP staff reviewed the draft and subsequently met with the town's counsel to review comments and proposed revisions. As of this time, DEP is still waiting to hear back from the town regarding the comments DEP provided.

The village and town also were involved in procuring easements needed for constructing the new sewer mains planned in areas outside of public right-of-ways during the past year. These easements are necessary in order to establish the final alignment of the planned extensions on the project's design plans.

Town of Shandaken (Pine Hill Wastewater Treatment Plant):

After several years of choosing not to participate in the Sewer Extension Program, the town requested that DEP allow them to be reinstated back into the program. To this effect, an agreement was finalized in 2006 to implement the program and move forward with the planning, design and construction of a planned extension along NYS Rt. 28 as previously noted. It is anticipated that the agreement will be signed by both parties early in 2007.

It is anticipated that construction of the planned extension will commence sometime during the 2008 construction season.

3.1.4 WWTP Upgrade Program

As part of the MOA, the City agreed to fund the upgrades of all existing non-City-owned wastewater treatment plants (WWTPs) in the watershed. As reported in previous annual reports, upgrades of City-owned WWTPs, which account for more than a third of WWTP flow in the Catskill/Delaware watershed, proceeded on a separate track and were completed in 1999. Once complete, the upgrades will provide highly advanced treatment of wastewater treatment plant effluent. The task of coordinating these complex projects with the WWTP owners (37) in the Catskill/Delaware watershed is enormous. Many of the owners are restaurateurs, hoteliers, camp operators, school administrators and managers of recreational facilities, not professional WWTP operators and construction specialists. DEP has proceeded diligently with this vast undertaking and provided step-by-step guidance on a host of engineering, operating, contracting and regulatory issues.

DEP has entered into a contract with the New York State Environmental Facilities Corporation (EFC) that identifies a wide range of tasks to be performed by both DEP and EFC to ensure comprehensive management of the overall WWTP Upgrade Program. DEP's and EFC's tasks

have included, but are not limited to: program start-up, establishing contracts with each WWTP owner, providing technical assistance to each WWTP owner and their consulting engineer, change order administration, construction oversight, funds management (including invoice review and reconciliation) and extensive project management. DEP and EFC have continued to provide technical and program guidance to each of the owners and their engineers to assist them through the process of upgrading each unique facility.

The upgrade of non-City-owned WWTPs is divided into two distinct programs: Regulatory Upgrades and (west of Hudson only) SPDES Upgrades. Although two separate programs, the Upgrade Agreement between EFC and the WWTP owner encompasses both programs.

The Regulatory Upgrade Program is designed to assist WWTPs in meeting requirements imposed solely by the WR&R. Treatment technologies required by the Regulatory Upgrade Program include, but are not limited to: phosphorus removal, sand filtration with redundancy, back up power, back up disinfection, tertiary treatment via microfiltration (or DEP-approved equivalent), effluent flow metering and alarm telemetering.

The SPDES Upgrade Program is designed to assist certain WWTPs in meeting the conditions of their current SPDES permits. Equipment that is unreliable or reaching the end of its useful life is eligible for replacement under this program. Additionally, certain SPDES improvements conducted at a facility after November 2, 1995, are also eligible for reimbursement under this program.

The 2006 efforts continued to focus on completing upgrades for WWTPs, as well as authorizing facility Start Up and Performance Testing (SPT), negotiating SPT budgets, negotiating O&M Agreements and processing O&M payments. By the end of 2006, 97% of the total west of Hudson flow had achieved either Functional Completion and began operations (96%) or was under construction (1%). The remaining 3% of the flow is represented by six projects that are finalizing design.

The nine WWTPs in the Upgrade Program scheduled to connect to New Infrastructure Program (NIP) facilities all made excellent progress. Consistent with EPA's direction, these facilities had previously completed installation of interim UV disinfection systems, pending connection to the NIP facilities. By the end of 2006, six facilities had completed construction and connected to local NIP collection systems. A seventh facility completed construction and connected to a local NIP collection system in January 2007. The remaining two facilities have completed connection design and are expected to complete those connections to municipal systems during the 2007 construction season.

Notable progress was also made in advancing projects in the Croton Falls-Cross River basins. Of the nine FAD related WWTPs, eight WWTPs are in the design phase and the largest, Carmel Sewer District 2 with a permitted flow of 1.1 mgd, is nearing completion of construction.

In addition to the above FAD obligations, the Upgrade Program is upgrading sixty non-FAD WWTPs in the east of Hudson watershed. These projects constitute approximately two-thirds of the total number of projects in the Upgrade Program and account for some 4.76 mgd of discharge into the east of Hudson watershed. As of the end of 2006, 76% of the total east of Hudson flow (6.1 mgd) had achieved either functional completion and began operations (28%) or was under construction (48%). Most notable among these projects is the 1.5 mgd Yorktown Heights WWTP for which in 2006, design was completed and construction began for this complex and vital project.

In 2006, some 142 disbursements were made to west of Hudson WWTP owners, valued at some $4.86 million. Of this amount, some $2.65 million was disbursed for construction costs, $0.78 million was for engineering, the bulk of which was design costs, $0.14 million was for SPT and the balance was for miscellaneous charges that included legal and administration activities. An additional $3.15 million in disbursements were made to the nine FAD related WWTPs in the Croton Falls and Cross River basins.

By the end of 2006, DEP had committed more than $100.5 million to filtration avoidance related projects. These include the thirty seven west of Hudson facilities and the nine east of Hudson facilities in the Croton Falls and Cross River Basins.

3.2 Septic Programs

3.2.1 Septic System Rehabilitation and Replacement Program

Since 1997, New York City has committed $28.6 million in funding to rehabilitate, replace, and upgrade septic systems serving single or two-family homes in the City's west of Hudson watersheds.

The Septic System Rehabilitation and Replacement Program is managed by the Catskill Watershed Corporation (CWC), a local not-for-profit organization created to manage Watershed Partnership and Protection Programs. CWC is made up of elected officials from within the west of Hudson watershed, as well as a state representative and a New York City representative.

The CWC Septic System Rehabilitation and Replacement Program consists of the following sub-programs: the Priority Area Program, the Hardship Program, the SDWA-Septic Monitoring Program, and the Reimbursement Program.

The Priority Area Program is an inspection and repair program implemented geographically based upon the proximity of septic systems to reservoirs and watercourses. The Priority Area Program was implemented by CWC in July 1999 in the 60-Day Travel Time Area and has since expanded sequentially to include first septic systems located within 50 feet of a watercourse and/or 300 feet of a reservoir or reservoir stem and then septic systems located between 50 and

100 feet of a watercourse. In 2006, CWC funded the repair or replacement of 202 failing septic systems under the Priority Area Program. A total of 508 failing septic systems have been repaired or replaced under the Priority Area Program.

The Hardship Program funds septic repairs outside of the Priority Area Program for applicants who meet certain income eligibility criteria. In 2006, CWC funded the repair or replacement of 11 failing septic systems under the Hardship Program. A total of 45 failing septic systems have been replaced under the Hardship Program.

The Septic Monitoring Program aims to provide information about the effectiveness of alternative onsite wastewater treatment technologies under local conditions to help designers and regulators select appropriate, cost-effective systems in the west of Hudson watershed. Five different septic system designs have been installed under this program: ATU's, sand filters with leach fields, peat filters with leach fields, raised systems, and conventional systems. CWC and EFC continue to conduct field sampling at the sites. While preliminary results of this research were presented at the September 2006 Watershed Science and Technical Conference, it is too early to make performance assessments. In 2006, CWC funded the repair or replacement of 10 failing septic systems under the Septic Monitoring Program. A total of 36 failing septic systems have been repaired or replaced under the Septic Monitoring Program.

The Reimbursement Program reimburses homeowners who repair or replace failing septic systems outside of the Priority Area Program depending upon funding availability. Presently, homeowners who fixed failing septic systems outside of the priority areas before December 1, 2005 are eligible for reimbursement.

Under the various sub-programs discussed above, CWC funded the repair or replacement of 252 septic systems in the west of Hudson watershed in 2006. Since program inception, the number of failing septic systems repaired, replaced or managed totals 2,380.

3.2.2 Septic Maintenance Program

The Septic Maintenance Program is funded for $1.5 million over ten years. It is a voluntary program intended to reduce the occurrence of septic system failures through regular pump-outs and maintenance. CWC pays 50% of eligible costs for pump-outs and maintenance.

This program has been expanded by making eligible new septic systems installed after January 1997 which are at least three years old.

CWC subsidized a total of 87 septic tank pump-outs in 2006**.** Since program inception a total of 235 septic tank pump-outs have been subsidized.

3.2.3 Alternate Design Septic Systems Program

The Alternate Design Septic Systems Program is a $3 million program to pay for the importation of fill material and/or pumping apparatus for the construction of septic systems where required solely by DEP or its delegate in order to comply with the Watershed Rules and Regulations.

One applicant received Alternate Design Septic System funding from CWC in 2006 for pumping and additional fill necessary to meet the requirements of the Watershed Rules and Regulations. The proposed location of the leach field was moved to meet the Watershed Rules and Regulations requirement of a 250 ft. setback from a watercourse.

3.3 Stormwater Programs

3.3.1 Stormwater Retrofit Program

The Stormwater Retrofit Program is administered jointly by CWC and DEP. The total program budget has risen to $14,041,800; $11,953,050 for capital expenditures, $2,088,750 for maintenance activities, and $1,250,000 to conduct community-wide stormwater infrastructure assessment and planning initiatives.

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 project has already been successfully completed or where a New Infrastructure Program project or Community Wastewater Management Program project is in progress. The required "local share" contribution is 15% of the projected capital construction cost; however, in areas of preference, New Infrastructure and Community Wastewater project areas, the local share requirement has been eliminated to promote the synergistic effect of coordinated project schedules.

Construction Grants

During the period from 2002 through 2006, 51 construction grants have been reviewed and approved for funding for a total of $9,264,426, with two project applications withdrawn and two others incorporated into other related projects. Twenty-nine projects have been completed utilizing $4,317,929 of program funds, focusing on street drainage, stormwater separation, and stormwater treatment and highway maintenance activities.

Table 3.1. Completed capital construction projects.

Applicant	Project Description	Grant Amount
	Cannonsville Watershed	
Village of Hobart Various Locations	Sewer Separation, I/I Reduction	$21,375
Village of Walton Bruce Street	Collection, Conveyance, Filtration	$475,989
Delaware County DPW Bovina Center	Collection, Conveyance, Sedimentation	$1,686,488
Delaware County DPW	Truck-Mounted Vacuum Equipment (Vac-All & Accessories)	$171,423
Delaware County DPW	Programmable Ice Control	$8,483
Village of Stamford Railroad Avenue	Sewer Separation, Collection, Conveyance and Sedimentation	$231,448
Clark Co.	Collection, Conveyance, Sedimentation and Infiltration	$148,304
Village of Delhi Orchard and Prospect Streets	Collection, Conveyance, Sedimentation	$37,005
	Pepacton Watershed	
Margaretville Central School	Collection, Conveyance, Filtration	$128,070
Roxbury Central School	Collection, Conveyance, Sedimentation	$34,149
Village of Margaretville Academy Street	Sewer Separation, Collection, Conveyance and Sedimentation	$679,943
Town of Halcott Elk Creek Road	Collection, Conveyance, Sedimentation	$47,034
Town of Roxbury Ridge Street	Collection, Conveyance, Sedimentation	$26,122
Village of Margaretville Park	Collection, Conveyance, Sedimentation and Infiltration	$6,878

Table 3.1. Completed capital construction projects.

Applicant	Project Description	Grant Amount
Town of Roxbury New Infrastructure Program	Conveyance, Erosion Control	$44,273
	Schoharie Watershed	
Town of Roxbury Johnson Hollow Road	Conveyance	$9,900
Green County SWCD	Critical Area Seeding Program / Hydro-seeder	$58,243
Town of Windham Mitchel Hollow Road	Collection, Conveyance, Sedimentation	$25,125
Village of Tannersville Various Locations	Sewer Separation, I/I Reduction	$107,161
Town of Jewett Carr Road	Feasibility Study	$9,900
Town of Windham Hickory Hill Road	Collection, Conveyance, Sedimentation	$87,671
Windham Ventures Parking Lot	Collection, Conveyance, Sedimentation	$20,500
Town of Roxbury Cronk Lane – Grand Gorge	Collection, Conveyance, Sedimentation	$36,575
Hunter Mt. Parking Lot	Collection, Conveyance, Sedimentation	$63,367
Town of Windham Municipal Parking Lot	Collection, Conveyance, Sedimentation	$25,834
	Rondout Watershed	
Grahamsville Deli Parking Lot	Collection, Conveyance, Sedimentation	$5,625
Town of Wawarsing Campbell Road	Collection, Conveyance, Sedimentation	$5,175
	Neversink Watershed	
Town of Denning Transfer Station	Collection, Conveyance, Sedimentation and Infiltration	$9,931

Table 3.1. Completed capital construction projects.

Applicant	Project Description	Grant Amount
	Ashokan Watershed	
Town of Hurley Landfill and Transfer Station	Collection, Conveyance, Sedimentation and Infiltration	$105,938

Planning and Assessments

Planning and Assessment project applications now have an "open" enrollment period, similar to the Construction Grant Program. Completed projects provide a basis for future capital construction projects. During the period through 2006, 13 Planning and Assessment projects were reviewed and approved for funding for a total of $438,058. To this date, four Planning and Assessment projects have been completed, for a total of $134,760.

Table 3.2. Completed planning and assessment projects.

Applicant	Grant Amount
Ashokan Watershed	
Town of Hurley / Glenford	$4,000
Ulster County Highways_1	$50,000
Schoharie Reservoir	
Village of Hunter	$42,260
Southern Schoharie County	$38,500

3.3.2 Future Stormwater Controls Program

The Future Stormwater Controls Program pays for the incremental costs of stormwater measures required solely by the 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.

There are two separate programs developed to offset additional compliance costs incurred as a result of the implementation of the Watershed Rules and Regulations. The west of Hudson Future Stormwater Controls Program was established by Paragraph 128 of the MOA, funded to a total amount of $31.7 million over ten years, and is administered by CWC, which reimburses municipalities and large businesses 100% and small businesses 50% for eligible costs. Paragraph

145 of the MOA is a separate program known as Future Stormwater Controls Paid for by the City and reimburses low income housing projects and single family homeowners 100% and small business 50% for eligible costs.

The west of Hudson Future Stormwater Controls program has paid out $3,170,000 to CWC in 2006, for a total of $30,643,333 paid out since 1997. Of that total, CWC has provided $2,391,211 in funding for stormwater BMPs and allocated $96,875 in maintenance funding. CWC has also, pursuant to contract terms, transferred $10,132,451 to other eligible watershed protection programs. See listing below.

Table 3.3. Future stormwater controls projects.

Applicant	Project	Approval Date	CWC Funding	Other Funding
Copperhead Inn & Spa	Inn Addition	7/27/99	$3,647	50% by NYC
	Subsurface Infiltration System	5/23/00	$3,250	50% by NYC
	Out-Fall Energy Dissipater			
	Maintenance	4/26/05	$3750.79	50% by NYC
D & D Real Estate, Inc.	Grahamsville Post Office	7/27/99 8/24/99	$2,000	50% by NYC
	Subsurface Infiltration	4/29/00	$3,562.98	50% by NYC
		5/23/00	$440.50	50% by NYC
		6/27/00	$5,176.07	50% by NYC
		8/22/00	$7,921.04	50% by NYC
Delaware National Bank of Delhi	New Margaretville Branch Office	12/17/98	$43,120.26	50% by NYC
	Water Quality Inlet	1/26/99		
	Infiltration Basin			
	Stabilized Channel			
Delaware Park, LTD	Car Wash / Commercial Park	4/24/99	$25,403.13	50% by NYC
	Extended Detention Basin	10/26/99	$1,677.52	50% by NYC
	Constructed Wetland	11/23/99	$2,367.30	50% by NYC
	Stabilized Over-Flow			
Town of Halcott	Sand and Salt Storage Bldg.			
	Extended Dry Detention Basin	11/23/99	$19,000	None
	Stabilized Channel			
Hamden Garage and Tire	Garage expansion - design only	4/24/99	$1,735	50% by NYC

Table 3.3. Future stormwater controls projects.

Applicant	Project	Approval Date	CWC Funding	Other Funding
Town of Hurley	Highway Storage Facility	4/24/99	$24,610	None
	Sand and Salt Facility	11/23/99	$5,130	None
	Sedimentation Basin			
I. & O. A. Slutzky	Tennis Courts			
	Retention Basin	4/24/99	$4,215	None
Mallinkrodt Corporation	Hobart Facility Expansion			
	Extended Dry Detention	10/27/98	$50,261.30	None
Ski Windham	New Ski Trail - costs over State /			
	Fed regs due to NYC regulations	4/24/99	$30,209.29	None
	Water-Bars			
	Flow-Levelers			
	Stabilized Out-Fall			
	Slope Stabilization			
Stucki Embroidery Works,	Building Addition			
Inc.	*Subsurface Infiltration*	7/27/99	$9,769.29	50% by NYC
Town of Windham	Soccer Field in C. D. Lane Park			
	Erosion Control and	9/28/99	$4,815	None
	Sedimentation			
Ulster County	Shandaken Sand & Salt Facility			
	Extended Dry Detention	11/23/99	$20,210	None
	Stabilized Outlet			
Verona Oil	Verona Service Station - Walton			
	Oil / Water Separation /	2/22/00	$95,448.89	None
	Subsurface Infiltration	2/22/05	$20,000	
	Maintenance			
Stamford Farmers	New Building Construction			
Cooperative	*Subsurface Infiltration*	3/28/00	$3,970.73	50% by NYC
Town of Middletown	Highway Complex (New)			
	Erosion Control and	6/27/00	$77,280	None
	Sedimentation			
	Extended Dry Detention			

Table 3.3. Future stormwater controls projects.

Applicant	Project	Approval Date	CWC Funding	Other Funding
Town of Middletown	Town Offices *Subsurface Detention* *Subsurface Infiltration*	3/27/01	$39,842	None
Ulster County	Sundown Sand & Salt Facility *Extended Dry Detention* *Stabilized Outlet*	8/28/01	$22,100	None
Camp Loyaltown	Swimming Pool *Extended Dry Detention*	9/25/01	$54,852.20	None
Walton Central School	High School Running Track *Subsurface Detention / Infiltration*	9/25/01 11/27/01	$146,155 $75,745	None
Clark Management, Inc.	Betty Brook Subdivision *Generic Stormwater Plan / Guidance Documents*	9/25/01	$9,712.50	50% by NYC
Hamil	Water Business Expansion	11/27/01	$1,991.99	50% by NYC
Village of Hunter	Dolan Park Project *Subsurface Infiltration* *Slope Stabilization*	11/27/01	$33,898.50	None
Tannersville (V)	Bike Path Progress Payment *Subsurface Infiltration*	10/22/02	$10,000	None
Tannersville (V)	Bike path remediation (not to exceed)	11/26/02 9/23/03	$160,000 $52,542	None
Daniel Pierce Library	Library addition and parking lot	11/26/02	$123,431	None
Septic Program Fund Transfer	General Program Funding		$3,170,000	
Morning Star Foods		3/25/03	$254,691	None
Tri-Valley Central School		3/25/03	$6,890	None

Table 3.3. Future stormwater controls projects.

Applicant	Project	Approval Date	CWC Funding	Other Funding
Grey's Woodwork	New Building Construction *Subsurface Detention / Infiltration*	11/26/03	$33,389	50% by NYC
Community Septic Program Fund Transfer	Bovina Community Septic	2/24/04	$1,585,000	None
Community Septic Program Fund Transfer	Hamden Community Septic	2/24/04	$200,000	None
Delaware County	Public Safety and Office Building	11/30/04	$45,976	None
Community Septic Program Fund Transfer	Lateral Reimbursement Program	11/30/04 4/26/05	$120,000 $880,000	None
Amy Jackson	New Building Construction *Subsurface Detention / Infiltration*	1/25/05	$15,000	
Cannie D's	New Building Construction *Subsurface Detention / Infiltration*	1/25/05	$29,772.29	50% by NYC
Septic Program Fund Transfer	Hardship	4/26/05	$500,000	None
Community Wastewater Program Fund Transfer	General Program Funding	4/26/05	$500,000	None
Stream Corridor Program Fund Transfer	New Program	4/26/05	$1,120,000	None
James Cox Gallery		4/26/05	$367.07	50% by NYC
Timber Lake Corporation	Camp Timber Lake	4/26/05 7/26/05	$12,025.98 $600	50% by NYC
Verona Oil	Verona Service Station - Windham *Oil / Water Separation* *Subsurface Infiltration*	5/24/05	$145,000	None

Table 3.3. Future stormwater controls projects.

Applicant	Project	Approval Date	CWC Funding	Other Funding
Frosty Land	Kaatskill Mountain Club Condos *Sedimentation / Detention / Infiltration* Maintenance	8/23/05 11/28/06	$287,025 $2,590.48 $10,000	None
DFF Enterprises, LLC	Meadow Hill Subdivision *Grassed Swales*	11/29/05	$5,504	50% by NYC
Stewart's Shops	Haines Falls Convenience Store *Underground Storage* *Oil/water separator* *Sand Filter*	2/28/06	$367,424.95	None
Community Wastewater Program Fund Transfer	Ashland, Bloomville, Boiceville, Bovina, Hamden and Delancey	5/23/06	$1,500,000	None
Verona Oil	Maintenance	7/25/06	$40,000	
Cannie D's	Maintenance	8/22/06	$10,000	50% by NYC
Stewart's Shops	Maintenance	8/22/06	$20,000	
Community Wastewater Program Fund Transfer	Delancey	9/26/06	$557,451.52	None
Trailside at Hunter Mountain	Condo Development *Sedimentation* *Infiltration* *Constructed Wetlands'*	9/26/06	$225,600.38	50% by NYC
Margaretville Lodging, LLC	Motel Development *Interceptor Piping* *Underground Detention* *Water Quality Ponds*	9/26/06	$238,600.08*	50% by NYC

3.3.3 Future Stormwater Controls Paid for by the City

In 2006, DEP received ten new applications for reimbursement of the design and implementation of stormwater controls pursuant to paragraph 145 of the Watershed Memorandum of Agreement. All the applications received were associated with projects in the west of Hudson watershed. Two additional outstanding applications from previous years are also included.

The following summarizes the applications for funding DEP received during the reporting period, and the disposition of those applications:

- DEP received an application from an existing small business to reimburse 50% of the costs related to operations and maintenance required of the previously approved Stormwater Pollution Prevention Plan (SPPP). Per the WR&Rs, the SPPP was required for the construction of a gas station. The applicant was approved for a reimbursement of $6,555.61 by DEP. As of the close of 2006 the applicant had not yet received the reimbursement. *(T)Neversink – Cannie D's*
- DEP received an application from an existing small business to reimburse 50% of the costs related to design and implementation of an SPPP required for expansion of an impervious surface within limiting distances of a watercourse, per the WR&Rs. The applicant was approved for a reimbursement of $112,800.19. As of the close of 2006 the applicant had not yet received the reimbursement. (V) *Hunter – Trailside Hunter Highlands*
- DEP received an application from an existing small business to cover 50% of the reimbursement costs related to design and implementation of an SPPP required for expansion of an existing impervious surface and disturbance greater than 2 acres, per the WR&Rs. The applicant requested $7,668.00 for engineering costs and $230,932.00 for construction. The reimbursement is still being reviewed by DEP. *(T) Middletown – Best Western*
- DEP received an application from a small business to reimburse 50% of the costs related to design and implementation of an SPPP required for expansion of an impervious surface within limiting distances of a watercourse per the WR&Rs. The applicant requested reimbursement of $5,000 in engineering fees and $51,354.24 in construction costs. The reimbursement is still being reviewed by DEP. *(V) Delhi – Ames Plaza Expansion*
- DEP paid $5,504.37 to a new small business for reimbursement of 50% of the costs associated with the design and implementation of an SPPP required for construction of a subdivision involving a disturbance greater than two acres located within limiting distances of a greater than 15% slope, watercourse, or wetland per the WR&Rs. *(T) Bovina –Meadow Hill Subdivision*
- DEP paid $3,750.79 to an existing small business for reimbursement of 50% of the costs associated with the emergency maintenance of a previously approved and constructed SPPP required for construction of a new impervious surface within 100 feet of a watercourse, per the WR&Rs. *(T) Shandaken – Copperhood Inn*
- DEP paid $1,058.75 to a low income housing project for reimbursement of 100% of the costs associated with construction of 40,000 square feet of new impervious surface, including four new two-story wood frame apartment complexes. *(V) Stamford – Stamford Village View Apartments*
- DEP reviewed an application from a new large business for reimbursement of 100% of the SPPP costs related to the design and implementation of a gas station. An approximate amount of $367,424.95 was reimbursed by the CWC under MOA 145 funds.(*T) Hunter – Stewart's*
- DEP reviewed an application from an existing large business for reimbursement of 100% of the SPPP costs related to the design and implementation of a gas station. An approximate amount of $120,097.11 was reimbursed by the CWC under MOA 145 funds.(*T) Windham – Verona Oil*
- DEP reviewed an application from a town for reimbursement of 100% of the SPPP costs related to the design and implementation of a municipal park. The application was denied as

DEP did not require an SPPP. NYSDEC required an SPPP which is not eligible for reimbursement under MOA145 funds. Disturbance was less than 2 acres. $163,350.00 was requested for costs related to engineering and construction, and $7400.00 for annual maintenance. (*T) Windham – Creamery Pond Park*

- Still outstanding, no response from applicant since 2004. In 2004, DEP received an application to cover 100% of the cost of designing and implementing an Individual Residential Stormwater Permit (IRSP) associated with the construction of a single-family residence. The WR&Rs required that an IRSP be prepared because the dwelling was within a limiting distance to a watercourse specified in the WR&Rs. The applicant did not submit breakdown costs for the construction by the close of 2004. *(T) Windham –Grabinski/Moreno*
- Still outstanding, no response from the applicant. In 2004, the City received an application to cover 50% of (approximately $18,400) the cost of designing and implementing an SPPP associated with the construction of impervious surface within 100 feet of a watercourse. The proposal included a commercial addition to an existing residence. A Variance was required in order for the project to be approved for construction. In 2005, the City offered a reimbursement of $2437.17. The applicant never responded to the offer. *(T) Hunter – Amy's Take Away*

4. Protection and Remediation Programs

4.1 Waterfowl Management Program

Pursuant to the November 2002 FAD, the Waterfowl Management Program will submit a separate annual report on July 31, 2007.

4.2 Land Acquisition

During 2006, the last year of the original ten-year program, there were no formal solicitation goals to meet; the required deliverable under the 1997 and 2002 Filtration Avoidance Determination (FAD) of soliciting 355,050 acres was met in 2004. "Resolicitation" goals had been established as outlined further below and in a DEP submission of October 2003. During December of 2006, DEP completed resolicitation of 88,850 acres as planned for Year 10 of the program. Total acres solicited remain over 385,000 acres, substantially beyond the deliverable of 355,050. The results of all resolicitation activity to date continue to indicate that such re-solicit efforts produce results, whether contacting the same landowner or one who recently acquired the property.

- By the end of calendar year 2006, DEP had secured a total of 842 purchase contracts (fee simple and conservation easements) comprising 61,753 acres throughout the Cat/Del watershed at a cost of $178 million (additional "soft" costs of roughly $16 million). Of these, 728 projects totaling 53,628 acres have been acquired (closed), with the remaining projects under purchase contract. During 2006, 65 projects comprising 4,960 acres were closed and 78 projects accounting for 5,454 acres were signed to purchase contract.
- As of 1996 the City owned 36,047 acres of land surrounding reservoirs in Cat / Del; as of December 31, 2006 the City (including WAC farm easements) had secured an additional 76,681 acres – more than tripling land under City control to a total of 112,728 acres. In 1996 roughly 3.5% of the watershed was owned by the City; today roughly 11% is controlled or owned.
- An additional 900 acres of land were signed to contract in Priority Areas 1A/B and 2.
- Due in part to a relaxation of market pressures along with continued strong solicitation by DEP, the downward trend in acres acquired was reversed with almost 10% more acreage and 18% more contracts signed than in 2005.

Solicitation

All solicitation requirements to date have been satisfied, with the total acres solicited exceeding 385,000 acres. With the end of formal MOA / FAD solicitation in 2004, LAP submitted to EPA a Resolicitation Plan (October, 2003) which has provided an efficient mechanism to solicit interest within the pool of those previously solicited. This plan has been followed and goals have been met. Experience indicates that re-soliciting the same acreage – those properties determined to be highly ranked against others in the same basin and Priority Area – continues to yield success.

Acquisition

During 2006 throughout the Cat / Del systems, 5,454 acres in 78 purchase contracts were signed by DEP, while 65 projects comprising 4,960 acres were closed by DEP. An additional 1,646 acres were signed by WAC yielding a total of 7,100 acres secured this year. As of the end of 2006, a total of 842 purchase contracts comprising 61,753 acres were secured by DEP alone watershed-wide (signed to purchase contract or closed) in the Cat / Del. Of these, 728 projects totaling 53,628 acres have been acquired (closed), with the remaining 114 projects totaling 8,128 acres under purchase contract.

The number of acres signed to contract by DEP increased from 4,879 in 2005 to 5,454 in 2006. This increase was due in large part to the perceived slowdown in recent market increases, a perception that led more owners to consider sale to the City.

Riparian Buffers: CAT/DEL only

Prior to 1997 the City controlled 1,490 acres of riparian buffers (100 feet from streams). Since 1997, the City has protected an additional 3,897 acres of buffers under fee simple acquisition and 1,088 acres under conservation easements; WAC has protected 1,204 acres through farm easements. When other entities (DEC, land trusts, etc.) are included, a total of 22,240 acres of stream buffers are protected, or 28.8% of the 77,228 acres of buffers calculated to exist in the Catskill / Delaware system.

Wetlands: CAT/DEL only

DEP calculates that 42,680 acres (4.1%) of the Cat/Del system are deepwater habitat (2.73%), or wetlands as defined by DEC or the US Army Corps of Engineers (1.34%). Of these, the City has protected 1,835 acres since 1997 within newly acquired lands or conservation easements, which represents 2.20% of wetlands and 0.23% of deepwater habitats.

Technical Program Improvements

During 2006 the City continued to improve and revise program documents and policies in order to maximize Program competitiveness within the marketplace and under the requirements of MOA, FAD, WSP, and City code:

- Purchase Contract: the terms were improved to allow for higher downpayments to landowners early in the contract process. Closing time frames are now down to 14 months WOH and 12 months EOH for standard fee simple projects.
- Conservation Easement: a comprehensive review was almost completed during 2006 and expected to be implemented in 2007; terms were designed to be more attractive to a certain class of landowners.
- Continued advancements were made with regard to technical support (Land Acquisition Tracking System and Watershed Land Information System).

Conservation Easement Program

During 2006, 10 easements totaling 1,428 acres were signed to purchase contract by DEP and 18 easements totaling 2,298 acres were closed. This brings DEP's easement program in the Cat/Del to 75 easements totaling 11,562 acres closed or under contract.

Whole Farm Easement Program

As of the end of 2006, the Watershed Agricultural Council (WAC) held Farm Easements on 32 farms totaling 6,202 acres, with executed contracts remaining on another 16 farms totaling 2,392 acres. The success of the program has convinced DEP, in consultation with EPA, to favorably consider additional funding beyond the $10 million for 'agricultural' easements and $10 million for 'forest' easements (from the original $250 million Land Acquisition Program fund) allocated to date. During 2006, $7 million in new funding (from the $50 million Supplementary Fund discussed in MOA section 74) was requested by DEP and formally approved and released, and has already been largely committed by WAC to new farm easement projects. An additional $20 million has been agreed to by EPA and DEP, also to be allocated from the Supplementary Fund. Prior to modifying the program contract and approving these funds, WAC and DEP have been negotiating terms of the program contract. These negotiations were almost completed by the end of 2006, and submission of the formal program contract amendments for internal budget approval is expected in early 2007.

Water Supply Permit

As provided by the 1997 Permit, the City submitted a letter mid-year to DEC in order to trigger the automatic Permit renewal. The renewal was issued just after the close of 2006.

Transfer of Conservation Easements on Fee Acquisitions to NYS

During 2006, 8 CEs covering 110 newly acquired parcels and 15,767 acres were submitted to DEC, bringing the total submissions to 20 CEs covering 246 parcels comprising 16,464 acres. The latest submissions are being processed by DEC, with filed deeds expected in 2007.

Table 4.1. Contracts signed in 2006 by system and R.E. type.

R.E. Type	# of Parcels	Acres	Average Acres	Purchase Price
System: Cat-Del				
Fee	68	4,030	59	$22,204.36
CE	10	1,426	143	$3,045.88
WAC CE	8	1,646	206	$2,714.94
Cat-Del SubTotal	86	7,102	83	$27,.965.18

* Includes all contracts signed or closed as of the effective date

Table 4.2. Program summary* through 12/31/06 by system and basin.

R.E. Type	# of Parcels	Acres	Average Acres	Purchase Price
		System: Cat-Del		
Kensico	11	219	20	$15,406,781
West Branch	177	8,419	48	$67,872,900
Ashokan	158	9,888	63	$22,104,688
Rondout	103	6,333	61	$7,756,099
Neversink	19	3,629	191	$3,195,463
Schoharie	137	13,323	97	$16,367,375
Pepacton	155	14,892	96	$15,077,787
Cannonsville	157	19,975	127	$20,494,047
Cat-Del Sub-Total	917	76,678	84	$194,827,985

* Includes all contracts signed or closed as of the effective date; includes fee, CE and WAC CE contracts

Table 4.3. Program summary* through 12/31/06 by system and priority area.

Priority Area	# of Parcels	Acres	Average Acres	Purchase Price
1A	103	4,800	47	$28,177,420
1B	248	12,592	51	$68,383,996
2	130	9,075	70	$17,906,660
3	201	22,590	112	$24,414,654
4	235	27,622	118	$29,392,410
CAT-DEL Sub-Total	917	76,678	84	$194,827,985

* Includes all Contracts Signed or Closed as of the effective date; Includes Fee, CE and WAC CE Contracts

4.3 Watershed Agricultural Program

The Watershed Agricultural Program began in 1992 as a comprehensive effort to develop and implement pollution prevention plans on 85% of the commercial farms[1] in the City's Catskill and Delaware watersheds. The program is a voluntary partnership between the DEP 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 seeks to incorporate the economic and business concerns of each farm into the development of its Whole Farm Plan in order to fully establish the principles and goals of pollution prevention into the farm operation. In recent years, the Program has expanded to farms with smaller gross farm income ("Small Farms") and farms in the Croton Watershed.

The Watershed Agricultural Program strives to maintain and protect the existing high quality of the NYC water supply system from agricultural nonpoint source pollution through the planning and implementation of Best Management Practices (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.

Largely funded by DEP, the Program is administered by the not-for-profit Watershed Agricultural Council, whose board consists of farmers, agri-business representatives and the DEP Commissioner. Over time, the City and WAC have been able to leverage generous financial support from other sources to complement and 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 the Council.

4.3.1 FAD Program Goals

Table 4.4 below summarizes the accomplishments to date of the Watershed Agricultural Program (WAP) towards meeting the goals and milestones of the November 2002 FAD.

Table 4.4. Accomplishments to date of the Watershed Agricultural Program (WAP).

Task	Farms	Sub-Farms	Total Farms	FAD Goal 12/31/06
Farm Sign-ups	329	-	329	Monitor
Current Eligible Sign-ups*	248	41	289	

1. "Commercial Farm" is defined as earning greater than $10,000 in annual gross farm income.

Table 4.4. Accomplishments to date of the Watershed Agricultural Program (WAP).

Task	Farms	Sub-Farms	Total Farms	FAD Goal 12/31/06
WFP Implementation Agreements	247	41	288	All Participating Farms
WFPs Commenced Implementation				All Participating
Active	154	27	181	Farms
Under Revision	45	12	57	
Inactive	38	2	40	
Total	237	41	278**	
WFPs Substantially Implemented				All Participating
Active	109	12	121	Farms
Under Revision	45	12	57	
Inactive	46	2	48	
Total	200	26	226	
WFP Annual Follow-up	196	25	221	206

*Note: 82 farms that have signed up are no longer eligible for the program due to a change in the farm operation (i.e. farm is out-of-business, all animals were sold etc.)
**Note: 8 farms went out of business before any implementation occurred.

There are three milestones that Watershed Agricultural Program did not meet this year even though it continued to maintain an aggressive rate of implementation.

Commenced Implementation: The goal for 2006 was for 288 (or all participating) farms to have commenced implementation. The number achieved was 278 farms (in addition, there are 8 farms that went out of business before any implementation occurred). This leaves two approved WFPs that have no documented implementation. One of these farms was approved in November of 2005 and has nine BMPs scheduled to be implemented in 2007, which will also make this farm substantially implemented. The other farm, a greenhouse operation, was revised in 2006 due a change in farm ownership and management and has two BMPs currently under contract and others scheduled for implementation in 2007. Figure 4.1**,** below tracks the program accomplishments for this milestone from 1999 through 2006.

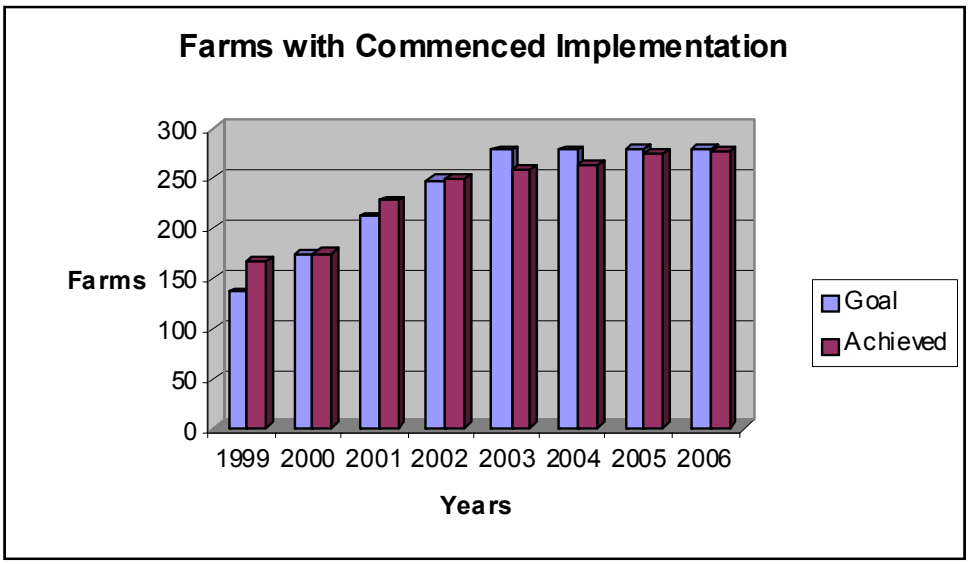

Figure 4.1. Farms with commenced implementation.

Farms Substantially Implemented: There are now 226 farms substantially implemented 62 short of the FAD milestone of 288. Figure 4.2 below tracks the accomplishments made towards achieving this milestone.

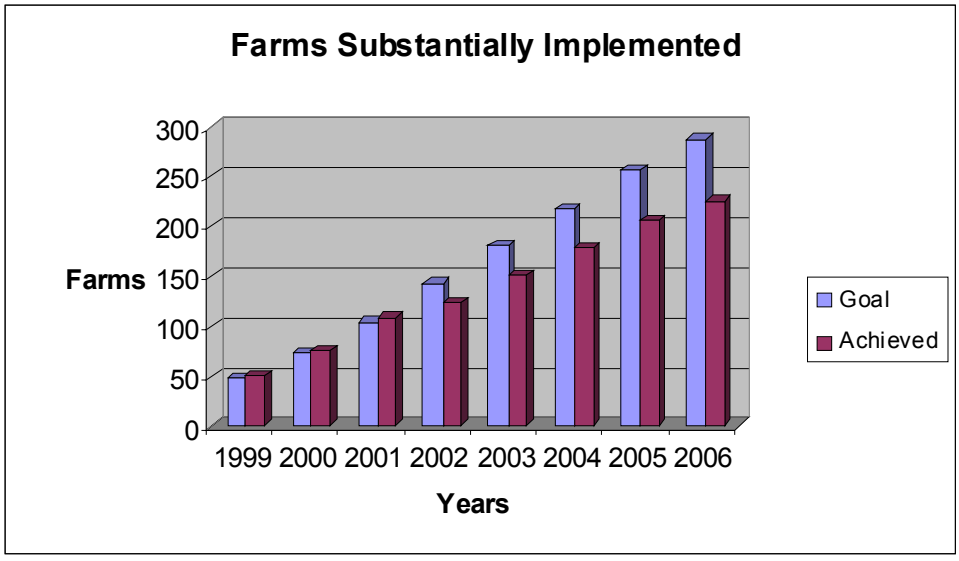

Figure 4.2. Farms substantially implemented.

WFP Annual Follow-ups: There were 206 farms that were substantially implemented in 2005 that required an Annual Status Review in 2006. See Figure 4.3. To date, WAP staff has completed ASRs on 221 farms. However there are still 21 farms that were substantially implemented in 2005, but did not have an ASR in 2006. DEP has requested and WAC has agreed that the outstanding ASRs for 2006 will be completed by the end of February.

4.3.2 Status of Farm Numbers in the Watershed

There are 289 (including 41 sub-farms) commercial farms signed up for the program out of a possible 308 farms. This represents 93.8% participation rate. The original FAD goal was to have 85% participation. The total number of commercial farms includes 6 previously unidentified farms that have expressed interest and WAC anticipates they will sign up to participate in the program in 2007.

Currently, there are 288 farms (including 41 "sub-farms") with Whole Farm Plan agreements, representing 93.5% of commercial farms in the watershed. There is one farm that has signed up but still does not have a plan. This farm has been unable to come to agreement on a final plan and is unlikely to do so. The landowner, who rents his farm to a dairy farmer, objected to having the dairy cows and heifers excluded from the water course or implementing any other BMPs that would have reduced the amount of time that the cows were in the stream. Despite this hurdle, the farmer has made some changes to his operation as a result of the whole farm planning process, such as: moving his feeding area away from the stream; no longer spreading manure up to the edge of the stream; and employing strip cropping to reduce soil erosion.

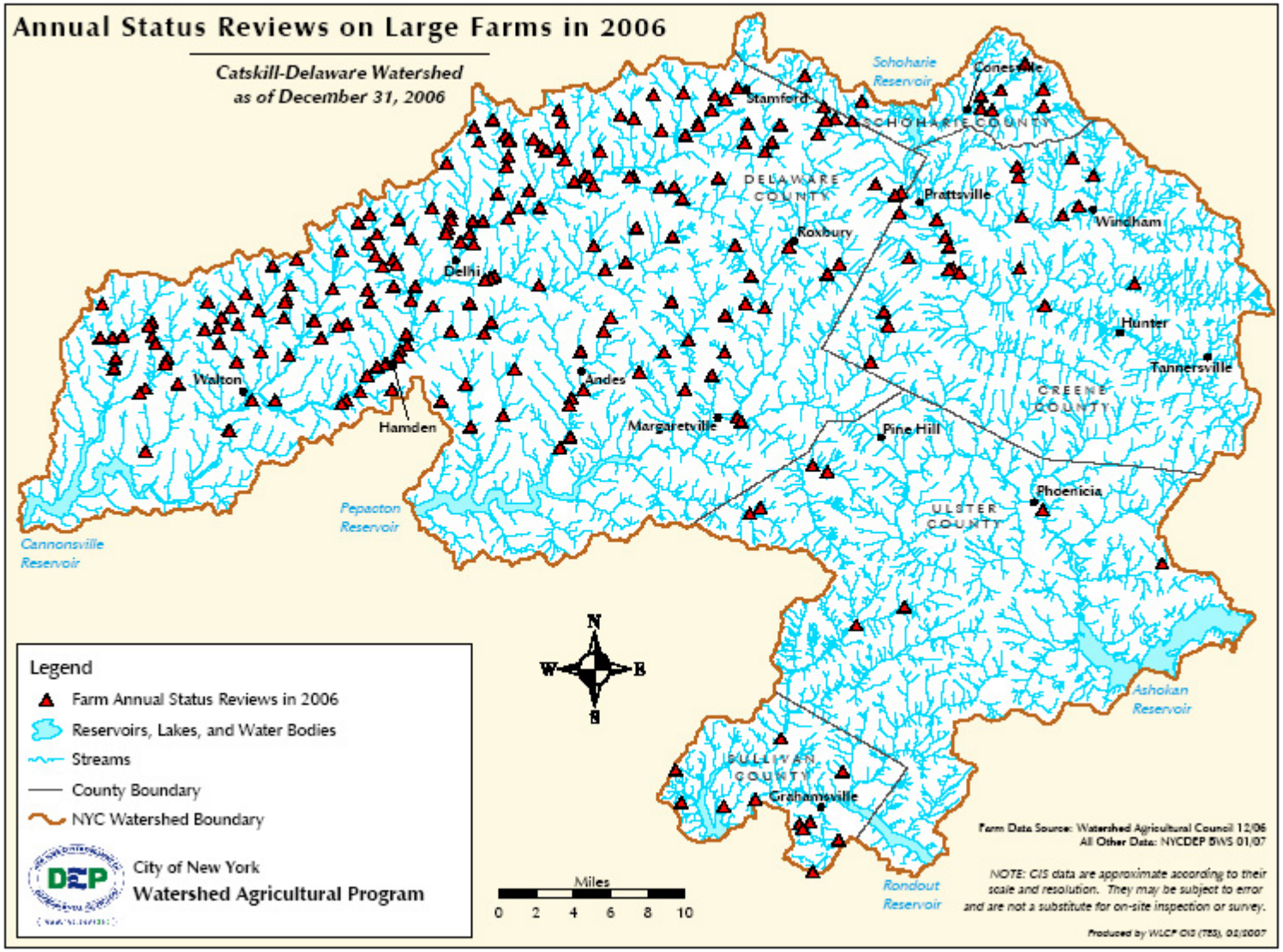

Figure 4.3. Annual status review of large farms, Catskill/Delaware watershed as of December 31, 2006.

4.3.3 Nutrient Management Planning (NMP)

The Nutrient Management Team (NMT) completed 55 new and updated nutrient management plans on large farms and 11 for Small Farms in 2006. There are 126 Large Farms with current NMPs, representing 27,485 acres and 13,625 animal units.

4.3.4 Conservation Reserve Enhancement Program (CREP)

There are now under contract a total of 1,720.4 acres of riparian forest buffers. See Figure 4.4.

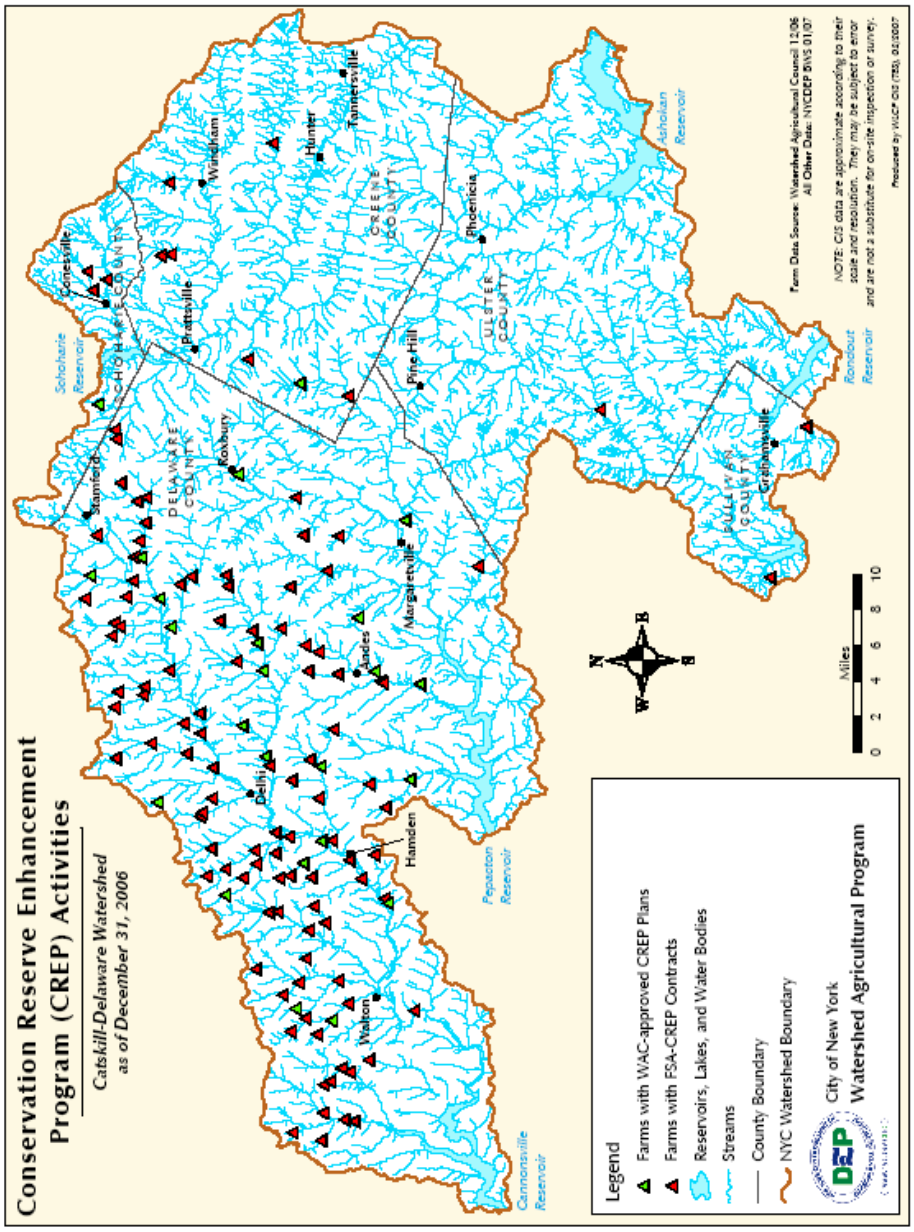

Figure 4.4. Conservation Reserve Enhancement Program (CREP) activities, Catskill/Delaware watershed as of December 31, 2006.

- More than 10,000 head of livestock (mainly dairy and beef cows) have been excluded from streams as a direct result of CREP.
- Based upon GIS data analysis conducted by Delaware County SWCD staff, the estimated stream miles protected is 165.4 miles.
- There are more than 224.4 acres of additional riparian buffers that have been approved by WAC that are in the USDA CREP contract development pipeline.
- There are a total of 161 contracts of which 141 are complete and have all the associated BMPs implemented.

4.3.5 Large Farm BMP Direct Implementation Costs

Over the past fourteen years (1992-2006) WAP has implemented 3,640 BMPs at a cost of $25.6 million on over 236 commercial farms. See Figure 4.5 for program activity. This past year alone 374 BMPs were implemented at a cost of $1.8 million. The majority of the design and implementation oversight of BMPs is accomplished with WAP staff.

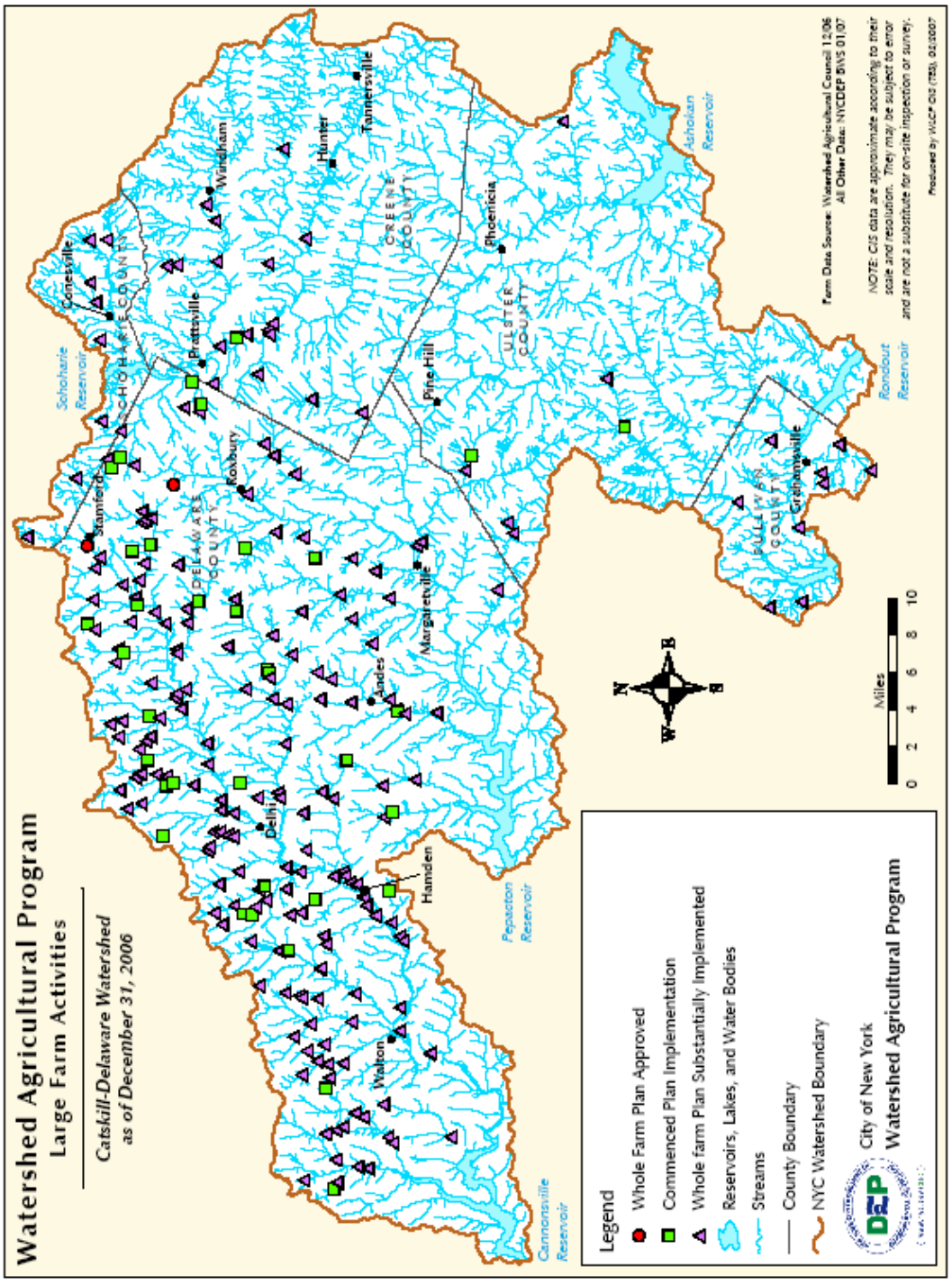

Figure 4.5. Watershed Agricultural Program, large farm activities Catskill/Delaware watershed as of December 31, 2006.

4.3.6 Small Farm Program

WAC has approved 47 Small Farm WFPs. See Figure 4.6. for location of farms.

- To date, 33 of the 47 approved WFPs have commenced BMP implementation.
- 460 BMPs have been implemented on Small farms at a cost of $1.55 million.
- 12 farms have had all identified pollutant issues addressed.
- The Small Farm Team conducted 33 annual status reviews in 2006.

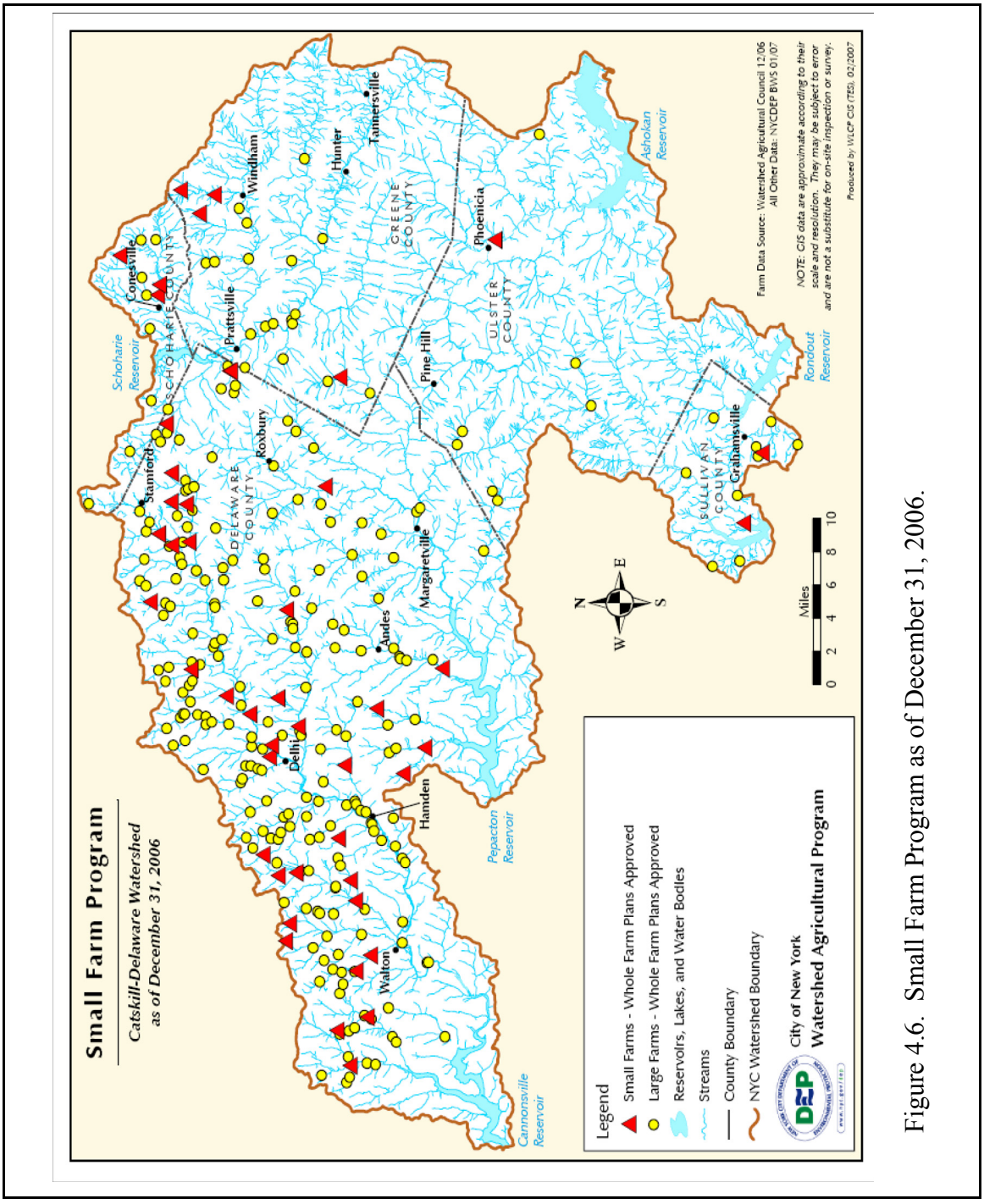

Figure 4.6. Small Farm Program as of December 31, 2006.

4.3.7 Croton Agricultural Program

WAC has approved to date 33 WFPs on farms in the EOH watersheds See Figure 4.7.

- To date, 26 0f the 33 approved WFPs have commenced BMP implementation.
- 168 BMPs have been implemented on EOH farms at a cost of $1.03 million.
- Seven farms have had all identified pollutant issues addressed.
- 20 annual status reviews were completed in 2006.

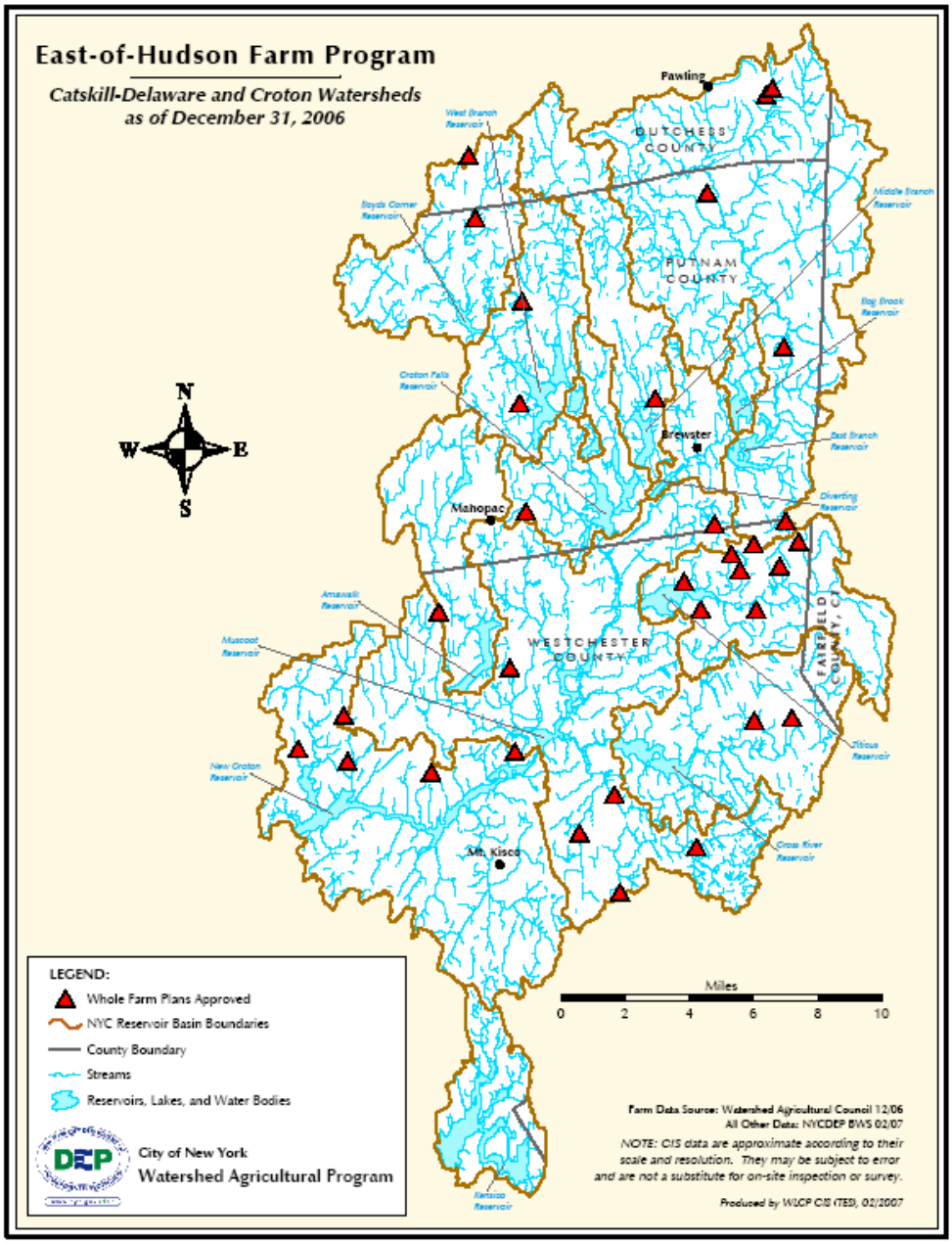

Figure 4.7. East of Hudson Farm Program, Catskill/Delaware and Croton watersheds as of December 31, 2006.

4.3.8 Farmer Education Program

The Watershed Agricultural Program continues to provide educational opportunities for watershed farmers through the Farmer Education Program. In 2006, WAC sponsored on farm classes throughout the year on calf management and disease prevention, rotational grazing management that were attended by over 100 watershed farmers.

4.4 Watershed Forestry Program

The Watershed Forestry Program is a partnership that supports well-managed working forests as a beneficial land use for watershed protection. Since 1997, DEP has contracted with the Watershed Agricultural Council (WAC) to administer and implement four core program tasks: (1) forest management planning; (2) best management practice (BMP) implementation; (3) logger training; and (4) research, demonstration and education. Through WAC, the Forestry Program also receives matching grants from the USDA Forest Service (USFS) to strengthen the economic viability of the wood products industry, develop forest management and riparian plans, and promote forest stewardship through education and outreach.

4.4.1 Forest Management Planning

The Watershed Forestry Program provides training to foresters and funding to landowners to encourage the development of written long-term forest management plans. During 2006, WAC sponsored one forester training workshop that was attended by seven participants. A total of 44 foresters are currently trained to write WAC forestry plans. At least half of these foresters provide services to East-of-Hudson landowners.

During 2006, 76 forest management plans were completed covering 12,990 total acres, of which an estimated 10,355 acres are forested. Twelve of these plans cover East-of-Hudson properties. Eight landowners updated their five-year old plans during 2006. To date, 606 plans have been completed covering 107,257 total acres, of which an estimated 83,673 acres are forested. These figures include 42 plans covering east of Hudson properties.

Riparian Planning. During 2006, 52 riparian plans were completed covering 1,339 riparian acres. To date, 119 riparian plans have been completed covering 4,184 riparian acres.

Management Assistance Program. In 2005, WAC initiated the pilot Management Assistance Program (MAP) for the purpose of providing landowners with limited funding assistance to implement certain forestry practices recommended in their WAC plans. During the first three pilot funding rounds, eligible practices included timber stand improvement, tree planting, riparian improvements, and wildlife improvements. In 2006, DEP and WAC agreed to extend the MAP pilot for a third year and to add "invasive species control" as a new MAP practice. To date, 43 landowners have been approved to implement 47 projects during the first three rounds of the MAP pilot. These approved projects include 32 timber stand improvement projects, 7 wildlife habitat improvement projects, 5 tree planting/deer fencing projects, and 2 riparian improvement

projects. Twenty-eight projects were completed in 2006. Once the final three funding rounds have been completed and evaluated in early 2008, WAC and DEP will consider how best to extend MAP to the wider forest landowner community.

Five-Year Plan Evaluation. During 2006, DEP and WAC evaluated the five-year implementation status of 86 WAC plans developed during 2001. The evaluation found that fifteen landowners (17%) participated in a road BMP program, six landowners (7%) participated in the federal Forest Land Enhancement Program, six landowners (7%) enrolled in WAC's Agricultural Easement Program, four landowners (5%) entered into permanent conservation easements through DEP's Land Acquisition Program, three landowners (3%) sold their properties to DEP, three landowners (3%) applied for MAP pilot funding, four landowners (5%) completed new WAC forestry plans on separate parcels of land, and two landowners (2%) updated their five-year old WAC plans. In addition, 28 of the 68 eligible landowners (44%) enrolled their WAC plans the New York State Forest Tax Law (§480-a program).

4.4.2 Best Management Practice (BMP) Implementation

The Watershed Forestry Program offers cost sharing, technical assistance, free samples and other incentives to loggers, foresters and landowners to promote their voluntary implementation of forestry BMPs before, during and after watershed timber harvesting operations. In particular, the program supports the installation of forestry stream crossings, the construction of new timber harvest roads, and the remediation of existing forest roads having erosion problems.

During 2006, WAC acquired eight plastic arch culverts that are available for loan as temporary stream crossings. Four of these culverts are housed East-of-Hudson, and four are located West-of-Hudson. WAC also procured five new short-span (20') bridges that are available for loan as temporary stream crossings. WAC now owns seven short-span (20') bridges, one long-span (30') bridge, eight arch culverts, and twelve sets of rubber tire land mats that are all available for loan. WAC also provides free samples of the following BMPs: geotextile road fabric, silt fencing, traditional pipe culverts, open-topped culverts, hay bales, grass seed, rubber belt water deflectors, and biodegradable (non-petroleum) chainsaw oil.

During 2006, WAC loaned out eight portable bridges (seven short-span and one long-span), two arch culverts, and ten sets of rubber tire land mats. WAC also distributed two free samples of geotextile road fabric, two free samples of pipe culverts, and one free sample of silt fencing. In terms of road BMP projects, 17 timber harvest road projects and two road remediation projects were completed during 2006. A total of 63 bridge projects and 116 road projects have been completed to date.

4.4.3 Logger Training

The Watershed Forestry Program partners with Cornell Cooperative Extension of Greene County and New York Logger Training to promote and support voluntary participation in the state-wide Trained Logger Certification Program. During 2006, thirteen training workshops were

sponsored for more than 110 participants. Topics included Game of Logging (six workshops), Forest Ecology & Silviculture (two workshops), First Aid & CPR (two workshops), Log Bucking (two workshops) and Logger Rescue (one workshop). Fifty-six individuals working in the Catskill/Lower Hudson region are fully certified as of December 31, 2006.

4.4.4 Research, Demonstration and Education

The Watershed Forestry Program partners with SUNY College of Environmental Science and Forestry (ESF), Catskill Center for Conservation and Development, Cornell Cooperative Extension (CCE), Catskill Forest Association, Frost Valley YMCA, New York State Department of Environmental Conservation (DEC), and the US Army Corps of Engineers to implement a variety of research, demonstration and upstate/downstate forestry education programs.

Model Forests. During 2006, SUNY-ESF continued to conduct field work at both the Lennox and Frost Valley Model Forests. Activities included the installation of deer fencing, completion of post-harvest inventories, continuation of a wood chip BMP study, and the marking of trees for upcoming silvicultural treatments (note: Frost Valley completed a number of these treatments using their own field crew). In June, SUNY-ESF organized the third annual Forestry Field Days at Frost Valley for approximately 35 participants. Finally, a new model forest site was selected during 2006. The Siuslaw Model Forest is owned by CCE of Greene County and located adjacent to its Agroforestry Resource Center. A ribbon-cutting ceremony is tentatively scheduled for May 2007.

Watershed Forestry Institute for Teachers. In August, the Catskill Center conducted the eighth annual Watershed Forestry Institute for 18 new teachers (8 downstate and 10 upstate) and two returning alumni. The teachers spent a week at the Menla Mountain Retreat in Phoenicia where they received an assortment of curricula and classroom instruction, and they also conducted watershed field trips to the Ashokan Reservoir, Frost Valley Model Forest, Shandaken portal, a DEP logging site, and a wood-using business. More than 140 upstate/downstate teachers have been trained during the past eight Institutes.

Green Connections. During 2006, the Catskill Center completed the 2005-2006 Green Connections program involving four New York City schools and five watershed schools. Fifteen teachers and approximately 400 students participated in this upstate/downstate partnership, which included six watershed field trips during Spring 2006. In September, the Catskill Center launched the 2006-2007 Green Connections program for five New York City schools and five watershed schools. Fourteen teachers and approximately 400 students are participating in this program, with five downstate field trips already conducted during Fall 2006.

Watershed Forestry Bus Tours. During 2006, the Catskill Center arranged 22 watershed forestry bus tours for the following downstate groups: City Parks Foundation (two tours), PS 206 (two tours), PS 107 (two tours), Washington Irving High School (two tours), PS 133, Mott Hall School, Sheepshead Bay High School, Eugene Lang College, NYC Housing Authority, Churchill

School, PS 57, PS 3, PS 109, The Neighborhood School, High School for Environmental Studies, High School for Law and Public Studies, New York City ReLeaf, and the Career Education Center. DEP also participated in watershed tours conducted for representatives from the Port Philip and Westernport Catchment Management Authority (Australia), Canandaigua Lake Watershed Council (Western New York), and *Northern Woodlands* magazine (Vermont).

Landowner Education. The Watershed Forestry Program supported several landowner education events during 2006. Between April and October, CCE of Delaware County conducted Friday Forestry School for 23 watershed landowners. In October, the Catskill Forest Association conducted a West-of-Hudson landowner workshop (40 participants) and an East-of-Hudson landowner workshop (14 participants). Finally, WAC partnered with *Northern Woodlands* magazine to develop and publish *The Place You Call Home: A Guide to Caring for Your Land in the Catskills*. This special magazine issue was directly mailed to more than 14,000 Catskill residents owning at least five acres of forest land, and it produced more than 400 information requests to *Northern Woodlands* magazine, 75 requests to WAC for copies of the magazine, and 14 applications for WAC forest management plans.

New York ReLeaf. In July, DEP was appointed to a three-year term serving on the board of directors for the New York State Urban and Community Forestry Council, which oversees the New York ReLeaf urban and community forestry program. In September, DEP and WAC collaborated with the State DEC and New York City ReLeaf to conduct an upstate/downstate watershed forestry bus tour exchange. The downstate tour highlighted the Asian Longhorned Beetle infestation in New York City, whereas the upstate tour highlighted Watershed Forestry Program projects and accomplishments.

Invasive Species. During 2006, WAC collaborated with DEP and The Nature Conservancy to initiate an invasive species public awareness survey. The purpose of this survey is to assess the knowledge, awareness and behaviors of three target audiences (forest landowners, forestry professionals, and local officials) about invasive species issues, and to identify the most effective means for reaching these audiences with appropriate education and training. WAC hired Cornell University's Human Dimensions Research Unit to conduct the survey, which is scheduled for completion in mid-2007. Also during 2006, DEP worked with The Nature Conservancy and State DEC to help organize the Catskills Regional Invasive Species Partnership (CRISP) – one of several voluntary regional partnerships that are forming across the State in response to the recent recommendations of the New York State Invasive Species Task Force. The official CRISP kick-off meeting was held in December 2006 at the Catskill Center.

Forestry Economic Action Grants. With limited funding from the USFS, WAC continued to implement and evaluate its Economic Action Grants Program during 2006. Two grants totaling $25,268 were awarded to Indian Country in Deposit and Pomeroy Lumber in Ninevah, both of which experienced uninsured losses as a result of the June flooding event. In terms of the 75 pre-

vious grants awarded (totaling $2.23 million in USFS funding), all of these projects have been completed and all grants are currently being closed-out. Finally, WAC continued working with a web designer to complete the Catskill WoodNet website (www.catskillwoodnet.org) which was expected to launch in October but is now expected to be launched in early 2007.

Municipal Training. With funding from the USFS and support from DEP, WAC is developing a municipal forestry training program for the East-of-Hudson watershed. The goal of this training is to educate local officials about the benefits of privately owned forests and the importance of a working forest landscape, and to support the New York State "Right to Practice Forestry" law. The first round of municipal training presentations are scheduled for early 2007.

Watershed Environmental Education Alliance (WEEA). During 2006, DEP supported the creation of a new regional partnership called the Watershed Environmental Education Alliance (WEEA). WEEA is comprised of environmental facilities, organizations and agencies based in and around the New York City water supply watersheds who develop, support and implement school-based education programs. The mission of WEEA is to reinforce watershed education programs, enhance professional development opportunities for school teachers and environmental educators, and encourage partnerships that provide New York City and watershed students with inspirational environmental learning experiences. During 2006, WEEA conducted a comprehensive survey of more than 40 educational entities in the Catskill Mountains and Hudson Valley region, and the results of these surveys were used to compile a New York City Watershed Environmental Education Resource Directory for school teachers and other educators. With DEP support, this brand new resource directory will be published in early 2007.

Public Outreach. Throughout 2006, the Watershed Forestry Program was represented at the following outreach events, conferences and professional speaking engagements:

- Trout in the Classroom Teacher Workshop (Black Rock Forest, NY)
- New England Wood Expo (Hartford, CT)
- Brooklyn Designs Show (New York City)
- International Contemporary Furniture Fair (New York City)
- Northeast Utilization and Marketing Council Annual Meeting (Vermont)
- International Symposium on Society and Resource Management (Vancouver, BC)
- Society of American Foresters (SAF) National Convention (Pittsburgh, PA)
- International Woodworking & Furniture Supply Fair (Atlanta, GA)
- Delaware County Fair (Walton, NY)
- Catskill Mountain Culture Festival (Hunter, NY)
- NYS Urban & Community Forestry Council meeting (Schenectady, NY)

The Watershed Forestry Program continued to implement its core program tasks during 2006. Next year, DEP anticipates a continuation of the Watershed Forestry Program's core program tasks with an increased emphasis on project evaluation, invasive species education, and improved integration of WAC's landowner incentive and stewardship programs.

4.5 Stream Management Program

The Stream Management Program (SMP) made significant progress in achieving its Program goals and FAD-mandated stream management plans and demonstration projects in 2006. Significant milestones included completion of the draft Esopus Creek Stream Management Plan and the Ashland Connector stream restoration project in the Batavia Kill watershed.

In April 2006, the SMP also completed its second biennial Program Evaluation Report which evaluates progress according to the five primary Program goals and included an analysis of progress by Nutter Associates, Inc. Program evaluation during the 2007 FAD planning period enabled the SMP to prioritize future plans according to the findings in the evaluation. Detailed accounting of Program progress is contained in this April 2006 Program Evaluation Report and in the two Semi Annual reports provided during the year.

The catastrophic June 26-28, 2006 flood in the western portion of the Watershed required DEP to redirect its stream management staff and those of the Delaware County Soil and Water Conservation District (DCSWCD) to guide emergency stream work. Flood crest elevations at gages on the mainstem Delaware River were near record, yet damage from the flood was greatest in the tributaries; especially hard hit were the communities near Walton in the lower Cannonsville and Downsville in the lower Pepacton basins where rainfall ranged from 6-13 inches over three days. Woody debris and sediment choked many bridges and channel constrictions resulting in stream avulsions and bank failures. As an indicator of the extent of damage, more emergency stream work permits were issued following this 2006 flood than the January 19, 1996 flood. Detail follows on the response of DEP SMP in this flood recovery effort.

4.5.1 Stream Management Plans

Stream management plans are intended to provide a framework for local long term stewardship of stream-related problems that impact water quality, transportation infrastructure, private property loss and aquatic and riparian integrity. Each plan presents a comprehensive set of recommendations that provides a hierarchy of programmatic, policy and action-related priorities, giving DEP and its partners a road map for accomplishing long term stewardship objectives. Figure 4.8 illustrates the status of stream management plans and restoration projects throughout the west of Hudson watershed.

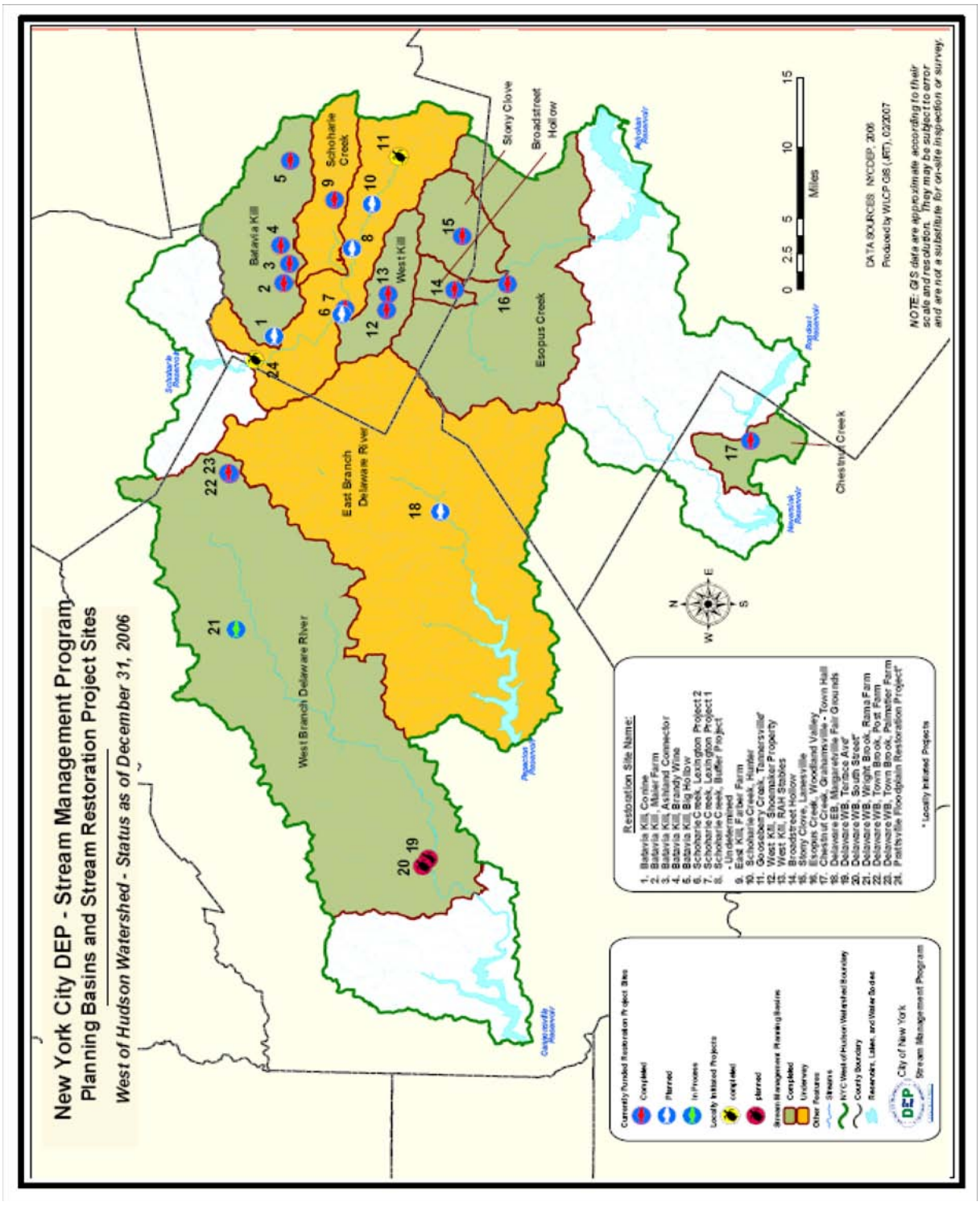

Figure 4.8. Stream Management Program planning basins and stream restoration project sites, west of Hudson as of December 31, 2006.

Esopus Creek

In 2006, DEP and its partners Cornell Cooperative Extension – Ulster County (CCE-UC), and the U.S. Army Engineer Research Development Center (ERDC) completed the community and watershed assessment phase for the Upper Esopus Creek Management Plan. The draft Management Plan was submitted to EPA on January 31, 2007. Volume I, Summary of Findings and Recommendations, provides an excellent tool for introducing lay readers and decision makers to the diversity of management challenges facing the basin and outlines the recommendations promoted by the Project Advisory Committee (PAC) to shape the "Annual Action Plan" that will guide implementation.

CCE-UC conducted an extensive effort in 2006 to survey streamside landowner opinion, identify community concerns and provide numerous education, outreach and training opportunities, depicted in Table 4.5 The survey results, in conjunction with the education and outreach work group process, have yielded a very well-informed, objective-driven education and outreach work plan detailed in the draft Management Plan. Further, close coordination with the PAC enabled careful review of Plan recommendations ensuring their concerns and needs are adequately addressed by the draft Plan.

Table 4.5. 2006 Outreach and Education activities.

Co-Host/Sponsor	Trainings	Audience	Number
DCSWCD	Gravel Mining Workshop	Local municipal officials, highway staff and community members	50
DEP Lands, CCE Ulster	Beaverkill Planting	High School Students: Gilboa-Conesville, Jefferson Central, High School for Environmental Studies	40
GCSWCD	Stream Process for Highway Workers	Local, County & State Highway Workers	30
CCE Ulster	Stream Walk & Talk	Community members	15
GCSWCD, CCE Greene	Banks & Buffers Workshop	Local and regional streamside landowners	100+
DEP SMP only	NOAA Project Design & Evaluation Workshop	GCSWCD, DCSWCD, UCSWCD, WAC, CCCD, CCE-UC & Greene, Frost Valley YMCA	30
GCSWCD	Schoharie Turbidity Summit	EPA, DEC, local municipal officials, county planning & highway staff, community members	100+
CCE Ulster	Leaf Pack Training	Community members	8
Meetings			
CCE Ulster	Esopus Creek PAC meetings (5)	UCCC, DEC, streamside landowners, CCCD,	20

Table 4.5. 2006 Outreach and Education activities.

Co-Host/Sponsor	Trainings	Audience	Number
GCSWCD	Batavia Kill PAC meetings (4)	CWC, TU, GC legislator, DEP Lands, Windham & Ashland Town Councils, local business owners, CCE Greene, Prattsville Town Supervisor	15
GCSWCD	West Kill PAC meeting (1)	Lexington Town Supervisor and 3 Board members, GC Highway, NRCS, TNC, DEC Region 4, landowner	17
DCSWCD	East Branch Delaware PAC meeting (1)	Town of Middletown, Andes and Halcott Supervisors, Village of Margaretville Mayor, Planning Board members, Code Enforcement Officers, Streamside landowners, Trout Unlimited, local business representatives	30
CCE Ulster	Open House	Community members	30
GCSWCD	West Kill Public Meetings (3)	Community Members	50
CCE Ulster	Focus Group Meetings (2)	Whitewater enthusiasts, streamside landowners	23
GCSWCD	Schoharie/East Kill Kick-Off Meeting	Streamside landowners	100+
CCE Ulster	Public Information Meeting	Landowners, anglers, whitewater recreationists, officials, and agency personnel.	~70
GCSWCD, CBI	Schoharie/East Kill Scoping Workshop	Local municipal officials	30
Conference Presentations			
GCSWCD	Mid-Atlantic AWRA Conference	Regional private consultants, agency and nonprofit staff and university professors	~50
DCSWCD	NYC Watershed Sci. & Tech. Conf.	Regional private consultants, agency and nonprofit staff and university professors	~50
DEP SMP only	Japanese Knotweed Workshop	Regional agency and nonprofit staff and university professors and students	~50
Other			
CCCD	CSWEP	3^{rd}-12^{th} grade students from schools within stream management planning sub-basins	954
CCE Ulster	Potluck Dinner	Streamside landowners	8
CCE Ulster	Guest Speaker (2)	Community members	127

DEP and ERDC continued and completed the watershed and stream assessment phase of the effort through 2006. Key work included (1) the development of hydraulic models to predict flood stage along the Upper Esopus Creek channel and flood plain; (2) sediment sampling and analysis to estimate the erodibility of glacial deposits that are the principal sources of turbidity within the watershed and to develop a first-cut fine sediment budget; (3) develop a preliminary stream erosion hazard rating model; (4) performed geomorphic assessments at several sites that are candidates for implementing stream management practices and began the establishment of long-term monitoring sites.

A unique challenge the Upper Esopus Creek project team faced in 2006 was the emergency operation of the Shandaken Tunnel, diverting the maximum discharge of Schoharie Creek water (up to 650 MGD) into Esopus Creek during the emergency repairs to the Gilboa Dam. Public perception of the sustained high releases even during flood flows (such as the extensive June 2006 flooding) was largely negative. CCE-UC and DEP addressed this issue by (1) having the director of WOH Operations give a presentation to the PAC on the dam rehabilitation and operation of the tunnel; (2) conducting a field trip for the PAC to visit the Gilboa Dam and Shandaken Tunnel intake chamber; (3) hosting a public meeting that addressed this issue among other topics.

One key finding summarized in the draft Plan clarifies the sources of turbidity within the watershed. Turbidity in the Esopus is primarily from suspended sediment and is a product of geology (the source of suspended sediment) and hydrology (flooding). The geologic source is from the glacial till and glacial lake silty clay deposits that are present throughout the Upper Esopus Creek watershed and often exposed in stream banks and the stream's bed. The stream bed sediment itself was found to be comprised of an average of 1.5% silt and clay that is easily re-suspended from disturbance or bed mobilization during flood events. During and following floods, all of the tributaries to the Esopus Creek can be significant sources of turbidity. While some stream restoration may be useful in treating localized chronic sources, it is not considered a feasible option for sufficiently reducing turbidity at the watershed scale to curtail the occasional use of alum as a coagulant at the Kensico reservoir. Modified operations of the Shandaken Tunnel should help mitigate turbidity at recreational flows, which was a major concern of the Esopus Creek PAC and addressed in the Esopus Plan.

Schoharie Creek and East Kill

DEP and the Greene County Soil and Water Conservation District (GCSWCD) entered into an agreement to complete stream management planning projects on the Schoharie Creek and East Kill on May 15, 2006. GCSWCD and DEP staff were challenged with completing the two stream assessments, incorporating the results into a new geo-database format, interpreting the results as a basis for writing plans for the two rivers and facilitating public participation through the development of a community-based PAC – all within a one year timeframe.

The assessments of the Schoharie Creek and East Kill were completed with detailed mapping of the locations of such attributes as bank erosion, clay exposures, invasive species, riparian buffer planting locations and infrastructure. Detailed surveys at monitoring stations were established for future assessment of stream condition. Geo-databases for the basins were completed, as well as the first vegetation mapping. Community outreach advanced through 2006 with public and PAC meetings. This effort to focus public attention on the Schoharie Creek benefited from a parallel effort of the GCSWCD: The Schoharie Turbidity Working Group. This group is tasked with developing a turbidity reduction strategy for the Schoharie watershed as per a 2003 grant from the New York State Department of State. This group met frequently during 2006 to better understand the challenges that turbidity poses to various interest groups and towards a Watershed Summit in January 2007.

East Branch Delaware River

The upper portion of the East Branch Delaware River watershed in the Town of Roxbury is in generally stable condition. This has enabled stream assessment efforts to focus on tributaries in the Towns of Middletown and Andes. Due to the size of the watershed, much of the assessment has been derived from low attitude helicopter video and digital orthophotography. Where appropriate, field assessments have been conducted to provide additional information on unstable and stable ("reference") conditions. In 2006, despite the curtailed public outreach effort due to the flood, DEP, DCSWCD and Delaware County Planning Department have met with the PAC to select a demonstration project site and hold a well attended public symposium on the controversial issue of gravel management in streams.

During 2006, DCSWCD constructed its first two streambank stabilization measures in support of the Conservation Reserve Enhancement Program (CREP). These projects (The Rama and Palmatier Farms), both located on the West Branch Delaware River, are an attempt to either enable the establishment of additional buffers under CREP or to protect existing CREP plantings. These projects represent implementation of recommendations made in the January 2005 West Branch Delaware River Stream Management Plan. DCSWCD has identified another possible CREP site at the Tuttle Farm in the Pepacton basin and has surveyed the site and prepared a draft design for the project.

4.5.2 Education and Outreach

DEP Stream Management Program continued to engage diverse audiences within and surrounding the west of Hudson watershed area to promote long-term stewardship of Catskill streams using multi-objective stream management planning and restoration. To this end, the Program used a variety of methods to reach these audiences, including holding numerous public meetings and information sessions, hosting workshops, developing publications, sponsoring classroom education, hosting college intern programs, participating in training programs, giving restoration project tours and coordinating internally with other DEP programs. The table below presents specific meetings, trainings and presentations co-hosted by DEP.

Specifically, DEP SMP developed and published the informational brochure, "Catskills Streams and You," which describes stream processes, functions and benefits in the context of watershed management and regional community and economic considerations. DEP also participated in the development of a multi-agency website, "Catskills Streams," which will provide direction on best management practices appropriate to regional conditions, agency contact information and web resources on a variety of topics related to stream and watershed management.

4.5.3 Flood Recovery Efforts

As previously mentioned, significant resources were dedicated to assisting local communities recover from the June 26-28 flood event. DCSWCD and the DEP worked together to initiate technically sound stream remediation measures in the wake of the flood in the Cannonville basin. With assistance from the DEP Police, immediately after the flood, DEP and DCSWCD stream managers performed a helicopter-based photo reconnaissance of streams in the affected watersheds. On the ground, stream crews mapped and photo documented flood damages, provided survey stakeout of stream channel dimension (based on DEP's regional curves of hydraulic geometry, see Section 4.5.7) and directed the National Guard as they cleared debris and excess sediment from streams and floodplains. DEP and District staff worked with WAP staff to develop a protocol for assessing damages to agricultural BMPs and undertaking emergency stream work to restore cropland and farm property. Again, through this process the DEP and the DCSWCD have promoted the use of DEP's regional hydraulic geometry relationships to size the channel to the width and cross section dimensions typical of naturally stable Catskill streams.

Along Third Brook in Walton, DEP and DCSWCD have sought to ensure that future activities were both responsive to the needs of the community and compatible with good stream and floodplain management practices. Following emergency debris clearing efforts by the town and village, local leaders are beginning understand the need for identifying practices that will support the long term recovery of the watershed. With guidance from the DCSWCD and the DEP and funding from CWC, the Town and Village are engaged in the creation of a flood recovery plan for the basin to halt further destabilization of the stream system and protect streamside properties in the watershed.

DEP also worked as an agency to protect its own lands following the flood with Stream Management Program staff advising Land Management and West of Hudson Operations staff on stream remediation and debris removal along Peakes Brook in Delhi and Readburn Creek in Tompkins.

DEP agreed to fund and aid planning for two workshops coordinated by Trout Unlimited and the flood affected counties to review the emergency response and recovery efforts related to streams and to plan for improving future flood response. The event has provided the opportunity

to extend the working relationships of stream managers and demonstrate sound stream management practices including the use of regional curves for estimating channel dimensions in disturbed settings.

4.5.4 Floodplain Mapping

DEC released the draft floodplain maps for the Schoharie Watershed in September 2006 and DEP continues to work with its partner GCSWCD to review and comment on the accuracy of these maps prior to their formal adoption by the local municipalities. DEP and the GCSWCD are also supporting the concurrent adoption of revised local floodplain regulations within the remapped municipalities under the National Flood Insurance Program. The DEC has provided the partners with standard language for consideration by the communities. These maps will help communities and resource managers to identify and mitigate flood threats, plan for secure future development, and further understand how their rivers and streams function. As a tool for protecting water quality, these maps can help communities reduce pollution and contamination associated with major flood events.

DEP and DEC continued to work out the terms of a contract to fund the revision of flood studies and creation of floodplain maps for all areas within the WOH watersheds. The updated maps are created with the latest in flood mapping technologies and will vastly improve the public knowledge of the region's floodplains and flood hazard areas

4.5.5 Stream Restoration Projects

Figure 4.8. depicts the status of twenty-four projects restoration projects at the close of 2006. These projects fall into four categories: 1) Projects completed prior to the 2002 FAD; 2) Demonstration projects tied to the development of Stream Management Plans (SMPs) in the 2002 FAD; 3) Projects implementing recommendations in completed SMPs; 4) Locally initiated projects that the Stream Management Program is involved with, either in their scoping, design review or as a secondary sponsor or partial funder.

Four stream restoration projects were completed prior to the 2002 FAD. As part of the 2002 FAD, the DEP SMP was tasked with completing twelve stream restoration demonstration projects during the period 2002 – 2007, of which nine are completed, one is cancelled, and the final two scheduled for completion during summer 2007. Five projects implement recommendations in Stream Management Plans. Finally, four locally-initiated projects represent significant DEP SMP involvement in design review and/or funding.

Significant program developments in 2006 related to restoration projects are summarized here. First, the Red Falls restoration, a 2002 FAD deliverable, was cancelled with EPA's concurrence, as complications related to the mitigation of geotechnical risks, a highly engineered solution, and archeological impacts escalated the cost / benefit ratio to unacceptable levels which, taken together with unprecedented permitting challenges, put the project out of reach. The Conine

site identified by the 2003 Batavia Kill Stream Management Plan and immediately downstream, was approved as a substitute for the purposes of monitoring pre and post project turbidity in fulfillment of this Red Falls project requirement.

Average cost per linear foot of restoration increased notably during 2006. One cause was the increase in fuel costs, both that used during construction (by equipment and pumps during dewatering) and as a major component in the cost of delivered rock. A second cause was an increase in the amount of rock used to lengthen keyways buried in the floodplains. Longer keyways were initiated on the Ashland Connector project to reduce the risk of headcuts in the floodplain which had compromised project performance at Big Hollow by cutting off three meander bends, and to avoid associated long-term maintenance costs.

A new DEP SMP policy was implemented in 2006 extending the temporary license agreement for landowners in project areas to ten years and prohibiting landowner modification of structures or riparian vegetation and allowing DEP and the SWCDs access for maintenance and monitoring for this period.

In 2006, DEP completed two FAD deliverable demonstration stream restoration projects: on the Batavia Kill at the "Ashland Connector" mentioned above (nearly connecting two previously-constructed projects), and on the West Kill at RAH Stables, which also nearly connects downstream to the Shoemaker Restoration Project completed in 2005.

On the Batavia Kill, the Ashland Connector project involved the restoration of 3400 feet of channel using natural channel design principles, flow diversion structures and bioengineering, and connected the previously constructed Brandywine and Maier projects. Final project costs (not including design and plant materials production) were approximately $1,000,000, or $294/ foot, reflecting the general cost increases noted above. By contrast, at RAH Stables on the West Kill, 1200 feet of channel were restored using modified natural channel design principles and bioengineering at a total project cost of approximately $63,000, or $52.50/ foot. The significantly lower per foot cost on this project is due to a novel arrangement where DEP funded the design and materials expenses, and the landowner contracted for construction labor. This contractual relationship may serve as one model for future DEP sponsorship of restoration projects needs evaluation. Passive dewatering also kept costs down.

Figure 4.9. Before and after photos at RAH Stables restoration.

As Stream Management Plans are completed, restoration work turns from demonstration projects chosen in large measure for their education and research/monitoring value, to projects that implement priority recommendations made in the stream management plans. Projects implementing recommendations in the West Branch of the Delaware Plan included stream work at Rama Farm on Wrights Brook which was necessary to enable subsequent enrollment in the CREP, and on Town Brook where retrofits at the Post Farm were required by DEC and ACOE to improve fish passage and new work at the immediately upstream Palmatier Farm was completed to protect existing CREP project areas. A recommendation in the Chestnut Creek Stream Management Plan, stabilization and restoration of an eroding streambank adjacent to Route 55 in Grahamsville on DEP property is now being funded and managed by the Stream Management Program through a contract with Sullivan County SWCD, and is on schedule for design completion by July 2007.

DEP involvement in the design review phase of locally-initiated and other non-FAD deliverable DEP sponsored projects increased significantly in 2006, with DEP staff providing design review on more than a dozen additional stream-related projects throughout the west of Hudson watershed, either in the scoping phase, or in the review of NYS Article 15 Stream Disturbance Permits.

All stream restoration projects that have been constructed require ongoing monitoring either as part of the DEP's BMP Project Evaluation (see below), to determine the need for maintenance, as well as to improve future designs. During 2006, DEP and GCSWCD hired Buck Engineering to evaluate the success of previously constructed restoration projects on the Batavia Kill and develop a standardized project monitoring protocol with criteria for triggering repair. DEP's vegetation monitoring protocol was implemented pre-construction on all restorations constructed this year, and post-construction on those completed last year. Sharpening its focus on the vegetative component of restoration projects, DEP funded the GCSWCD's Plant Materials Center for increased planting stock and infrastructure.

4.5.6 Stream Data Management

Through the creation of stream management plans, design and construction of stream restoration projects, and the research into stream processes and project performance the DEP and its project partners have created significant quantities of information about Catskill streams. To ensure this information is available and useful to all of our stream managers and partners for the long term, the DEP has developed a geodatabase of stream information for the west of Hudson watershed. This GIS database integrates information from stream assessments, reference reach and design surveys, monitoring efforts and other associated studies and enables managers to review conditions across the watersheds where surveys have been completed. In 2006, PAR Technologies, consultant to DEP on this project, completed the database design, constructed a database schema and created a set of tools to enable users to enter survey data and query the database. Following deployment of the geodatabase and toolset to the DEP and local partnering agency offices, PAR continued to provide support for the use of the tools and minor modifications as needed. DEP and the partnering agencies are now using the geodatabase format for all new stream assessment surveys and gradually incorporating existing surveys into the database

4.5.7 Stream Process Research

In 1996, the DEP initiated a multi-year effort to develop and distribute regional stream morphology databases to support stream management decisions, stream restoration design, and program and project evaluation. This effort is composed of a set of coordinated data development projects including development of Catskill regional bankfull discharge and hydraulic geometry relationships, reference reach design geometry and fluvial processes database, and monitoring effectiveness of stream restoration demonstration sites. Specific sites and elements of the projects are summarized in tables presented in past FAD annual reports as well as FAD Assessment reports and peer-reviewed published reports and papers.

The geographic extent of these projects covers the entire Catskill and Delaware watersheds, with monitoring sites in all six reservoir basins, and including three sites outside the NYC watershed (see summary map of Stream Management Program Planning Basins and Stream Restoration Project Sites located in April Stream Management Program Second Biennial Program Evaluation Report, 2006; see also Miller and Davis, 2003, for regional curve study sites). These projects have refined and strengthened our knowledge of how streams in the Catskills function and how we as stream managers can best interact with streams and instruct our partners and stakeholders better to create sustainable stream stewardship while incorporating our goals of continued high water quality.

Initially scoped as a set of multi-year projects, a number of these efforts are nearing completion. Development of regional curves for the Catskills is the foundation for multi-objective stream management, and this task is largely complete. Though versions of modified curves have been made available to DEP project partners and internal DEP staff, additional outreach and further refinements of these curves are proving to be essential, particularly to address increasing

demand for project and design review and during emergency flood response. For example, during the June 2006 flood recovery efforts, these curves were used to guide implementation of an "emergency stream intervention protocol" developed by DEP and DCSWCD. Relationships developed through this study are used to help identify and confirm field indicators of bankfull stage, a necessary first step in any geomorphic stream assessment.

Out of the research and database development initiatives to date, DEP has achieved the greatest success in development, distribution and training in regional curve use within and outside the agency. Regional curves were used in watershed assessments by SWCDs in Ulster, Sullivan, Greene, Delaware Counties in support of stream management plan development. Regional curves have also been used in ongoing SMP BMP monitoring; Reference Reach database development; individual landowner site visits; permit and project review; and as one tool in BMP design by project partners.

Substantial progress was made toward completion of the second project: create design geometry and fluvial processes data and monitor biological and aquatic habitat for up to 15 reference Catskill stream reaches (set currently includes nine sites). Documenting both physical and biological form and function will provide a valuable set of templates for Catskill regional stream stability restoration designs and assessments. This database will also provide the start of an understanding of sediment transport and hydraulic characteristics for stable streams for comparison with unstable streams and project sites. Study of fish population dynamics, associated aquatic habitat, detailed morphology and sediment transport measurements enable better understanding of variability range we can expect in stable stream settings. The Reference Reach Design Geometry and Fluvial Process Study final report is due in 2007. Interim reporting with initial data analysis and findings was completed in 2005 in a paper with USGS (SDWA, 2005). Although the USGS paper is in draft format, initial analysis and conclusions regarding habitat conditions and fish population studies confirm reference reaches appear to maintain relatively low variability and high function, suggesting a level of "stability" in these reaches year to year. DEP provided preliminary reporting on this project in the 2005 SDWA summary report, and expects to be able to report more detailed draft reference reach database in 2007.

Substantial progress was also made toward completion of the third project, to monitor the effectiveness of stream restoration demonstration projects installed on three unstable stream reaches, and compare findings to the same monitored information at six control sites (three stable and three unstable sites), over a five year period. Evaluation includes analysis and comparison of post-construction adjustment of its fish population, geomorphic stability and aquatic habitat. A total of five construction projects with unstable and stable control and reference reaches have been monitored and analyzed throughout the last 4 years (total of 15 sites). This project was scoped to provide an Interim Report in 2007, with USGS papers having published preliminary results of fish and habitat data related to restoration and control sites (SDWA, 2005). Although

USGS papers are in draft form, initial analysis and conclusions are presented. Findings indicate that biological integrity of resident fish communities in Catskill Mountain streams can be improved by natural channel design restorations.

Both construction and monitoring are dependent on both weather and scheduling of project construction, delays in which have been documented previously. Field work originally scoped for 2003 and 2004 took place during 2005 and 2006, with additional monitoring scoped to continue through 2007 and 2008 to achieve sufficient monitoring records. Preliminary reports of findings were produced (SDWA, 2005) with additional reporting provided as peer-reviewed papers by USGS. Additional data collected during 2006, 2007 and 2008 field seasons, with final findings, will be reported in 2008 if seasonal conditions provide sufficient information on process and function of these important projects.

Stream bed and bank erosion and scour pilot measurements in support of reference reach and BMP reach studies also proceeded as planned for the 2006 field season, with all planned field work completed. Data entry and data analysis are also in progress. Scour and bed mobility requires 5 or more bed mobilizing events. Most sites reported on in 2004 have a sufficient number of monitored events. Sites that were monumented in 2005 or 2006 will not have sufficient monitoring until 2007, 2008 or possibly later, depending on weather conditions.

4.6 Wetlands Protection Program

In 1996 DEP developed and began implementation of an interdisciplinary Wetlands Protection Strategy consisting of regulatory and non-regulatory elements designed to protect and preserve the water quality function of wetlands in the watershed. In September 2001, DEP completed an enhanced Wetland Protection Strategy that, in addition to regulatory and non-regulatory components of the previous strategy, also includes important additions to DEP's approach to protecting wetlands in the watershed, and their water quality protection and improvement functions.

Much of the field data collection for the Wetlands Protection Plan was completed and reported on in 2005 (DEP 2005; Tiner, 2005a, 2005b). Highlights for 2006 were closing out the west of Hudson Reference Wetland Monitoring Program, reporting on the results of the Wetlands Functional Assessment, continuation of well monitoring for water table data and regulatory wetland reviews.

4.6.1 Regulatory Programs

A main component of DEP's Wetland Protection Strategy is reviewing and commenting on applications for federal, State, and municipal wetlands permits, as well as proposals subject to environmental review under the State Environmental Quality Review Act (SEQRA). In 2006, DEP continued to review applications for permits for activities on regulated wetlands and regulated adjacent areas (Figure 4.10).

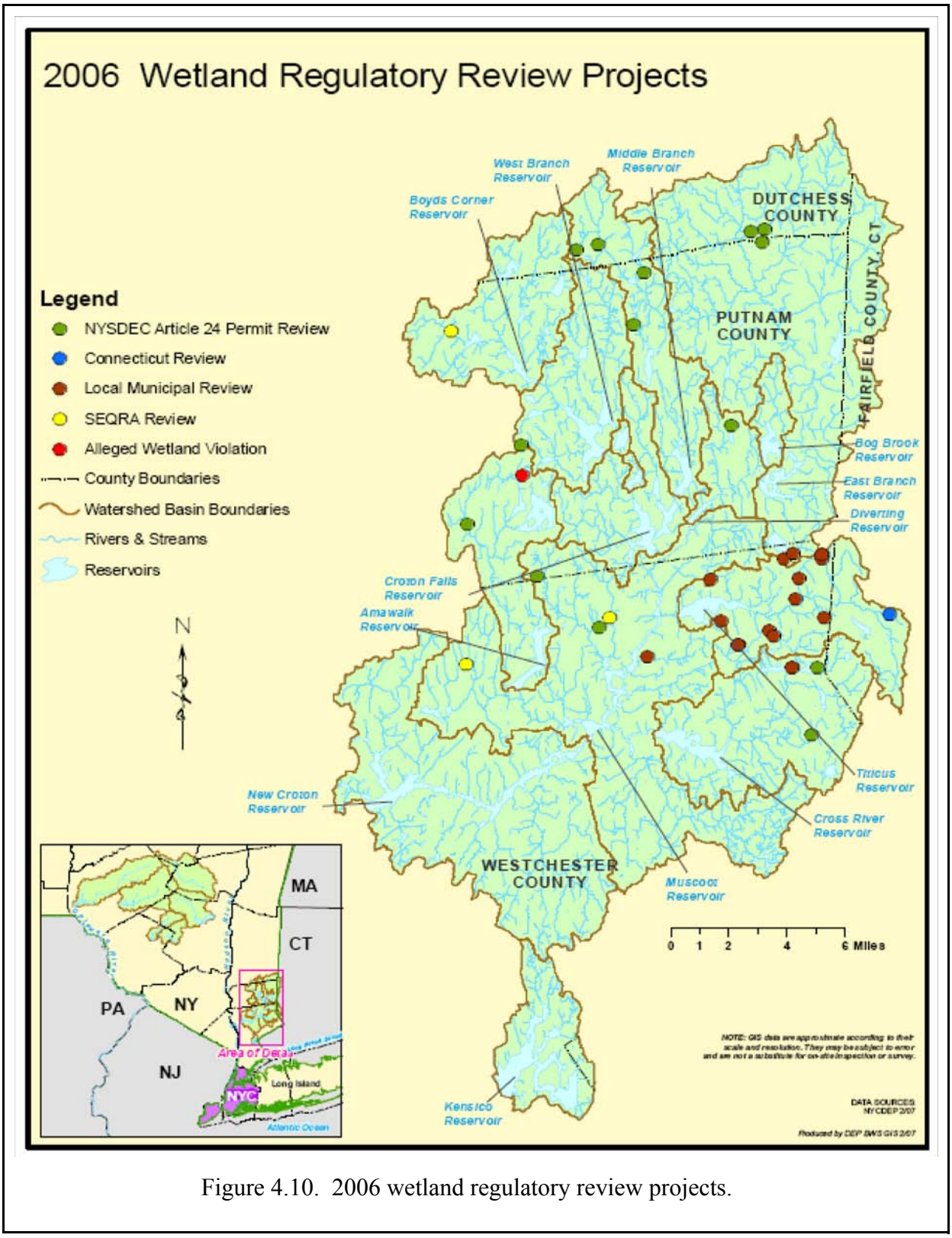

Figure 4.10. 2006 wetland regulatory review projects.

United States Army Corps of Engineers

DEP completed an on-line registration on the ACOE's website to receive Pre-Construction Notifications (PCN), Individual Permits and other notices for projects affecting wetlands in the watershed. During the year, ACOE delivered on-line notifications to DEP regarding projects in the region.

During 2006, DEP continued to review PCNs, which notify ACOE that a project sponsor believes their project is authorized by a Nationwide Permit and that an Individual Permit will not be sought before the project begins. When, based on a review of a PCN, DEP concludes that a project will adversely impact a wetland, or water quality in the watershed, DEP requests that ACOE require an Individual Permit Application to allow for thorough review of the proposal. In those instances, DEP encourages ACOE to require an alternative project design or location that will avoid adverse impacts. Finally, if opportunities to avoid or minimize impacts do not exist, DEP assesses mitigation options that would compensate for any wetland impacts that result from the project. In these cases, DEP proposes alternatives that might better replicate any water quality function(s) of the impacted wetland.

Table 4.6. DEP received the following 4 proposals from the ACOE during 2006:

Project Name	NYC Reservoir Basin	Notification/ Permit	Wetlands Losses (acres)	Wetlands Gains (acres)	Activity
McDonald & Leiner	West Branch	Public Notice	0.33	0.37	Discharge of fill in association with the construction of a road to facilitate the construction of a residential subdivision.
NYC Croton Falls Dam	Croton Falls	Public Notice	0.13	0	Installation of 2 concrete boat ramps, the rehabilitation of the Croton Falls Reservoir Dam, the realignment of Hemlock Dam Road and the replacement of a USGS flow measuring weir.
Ashland Connector Stream Restoration Project	Schoharie	PCN	2.1	2.5	Construction of emergent wetland and riparian buffer.
Proposal To Reissue and Modify Nationwide Permits	Watershed-wide	Notice	0	0	Proposal To Reissue and Modify Nationwide Permits

New York State Department of Environmental Conservation

Article 15 Protection of Waters Permit Reviews

In 2006, DEP continued to receive and review New York State Department of Environmental Conservation (DEC) stream disturbance permit applications. DEP issues comments to DEC Regions 3 and 4 concerning proposals with potential wetland impacts. The comments identify instances of noncompliance, potential impacts on water quality, and measures that could be incorporated into a proposal to avoid, minimize, and mitigate the water quality impacts anticipated from the activity. A flood event in June 2006 resulted in many emergency stream permit applications in the west of Hudson (WOH) watersheds. Delaware County received 90% of these permit applications. During 2006, DEP reviewed and commented on the 21 DEC Article 15 Protection of Waters Permits represented in the table below.

Table 4.7. DEP reviewed and commented on 21 DEC Article 15 Protection of Waters Permits in 2006.

Project Name	Town	State Permit	Federal Permit	Project Type
Liftside WWTP	Hunter	DEC Article 15		Stream Disturbance
Coulter Brook Meadow	Bovina	DEC Article 15	NWP 14 & 33	Stormwater
Hutson Property	Hamden	DEC Article 15	NWP 13	Stream Disturbance
Tuscarora Club Property	Middletown	DEC Article 15		Stream Disturbance
Seiden Stream Disturbance (SD)	Walton	DEC Article 15		Stream Disturbance
Town Brook Road	Stamford (V)	DEC Article 15		Stream Disturbance
Delgrange Property	Colchester	DEC Article 15		Stream Disturbance
Dry Brook Road SD	Middletown	DEC Article 15		Stream Disturbance
Barkaboom Road SD	Andes	DEC Article 15		Stream Disturbance
Collins and Kopcienski Property	Andes	DEC Article 15		Stream Disturbance
Emory Brook SD	Middletown	DEC Article 15		Stream Disturbance
Richard Guide Property	Middletown	DEC Article 15		Stream Disturbance
Gould Stream Disturbance	Hardenburgh	DEC Article 15		Stream Disturbance
Ashland Connector Stream Permits	Ashland	DEC Article 15	NWP 27	Stream Disturbance
Bono Property SD	Hunter	DEC Article 15		Stream Disturbance
County Route 6 SD	Lexington	DEC Article 15		Stream Disturbance
Kissley Road SD	Hunter	DEC Article 15		Stream Disturbance

Table 4.7. DEP reviewed and commented on 21 DEC Article 15 Protection of Waters Permits in 2006.

Project Name	Town	State Permit	Federal Permit	Project Type
Hitchcock Property	Jewett	DEC Article 15		Stream Disturbance
Fisher Property	Jewett	DEC Article 15		Stream Disturbance
Orchard St. at Bull Run Creek	Margaretville	DEC Article 15		Stream Disturbance
West Brook SD	Walton	DEC Article 15		Stream Disturbance

Article 24 Freshwater Wetland Permit Applications

DEP reviews DEC Article 24 Freshwater Wetland Permit Applications subject to the State's Wetlands Regulations. DEP's review of freshwater wetland permit applications assesses the proposal's impact on wetlands and identifies measures to mitigate those impacts. Once DEP becomes aware of a permit application through DEC's Environmental Notice Bulletin, discussions with DEC, or other means, DEP reviews the permit applications. Comments issued by DEP identify omissions in the applications, and measures that should be incorporated into a proposal, or included as a condition of approval, to protect a wetland, its water quality function, or water quality.

Table 4.8. DEP reviewed 16 DEC Article 24 Freshwater Wetland Permits during 2006.

Project Name	NYC Reservoir Basin	Notification/ Permit	Wetlands Losses (acres)	Wetlands Gains (acres)	Activity
Polimeni Property	Cross River	Article 24	0.06 buffer disturbance	0	Improvements to single family residence.
Ames Farm	East Branch	Article 24	0 wetland, Unspecified buffer disturbance	Unspecified	Enhancement for agricultural activities and waterfowl habitat.
Lake Tonetta	Diverting	Article 24	0 wetland, Unspecified buffer disturbance	0	Control nuisance aquatic vegetation.
Judith Katz Property	Middle Branch	Article 24	0.08 wetland, 0.63 buffer disturbance	Unspecified	Driveway access to single family residence.
Kenilworth Subdivision	Muscoot	Article 24	0 wetland, 0.03 buffer disturbance	0	Drill a test well w/in buffer, construct well access road and a buried water line.
Lake Secor Park District	Amawalk	Article 24	0	0	Treating of 24 acres of Lake Secor with copper sulfate to control algae
Michael Quinonis	Muscoot	Article 24	0 wetland, 0.1 buffer disturbance	0	Gravel driveway in buffer

Table 4.8. DEP reviewed 16 DEC Article 24 Freshwater Wetland Permits during 2006.

Project Name	NYC Reservoir Basin	Notification/ Permit	Wetlands Losses (acres)	Wetlands Gains (acres)	Activity
Ferrarone	Cross River	Article 24	0.06 wetland, 0.14 buffer disturbance	0.1	Improvements to single family residence.
Bottlegate Farm	Middle Branch	Article 24	0 wetland, 0.37 buffer disturbance	0	Construction of storm-water detention basin in the wetland buffer.
Bocklet Residence	Cross River	Article 24	0.01 wetland, 0.025 wetland buffer disturbance	0.007	Construct boardwalk extension in wetland and other activities in buffer.
Presbyterian Camp & Conference Center - Brown's Pond	Middle Branch	Article 24	5.25	0	Pesticide application - Aqualthol K and Aqua-Pro
Stay Sail Farm	Titicus	Article 24	0.02 wetland, 1.5 buffer disturbance	0.15	Expand existing horse farm
McDonald/Leiner	West Branch	Article 24	0.33 wetlands, 1.39 buffer disturbance	0.37	Road fill for subdivision.
Silver Property	Middle Branch	Article 24	0 wetlands, 0.13 buffer disturbance	0	Dredging Pond and depositing spoils on property.
Dill's Best	East Branch	Article 24	0 wetlands, 0.47 buffer disturbance	0	Grading for upgrade of stormwater management facilities and gravel storage area within the buffer.
Telecom Property	East Branch	Article 24	0.036 wetlands, Unspecified buffer disturbance	Unspecified	Wetland Crossing for gravel drive to parking area

401 Water Quality Certifications

DEP did not receive any requests for DEC 401 Water Quality Certifications during 2006.

2006 DEC Wetland Violations

As part of the Wetland Protection Strategy, DEP identifies violations of federal, State and municipal wetland regulations, refers the violations to the appropriate agency and assists in resolving the violations. DEP attempted to follow up on an alleged wetlands violation on private property but was unable to determine the exact location. During the reporting period, DEP participated in the violations identified in the table that follows.

Table 4.9. 2006 DEC wetland violations.

Project Name	NYC Reservoir Basin	Notification/ Permit	Wetlands Losses (acres)	Wetlands Gains (acres)	Activity
35 Somerset Road	Amawalk	Engineering Department – DEP	Unknown	0	Alleged Wetland Violation

In addition to reviewing applications, DEP and DEC maintain an ongoing dialogue concerning federal, State and City wetland programs.

Local Municipal Reviews

DEP continued to review local municipal wetland applications and SEQRA documents from towns that forward projects to DEP for review. Connecticut also forwards notification of wetland permits within the NYC watershed boundary located in Connecticut. As with the State and federal application, DEP assesses the proposal's impact on wetlands and identifies measures to mitigate those impacts.

Table 4.10. Eighteen municipal permit applications were reviewed in 2006:

Project Name	NYC Reservoir Basin	Notification/ Permit	Wetlands Losses (acres)	Wetlands Gains (acres)	Activity
Barbara Morris	Titicus	Town of Ridgefield, CT Inland Wetland Board	6 sq. ft.	0	Install 24' x 6' fishing dock into lake.
Moran Property	Titicus	Local Municipal - Town of North Salem	0 wetlands, 0.04 buffer disturbance	0.04	Driveway extension to an existing Driveway.
Peter Kamenstein	Titicus	Local Municipal - Town of North Salem	0 wetlands, 0.02 buffer disturbance	unspecified	Construct building in 100' wetland buffer.
James O'Brien	East Branch	Local Municipal - Town of North Salem	0 wetlands, 0.01 buffer disturbance	0	Replacement of existing deck and deck extension.
Moreira Residence	Muscoot	SEQRA – Town of Yorktown	0 wetlands, 0.23 wetland buffer disturbance	0.29	Wetland Permit for a single family home and sewer extension.

Table 4.10. Eighteen municipal permit applications were reviewed in 2006:

Project Name	NYC Reservoir Basin	Notification/ Permit	Wetlands Losses (acres)	Wetlands Gains (acres)	Activity
Robert Armentano	Muscoot	Local Municipal - Town of North Salem	0 wetlands, Unspecified buffer disturbance	Unspecified	Improvements to single family residence.
Metro International Holdings Corp/New Icon TV HQ	Boyd Corners	SEQRA – Town of Putnam Valley	Unspecified	Unspecified	Commercial development
Somers Intermediate School WWTP Upgrade	Muscoot	SEQRA – Town of Somers	0 wetlands, 0.16 buffer disturbance	0	Placement of a force main and gravity sewer and a sewer manhole within the wetland buffer.
Monomoy Farm, LLC	Titicus	Local Municipal - Town of North Salem	0.42 wetlands, 0.02 buffer disturbance	0	Mitigation for bridle trails that were installed without permits in the wetland and wetland buffer.
Timothy and Allison Collins	Muscoot	Local Municipal - Town of North Salem	0.002 wetlands, Unspecified buffer disturbance	0	Additions and alterations to existing one family dwelling.
Moran Property	Titicus	Local Municipal - Town of North Salem	0 wetlands, 0.04 buffer disturbance	0.04	Driveway extension to an existing Driveway. Revised plan showing drainage system discharges.
Katchadurian	Titicus	Local Municipal - Town of North Salem	0 wetland, 0.004 buffer disturbance	0	Shed in buffer.
Bocklet Residence	Cross River	Local Municipal – Town of Lewisboro	0.01 wetlands, 0.063 buffer disturbance	0.007	Construct boardwalk extension in wetland and other activities in buffer.
Pietsch Gardens Coop	East Branch	Local Municipal - Town of North Salem	0 wetlands, 0.025 buffer disturbance	0	Install blacktop road turn-around at end of Cottage Lane.

Table 4.10. Eighteen municipal permit applications were reviewed in 2006:

Project Name	NYC Reservoir Basin	Notification/ Permit	Wetlands Losses (acres)	Wetlands Gains (acres)	Activity
Trencher	Titicus	Local Municipal - Town of North Salem	0	0	Cleaning of 2 small ponds along a tributary.
Sullivan and Straus Property	Titicus	Local Municipal - Town of North Salem	0 wetlands, 0.005 buffer disturbance	0	Addition to house.
Stay Sail Farm	Titicus	Local Municipal - Town of North Salem	0.02 wetlands, 1.5 buffer disturbance	0.15	Expand existing horse farm.
Robert Abrams	Titicus	Local Municipal - Town of North Salem	0.09 wetlands, 0.08 buffer disturbance	0	Fencing, Erosion repair, footpath creation, remove existing tennis court, construct pond, reinforce existing pond edge.

4.6.2 Non- Regulatory Programs

Acquisition of Wetlands:

See section 4.2 Land Acquisition.

NYS Freshwater Maps

At DEP's request, DEC examined existing data sources and, in conjunction with DEP's Natural Resources staff, conducted fieldwork to revise the NYS Freshwater Maps for the east of Hudson (EOH) watersheds. Specifically, DEC verified the boundaries of existing regulated wetlands, locating additional wetlands that meet the regulatory threshold of 12.4 acres, and identifying smaller wetlands of Unusual Local Importance (ULIs) that are adjacent to the reservoirs. The wetlands identified on the State maps are subject to both DEC regulations as well as DEP Watershed Rules and Regulations.

DEC completed revisions of the NYS Freshwater Wetland Maps for the Croton and Kensico watersheds and the additional lands were adopted in November 2004. DEC's field work for the Putnam and Dutchess Counties map revisions was completed in 2004. In 2005 DEC held public hearings on the proposed map revisions and the final maps were adopted in April 2006. A total of 4,500 acres of wetlands were added to the state maps in the NYC watershed in Putnam and Dutchess Counties.

Wetland Mapping and Research

The majority of the Wetlands Mapping and Research component was completed in 2005 with data analysis and reporting completed early in 2006 for the wetlands functional assessment. The WOH National Wetlands Inventory Maps and EOH trends analysis was also completed and the deliverables finalized in 2005. These wetland mapping and research projects are designed to support both the regulatory and non-regulatory aspects of the DEP's Wetlands Protection Strategy (DEP, 2001).

National Wetland Inventory (NWI) Map and EOH Trends Update

This component of the Wetlands Protection Strategy was completed and all maps, reports and deliverables finalized in 2005. There was no activity in 2006. The results of the NWI map revisions and the EOH Trends Analysis can be found in Tiner 2005a and 2005b.

Wetland Functional Assessment

DEP's Wetland Functional Assessment Program combined the USFWS Watershed-based Wetland Characterization and Preliminary Assessment of Wetland Functions (W-PAWF) with a reference wetlands monitoring program to determine baseline characteristics and water quality functions of wetlands among various hydrogeomorphic settings. For the W-PAWF, the USFWS attaches hydrogeomorphic modifiers (landscape position, landform and water flow path [LLW]) to each wetland polygon in the NWI database to support preliminary, basin-wide assessments of eight wetland functions. DEP is conducting a monitoring program to verify the hydrogeomorphic classifications and preliminary functional assessments and to provide additional measures of ecological and water quality conditions for reference wetlands.

The W-PAWF for the entire Catskill, Croton, and Delaware watersheds was completed in December 2004 and was submitted as a FAD deliverable. Results and details of the W-PAWF can be found in DEP 2004a and DEP 2004b.

WOH Reference Wetland Monitoring Program

The WOH Reference Wetland Monitoring Program was a two-year project that sampled water quality, vegetation, and soils at 22 reference wetlands located throughout the Catskill and Delaware watersheds to evaluate the functional assessment based on wetland characteristics interpreted through remote sensing. The project officially started in September 2003 as the SDWA grant got underway and two new wetland staff were hired. Water quality monitoring for this project was conducted through a contract with SUNY School of Environmental Science and Forestry (SUNY ESF). Vegetation, soil, and water table monitoring was conducted by DEP.

Results of this monitoring program will enable DEP to determine baseline conditions and water quality functions of a number of wetland types. The data will be evaluated based on the hydrogeomorphic classification in order to characterize the distribution, composition, and functions of watershed wetlands. This approach will provide a means of identifying wetlands for

strengthened protection based on their landscape positions and associated water quality functions and will benefit the development of both regulatory and non-regulatory wetland protection as well as non-point source programs.

Site selection and study methodology can be found in DEP, 2005. Much of the field work for the Reference Wetland Monitoring Program was completed in 2005. In 2006 DEP continued to collect water table elevation data from the monitoring wells and confirmed plant species identification with plant specimens collected during the vegetation surveys. As part of the requirements for the SDWA Grant 4, a final report was generated. Details of the methods, results and conclusions can be found in DEP, 2006. Some of the major findings are as follows:

- LLW classifications ascribed by the USFWS were accurate for landscape position with two of 14 sites misidentified but almost half were misidentified for flow path. That was partly due to the difficulty in identifying flow regime through remote sensing.
- Ascribing a single landform designation was not appropriate for Terrene (TE) and Lotic Stream, headwater (LShw) wetlands in the Catskill and Delaware watersheds. Many of the wetlands had multiple landforms within a single NWI polygon.
- The NWI tended to underestimate wetland size. Field delineated wetlands were found to almost always be larger than as mapped by the NWI, by as much as 490%.
- A comparison of inflow and outflow stream gauges during storm events at the LShw intensive sites indicated a dampening of discharge at the outlets. This flow attenuation could mitigate downstream flooding and provides evidence for flood abatement functions of lotic headwater wetlands.
- Controls on wetlands water quality included LLW landscape position, anthropogenic inputs and the underlying geologic formation mineralogy. The water table in TE had a higher median elevation and less fluctuation than LShw probably due to the small drainage basin and greater input from groundwater for TE wetlands.
- Dissolved organic carbon (DOC) concentrations during baseflow were lower in TE than LShw wetlands but DOC storm dynamics were similar. DOC concentrations were positively correlated with discharge indicating a mobilization of near surface ground water form wetlands during storms.
- Baseflow concentrations of Nitrate (NO_3^-), total dissolved nitrogen (TDN), Sodium (Na^+), Chloride (Cl^-) and Specific Conductance also differed between LLW classes with LShw having the highest median concentrations and TE the lowest. These differences were likely due to the combined effects of anthropogenic inputs (i.e. road salts) and landscape position. The presence of stream throughflow in LS and LShw wetlands provides the opportunity to receive and potentially transform or retain surface water pollutants.
- Specific conductance was also influenced by the underlying geology as base cation concentrations and total alkalinity varied in wetlands among basins. The lowest levels of base cations, pH and alkalinity were consistently found in sites located within the Neversink and Ashokan basins and the highest were in Pepacton, Schoharie and Cannonsville basins.
- Most of the vegetation species observed in this study were unique to a small fraction of the 22 sites sampled, indicating that species composition was controlled by site-level factors rather

than the broad landscape positions assessed in this study. Microhabitat variation was more important in determining species numbers than gross landscape position.

4.7 East of Hudson Non-Point Source Pollution Control Program

DEP released its comprehensive plan to address nonpoint source pollution in the east of Hudson Catskill and Delaware reservoir watersheds[1] in October 2003 and revised the plan in December 2003. The Nonpoint Source Management Plan (NPS Plan) was designed to identify and eliminate sources and incidents of nonpoint pollution. The nonpoint sources targeted for remediation programs in this Plan include wastewater, stormwater, turf management chemicals and hazardous materials.

4.7.1 Stormwater

Stormwater Infrastructure Mapping and Inspection

Video inspection and digital mapping of stormwater infrastructure is being completed in order to locate, characterize and identify potential pollution threats associated with the stormwater infrastructure in the east of Hudson Catskill and Delaware System. The areas prioritized for inspection were identified in the Croton Watershed Strategy (CWS) (DEP, 2003). They included stormwater management, wastewater management, septic focus and wastewater treatment plant service areas.

The first phase of video inspection and digital mapping of the stormwater infrastructure was completed in 2005. The program identified the locations, conditions and potential pollution threats associated with this stormwater infrastructure. During the course of inspecting the stormwater infrastructure, the contractor identified defects. DEP investigated these areas or forwarded the information to the appropriate authorities. Those determined to be illicit discharges were satisfactorily remediated or eliminated.

A contract to complete the mapping and inspection in the West Branch and Boyd Corners basins was registered in December 2006. The data being digitized includes stormwater pipe size, estimated age, material and location; catch basin manholes, culverts and outfall location, size and estimated age; and all pertinent data concerning cross and illicit connections. The condition of the area surrounding stormwater discharges are also examined for information relevant to the stormwater remediation program. The digital data will be provided as baseline information to local and regional entities to establish future maintenance and inspection programs. Table 4.11 and Figure 4.11 show the infrastructure inspected to date.

1. The east of Hudson Catskill and Delaware reservoirs include West Branch, Croton Falls, Cross River and Boyd Corners.

Table 4.11. Inspected and Mapped Stormwater Infrastructure.

Reservoir Basin	Length of Pipe (linear feet)	Length of Ditches (linear feet)	Number of Structures (manholes, outfalls)
Boyd Corners	3,540	11,275	427
West Branch	49,560	18,279	1,064
Croton Falls	55,850	29,860	3,848
Cross River	46,690	18,515	2,644
Total	155,640	77,929	7,983

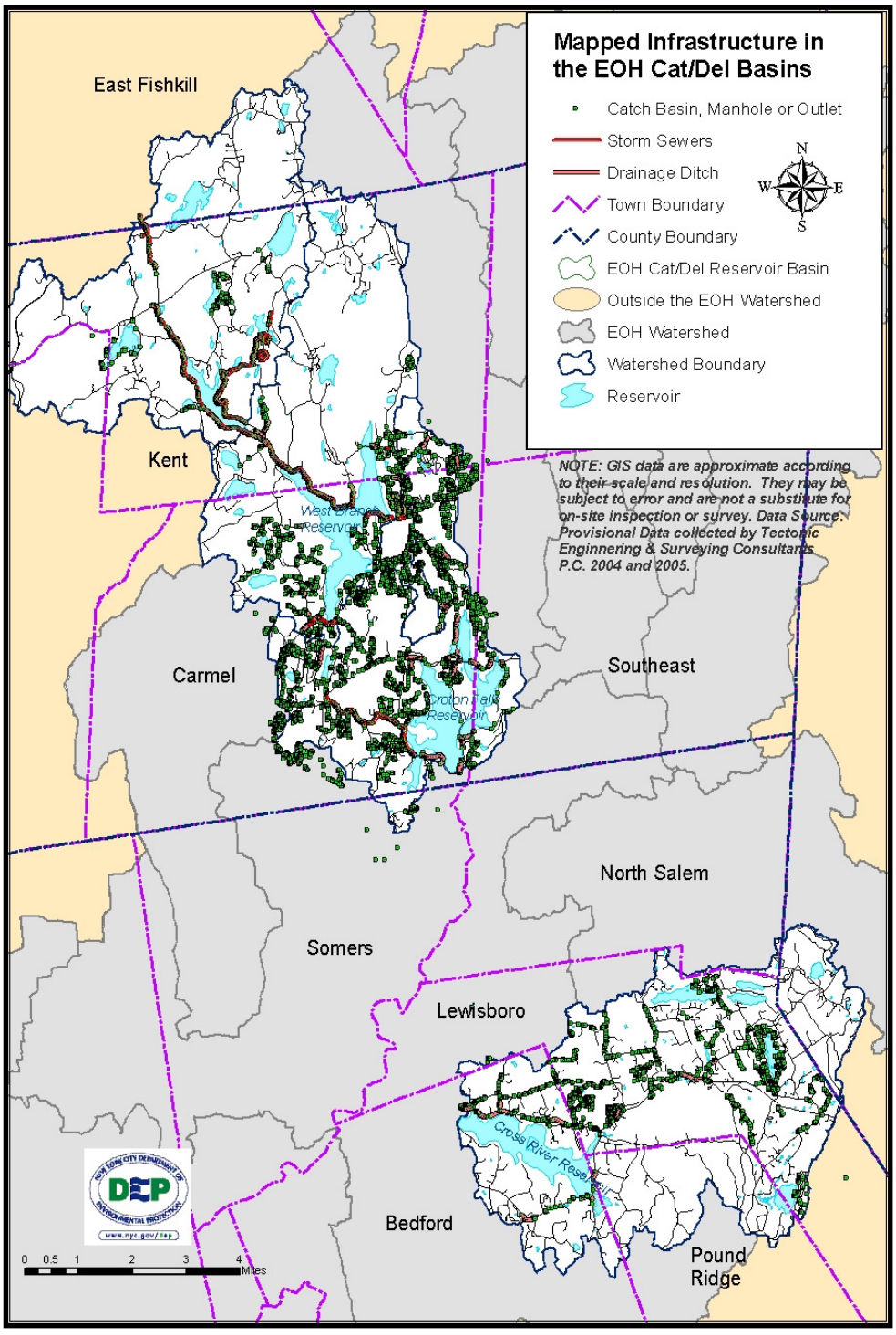

Figure 4.11. Mapped infrastructure in the east of Hudson Catskill/Delaware basins.

Stormwater Remediation Plan Implementation

DEP's Retrofit and Remediation Program includes all remedial measures associated with stormwater and the application of the site and facility selection criteria. The east of Hudson sites are shown in Figure 4.12.

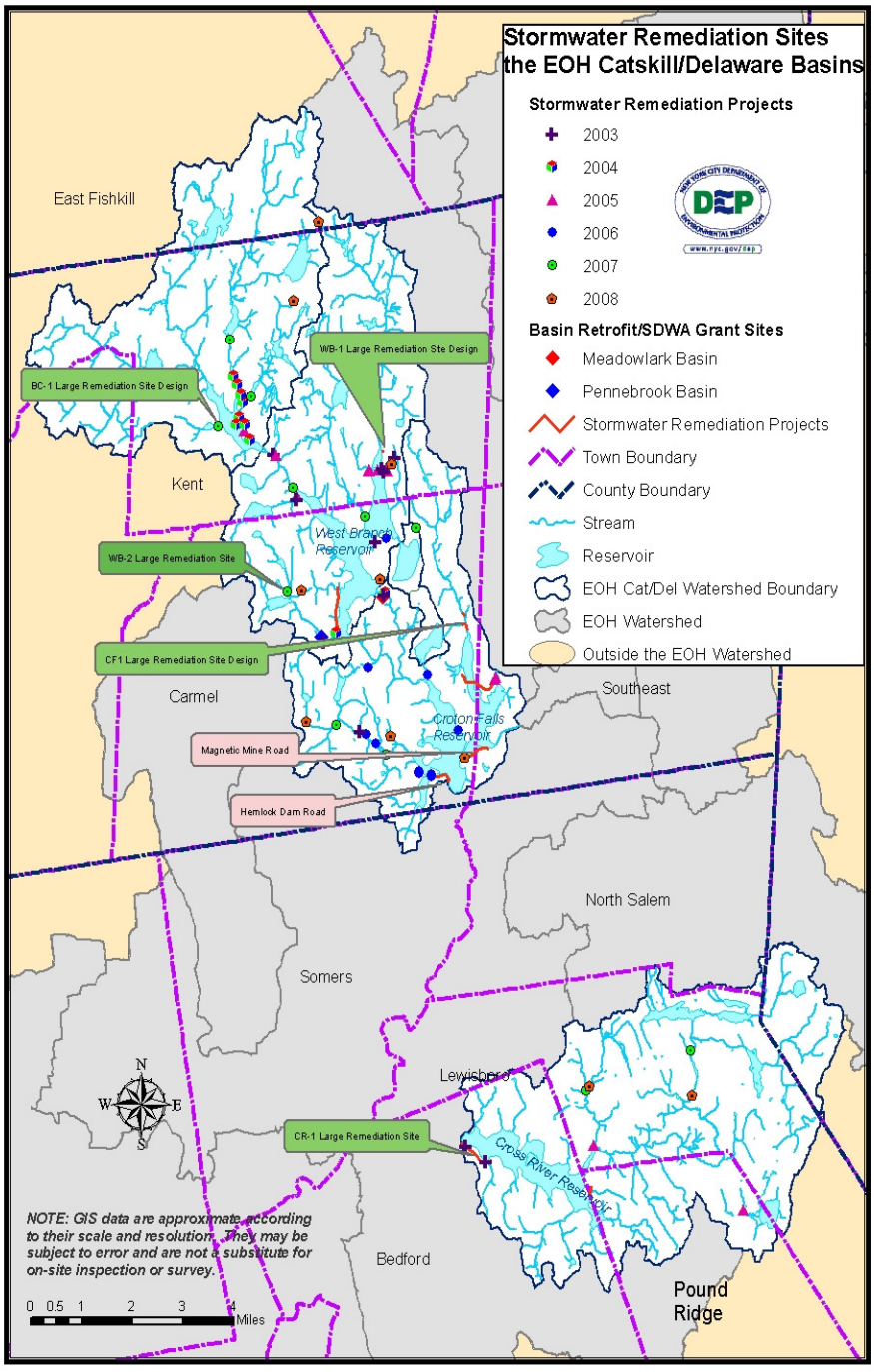

Figure 4.12. Location of proposed new stormwater remediation sites, large stormwater remediation sites and small stormwater remediation project sites.

The remediation sites are shown in Table 4.12. The preliminary design scope contract is complete. Final designs for the five east of Hudson site locations will be prepared under a new design contract.

Table 4.12. Stormwater remediation design sites and status.

Site Name and Pollutant	Reservoir Basin	Town	Location and Description of Remediation
WB-1 Sediment	West Branch	Kent	Joseph Court: Repair severely eroded channel on steep slope. Install catch basin, drop manhole, stormwater drainage pipe, outlet protection, and wetland plants. Town Planning Board has given approval of the scope of this project.
CR-1 Sediment	Cross River	Bedford	Maple Road: Install stormwater drainage improvements (swales and forebays), and landscape improvements, stabilize the parking areas with porous pavers, repair the culvert, stabilize embankments, and clean out sediment and debris build up at the outfall.
CF-1 Sediment	Croton Falls	Carmel	Stoneleigh Avenue: Stabilize the eroded length of stream channel, install road drainage improvements at Kelly Road (swales and erosion mat on eroded slopes) and Hughson Road (install swale and repair severely eroded drainage ditch). Presented preliminary scope to Carmel Planning in December 2005.
BC-1 Sediment	Boyd Corners	Kent Cliffs	Richardsville Road: Install a new drainage culvert, stabilize the embankment and channel, headwalls and endwalls, construct a forebay, remove accumulated sediment at the pond weir, remove accumulated woody debris immediately downstream from the weir, and replace guide rail. Property owners are amenable to the project. The Town of Kent has given preliminary approval of the scope of the project.

Table 4.12. Stormwater remediation design sites and status.

Site Name and Pollutant	Reservoir Basin	Town	Location and Description of Remediation
WB-2 Sediment	West Branch	Carmel	Long Pond Road/Crane Road: Install porous pavers to stabilize parking area, drainage improvements including forebays, and landscape improvements, and clean out sediment and debris build up at outfall. Presented preliminary scope to the Town Planning Board.

DEP will be conducting a pre-solicitation meeting for the new design contract in early 2007. The new design engineers will assist DEP in obtaining all necessary easements from private property owners and required permits and approvals for the five east of Hudson projects. Obtaining comments and approvals before the designs are final will assist in avoiding contract change orders and delays during the construction phase. To date, the private property owners have been agreeable to the designs and allowing the necessary access. The proposed project plans and designs were presented to the planning departments in Kent and Carmel in 2005.

Three Large Remediation Sites

DEP designed and constructed three large stormwater remediation sites that met the selection criteria in the NPS Plan; Washington Road, Pennebrook Lane, and Meadowlark Drive.

Washington Road

Washington Road, an unpaved road adjacent to the West Branch Reservoir, was characterized by a lack of adequate stormwater infrastructure, accelerated erosion of the road's surface, shoulders, and existing stormwater conveyance channels, and the discharge of sediment into West Branch. The retrofit included installation of stormwater collection and conveyance facilities to eliminate the uncontrolled flow of runoff, stabilization of the eroding road shoulders and reestablishing channels.

The repairs were made in the winter of 2004 and 2005. DEP assumed maintenance responsibilities in May 2006 when the construction guarantee period ended. Since that time, needed maintenance, such as sediment removal from forebays and swales, has been completed.

Pennebrook Lane and Meadowlark Drive

The establishment of wetland plants in the Pennebrook Lane extended detention basin has been successful and the basin functions as intended. The Meadowlark Drive detention basin was not able to fully provide all of the water quality functions for which it was designed. Prior to complete establishment of wetland plants, DEP observed cloudy water discharge. In May 2006,

DEP diverted the flow of water around the basin using sandbags. The combination of the groundwater in the basin and the water that was seeping through the sandbags allowed for a more thorough establishment of wetland plants within the basin.

In November 2006, DEP put the Meadowlark Drive basin back on line. In December 2006, DEP observed that the water level within the basin was extremely high thereby causing the wetland, transitional and upland vegetation to be covered with water. Water within the basin was turbid. The water entering the West Branch Croton River was not cloudy. DEP cleaned the outlet of debris to allow the basin to empty. Since then, the water level has not risen very high and seems to have stabilized.

Remediation Sites

The Bureau of Engineering Design and Construction (BEDC) performed a field inspection of the two new remediation sites along Magnetic Mine Road and Hemlock Dam Road in the Croton Falls Basin. Based on a general scope of work, BEDC selected a consultant engineering firm, Malcolm Pirnie (MP), to perform the stormwater remediation design work. BEDC and MP met at the site and performed an inspection of each design point.

Small Remediation Projects

Small eroded sites in the four east of Hudson Catskill/Delaware basins that might impact water quality are identified and repaired under the Stormwater Remediation Small Projects Program. Typical erosion abatement repairs include embankment stabilization, headwall repair or construction, road drainage improvements, parking area stabilization and trail stabilization. The small project program has evolved since the first sites were selected, designed and built. In addition to incorporating aesthetic elements in the designs, more detailed prioritization and site selection parameters are being developed based on results of sites remediated to date.

Of the sites selected for remediation under the current three year contract, approval of designs for the first ten sites is complete and construction has begun. Review of the second ten sites is currently underway.

4.7.2 Spill Containment Plan

DEP developed a Spill Containment Plan for the east of Hudson basins modeled after the Kensico spill containment plan. See Table 4.13.

Table 4.13. Spill Containment Plan.

Reservoir	Boat Ramps New	Boat Ramps Improve Existing	Building(s)	Booms Number of Deployable & Permanent
West Branch	Shaft 9	Belden Road provide turn around, move gate off road	2 15' x 30', capable of housing boats, one at Belden Road, one at Shaft 9	2 Deployable 3 Permanent
Boyd Corners	East Boyds Road	None	12' x12' @ E. Boyds Rd ramp	3 Deployable 4 Permanent
Croton Falls	Croton Dam Road	Drewville Road at sharp curve, improve entrance/egress, move gate	1 12'x12' @ Reservoir Road, 1 15'x'30' @ Croton Dam Road.	5 Deployable 0 Permanent
Cross River	None	None	1 15'x30'	5 Deployable 5 Permanent

Tripod anchors are used as tie downs for oil booms traversing the reservoir from shore to shore effectively sectioning it off in the event of a spill emergency. DEP has constructed all the tripod anchors for West Branch, Boyd Corners, and Cross River reservoirs. Fifty percent of the proposed tripod anchors for Croton Falls have also been constructed. The tripod anchors are located at various locations around the reservoirs. DEP has purchased 6,200 linear feet of oil boom to be used for such an emergency, and expects delivery of approximately 10,000 additional linear feet of boom (See Figures 4.13a and 4.13b). The booms will be stored in concrete storage buildings constructed on the shores of the reservoirs. DEP has already procured drawings for the storage buildings and for the proposed boat ramps and is pursuing approval for the necessary permits to erect them. DEP will construct the ramps with cable concrete which consists of trapezoid concrete blocks held together with stainless steel cable. The proposed boat ramps will facilitate access to the reservoir for emergency response and deployment of booms.

Figure 4.13. a) Oil boom. b) Tripod anchors.

All the anchors for the permanent boom / containment facilities for all four east of Hudson Catskill and Delaware reservoirs have been constructed. These containment facilities are located at selective streams outlets along the shores of the reservoirs and will be added protection to the reservoirs from possible spills occurring on roads crossing or near specified streams.

4.7.3 Maintenance Implementation and Tracking

As each new facility is brought on line, it is added to the routine inspection program. Facility maintenance is promptly completed under the construction contract warranty for the first year and under the 3-year maintenance contract thereafter. Inspection and maintenance follows procedures identified in the Operation and Maintenance Guidelines (DEP, 2000).

A Computer Assisted Facilities Management (CAFM) application is being developed for DEP staff to use to ensure the facilities are inspected and maintained properly. DEP staff beta tested several prototypes of the maintenance software in 2006. Beta testing involved entering multiple inspection reports and maintenance requisitions and allowed the consultant to identify any abnormal conditions to repair and restore functionality. The beta test version has been revised to expand the application's functional capabilities and the types of facilities that can be managed. The current application utilizes GIS to link all of the pertinent construction, operation, maintenance, inspection and evaluation requirements to a graphic illustration.

4.7.4 Hazardous Materials/Stormwater Audits

In 2004, DEP initiated a hazardous material audit of sites in the four east of Hudson Catskill and Delaware reservoir basins that generate, treat or store hazardous materials and/or petroleum products. Sites selected for the audit program were previously identified through the CWS. The types of sites included in the audit were automobile refueling and service stations, car washes, automobile body shops, greenhouses/nurseries, pavement manufacturing facilities, mason supply shops, schools and government facilities.

In continuing the effort, hazardous materials audits were conducted at the publicly-owned facilities. Eleven sites were visited in conjunction with the audits. Several schools and one town did not grant access. One address noted on the original list contained no facility but is a closed landfill which now monitors its groundwater. Of the eighty (80) sites that were originally identified in the audit, DEP inspected all of the sites that granted DEP access - over 92% of the sites.

4.7.5 Turf and Pesticide Management

In 2006, an interagency workgroup continued to address turf management and turf chemical use in the New York City Watershed. The group's main goal is to promote the use of no or low phosphorous fertilizers in the watershed, to educate residents on the link between individual turf management activity and water quality, and to promote soil testing prior to turf management activities. Since 2002, the group has developed and distributed educational brochures for homeowners in the watershed, produced short presentations to deliver to landscape professionals and individual residents regarding turf management and water quality and has approached local retailers about carrying low or no phosphorous fertilizer for sale in the watershed. DEP provided financial, technical, and administrative support in these endeavors. In 2006, the workgroup also met with leaders in the phosphorus fertilizers industry in an effort to increase the availability of phosphorus-free fertilizers.

4.7.6 Map, Analyze and Track Impervious Cover

DEP's program to map, analyze and track impervious cover in the watershed also included a component to evaluate the thresholds at which the water quality impacts from development are measurable and irreparable. The initial evaluation (DEP, 2002), based upon aerial mapping and water quality data, concluded that "there is no observable threshold of impervious cover where water quality becomes so poor the water quality standards are consistently exceeded." Instead, the data showed a slight trend towards decreasing water quality that corresponds to an increase in impervious cover. No thresholds were evident in the trend.

DEP initiated an expanded evaluation into the impacts of impervious cover. However, other investigations into impervious surfaces have indicated that the project design would not yield much useful information given the inherent scatter in water quality data at these scales and the low percentage of impervious cover. DEP decided not to proceed with this project and cancelled the contract with Horsley and Whitten.

4.7.7 Wastewater Infrastructure Mapping, Inspection, and Remediation

To locate and characterize the sanitary infrastructure in the four basins, DEP funded a program to video inspect and digitally map sanitary infrastructure. The inspection program is assessing defects and identifying those that may result in exfiltration of effluent to surface water. Digital mapping data is being collected for system maintenance. Digitized data includes sewer pipe size,

estimated age, composition, and precise location; manhole location, size and estimated age; pump station locations, size and flow capacity; interceptor sewer location, size, estimated age, and data concerning cross and illicit connections.

The program will develop:

- digital maps of the sewer infrastructure and their ownership;
- a database of the system's make up linked to the digital maps; and
- a summary report that identifies cross connections, illicit connections, pump station failures and defects that may lead to exfiltration of wastewater.

To minimize delays, DEP requested the work be completed under the stormwater infrastructure inspection contract through a change order. Approval was granted in December 2004 and inspections began shortly thereafter. No cross connections, illicit connections, pump station failures, or defects that may lead to exfiltration of wastewater into the water supply were identified in the over 6,000 feet of sanitary sewer inspected and 40 manholes inspected.

The contractors discovered that the number of structures and length of pipe were substantially more than initially estimated. A scope of work to inspect and digitally map the remaining 250,000 linear feet of sewer pipelines and 1,200 structures has been submitted and will be completed under a new contract.

Wastewater Infrastructure Remediation Plan

When the NPS Plan was prepared, DEP proposed to use the results of the video inspection and mapping program to develop a Wastewater Infrastructure Remediation Plan. To expedite repairs, DEP will negotiate agreements with municipalities, infrastructure owners and appropriate jurisdictional authorities to complete the repairs. DEP will not need to use the City contracting process to complete repairs, as they will be made by appropriate jurisdictional authority. The final report submitted for the infrastructure inspection program, with its findings report, will constitute the Remediation Plan.

In the event illicit connections to the infrastructure are identified during the inspection program, DEP forwards relevant information to infrastructure owners and appropriate regulatory agencies for possible enforcement action. To date, no illicit connections have been identified.

The Wastewater Infrastructure Mapping and Inspection schedule was revised to reflect the delay in issuing a new mapping and inspection contract. The date for completing remediation would be revised accordingly.

4.8 Kensico Water Quality Control Program

The Kensico Water Quality Control Program continued to effectively address potential pollution sources in the watershed. The status of program elements and significant accomplishments are described in this portion of the report.

4.8.1 Stormwater Management

DEP constructed 45 stormwater management and erosion abatement facilities throughout the watershed to reduce loads of fecal coliform bacteria and suspended solids conveyed to the reservoir by stormwater. The facilities are shown in Figure 4.14.

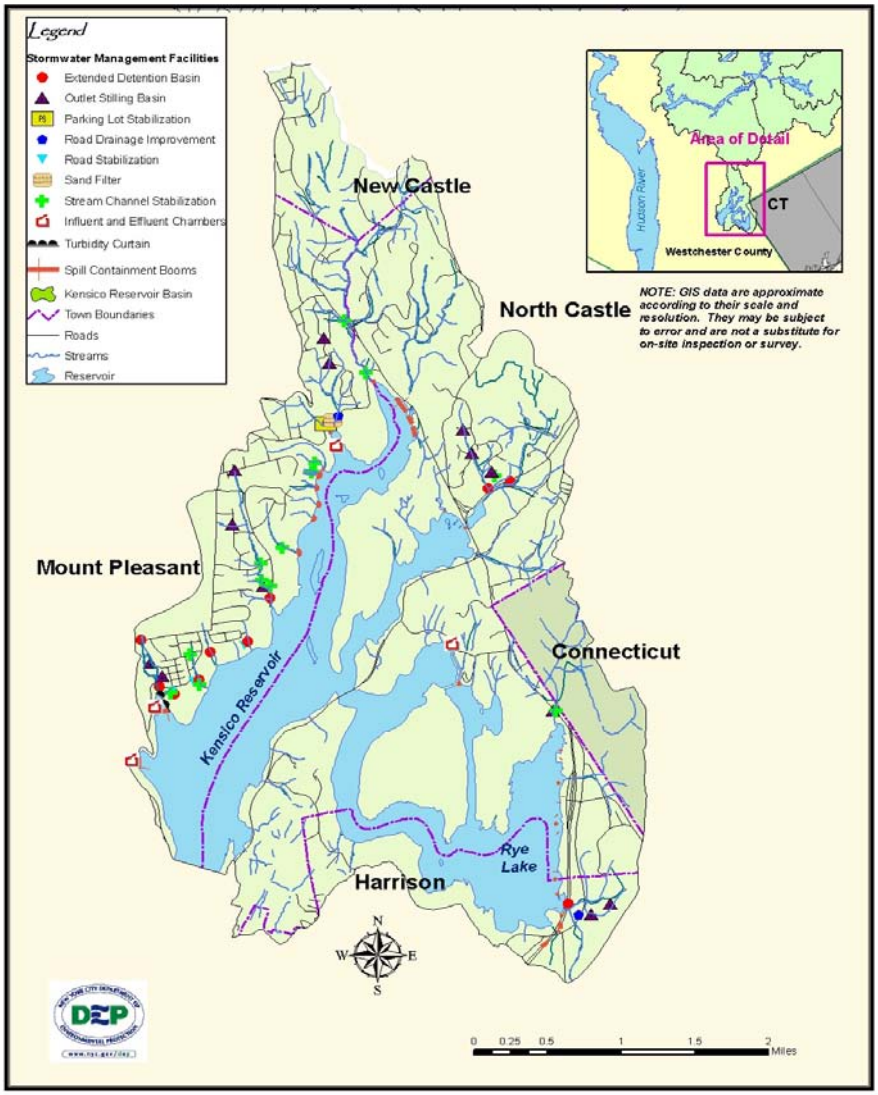

Figure 4.14. Location of stormwater management facilities in the Kensico Reservoir watershed.

4.8.2 Stormwater Facility Maintenance

The stormwater management and erosion abatement facilities were routinely inspected and maintained as needed throughout the year. Inspections and maintenance were completed in accordance with the Operation and Maintenance Guidelines (DEP 2000, revised 2003). Table 4.14 shows inspection requirements and typical maintenance needs.

Table 4.14. Inspection checklist for extended detention basins.

Inspection Guidelines	Minimum Inspection Frequency	Maintenance Guidelines
Access routes, basin structures, including rip-rap stabilized outlet, emergency spillway, headwalls, riser boxes, embankments, weirs, handrails and trash racks for cracks, seepage and settling of embankment.	Four times a year and after heavy storm events for erosion, structural damage, debris accumulation and vegetative growth.	Report access obstructions, damage to access route, damaged structures and erosion to Project Manager and repair as advised. Remove debris, clogs and vegetative growth promptly. Replace or remove debris and sediment accumulation from rip rap when clogging becomes apparent. Replace filter fabric when rip rap is replaced. Maintain clear access to manholes, gate valves, and catch basins.
Inlet/outlets, basins, and maintenance access roads for debris and trash accumulation, obstructions and clogging.	Monthly and after heavy rain or snowmelt for clogging.	Remove debris, trash and obstructions promptly using hand tools if tools are needed.
Vegetation - health of planted vegetation (wetland, embankment, coconut rolls and seeded areas), erosion of planted areas.	Monthly during growing season. Quarterly during non-growing season.	Replace dead and dying wetland and planted vegetation, repair erosion and prevent future erosion and reseed and mulch bare areas. Maintain/mow/prune embankment vegetation and remove tree growth from embankment bi-yearly. Do not mow wetland vegetation.

Table 4.14. Inspection checklist for extended detention basins.

Inspection Guidelines	Minimum Inspection Frequency	Maintenance Guidelines
Nuisances: odors, burrowing pests	Monthly	Identify source and remove nuisance. Report nuisances to Project Manager and address as advised
Gate Valve	Yearly	Check integrity of the valve by fully opening and closing the valve to ensure it is functioning properly.
Dams for structural integrity (seepage, settling and erosion.)	Annually	Report damage to Project Manager and repair structures as advised.
Sediment depth in forebay and detention basin. Measure sediment depth with marked measuring stick. Once a year, drain pond to measure sediment depth.	Once a year and after significant storms.	Remove sediment from forebay every 5 years and from main basin every 15 or when depth >50% of the basin depth. If basin does not contain a forebay, remove sediment at least every 15 years. A backhoe will be required to clean out the sediment. Dispose of the removed material in accordance with federal, state and local regulations.

The 3-year maintenance contract commenced in March 2005. As a result of the unusual severity of storms, the volume of accumulated sediment in some of the basins was higher than anticipated. Thus, the original engineering estimate underestimated the maintenance for items such as sediment removal, vegetation removal and rip-rap replacement. To complete the outstanding work within permitted time frames, DEP has submitted a change order to dedicate the necessary funds toward these maintenance tasks. DEP is now planning for 2008, when a new contract will be put in place.

Computer Assisted Facilities Management

A Computer Assisted Facilities Management (CAFM) application is being developed for DEP staff to use to ensure the facilities are inspected and maintained properly. The beta test version has been revised to expand both the application's functional capabilities and the types of facilities that can be managed. The database and application design were modified to refine the

scheduling and management of inspection, maintenance, construction and repair activities and the reporting related to those activities. Greater flexibility in relating other project documents within the application was also added. The application design now accommodates the facilities management for wastewater infrastructure, stormwater infrastructure, septic systems, reservoirs and in-reservoir facilities and turbidity curtains.

DEP staff beta tested several prototypes of the maintenance software in 2006. Beta testing involved entering multiple inspection reports and maintenance requisitions and allowed the consultant to identify any abnormal conditions to repair and restore functionality. The current application utilizes GIS to link all of the pertinent construction, operation, maintenance, inspection and evaluation requirements onto a graphic illustration of the Kensico Reservoir Basin. The software consultant is charged to enhance the program's functionality and provide a demonstration of software that is intended to be compatible with the current DEP engineering database.

Stormwater Facility Monitoring

Monitoring to assess the pollutant removal rates of the detention basins and sand filter continued in accordance with the Monitoring Plan for the Kensico Basins (DEP 2000b, revised 2004).

Monitoring data through the 2005 sampling period (2006 data analysis pending) has shown that the detention basins function as designed. Monitoring data in combination with the maintenance program's volume of accumulated sediment removed from each basin confirm that the basins reduce sediment loading to the reservoir. Similarly, measured accumulations removed from outlet stilling basins confirm that sediment is detained. Inspectors confirm the stability of repaired outlets and streambanks further ensuring repaired areas do not return to their eroded state and a source of stormwater borne sediment.

4.8.3 Enhanced Spill Containment

In 2006, DEP continued to maintain the 39 spill containment facilities installed at the outlets of 26 storm drains along Interstate 684 and Route 120. The facilities improve spill response, clean up and recovery, thereby minimizing water quality impacts. See Figure 4.15.

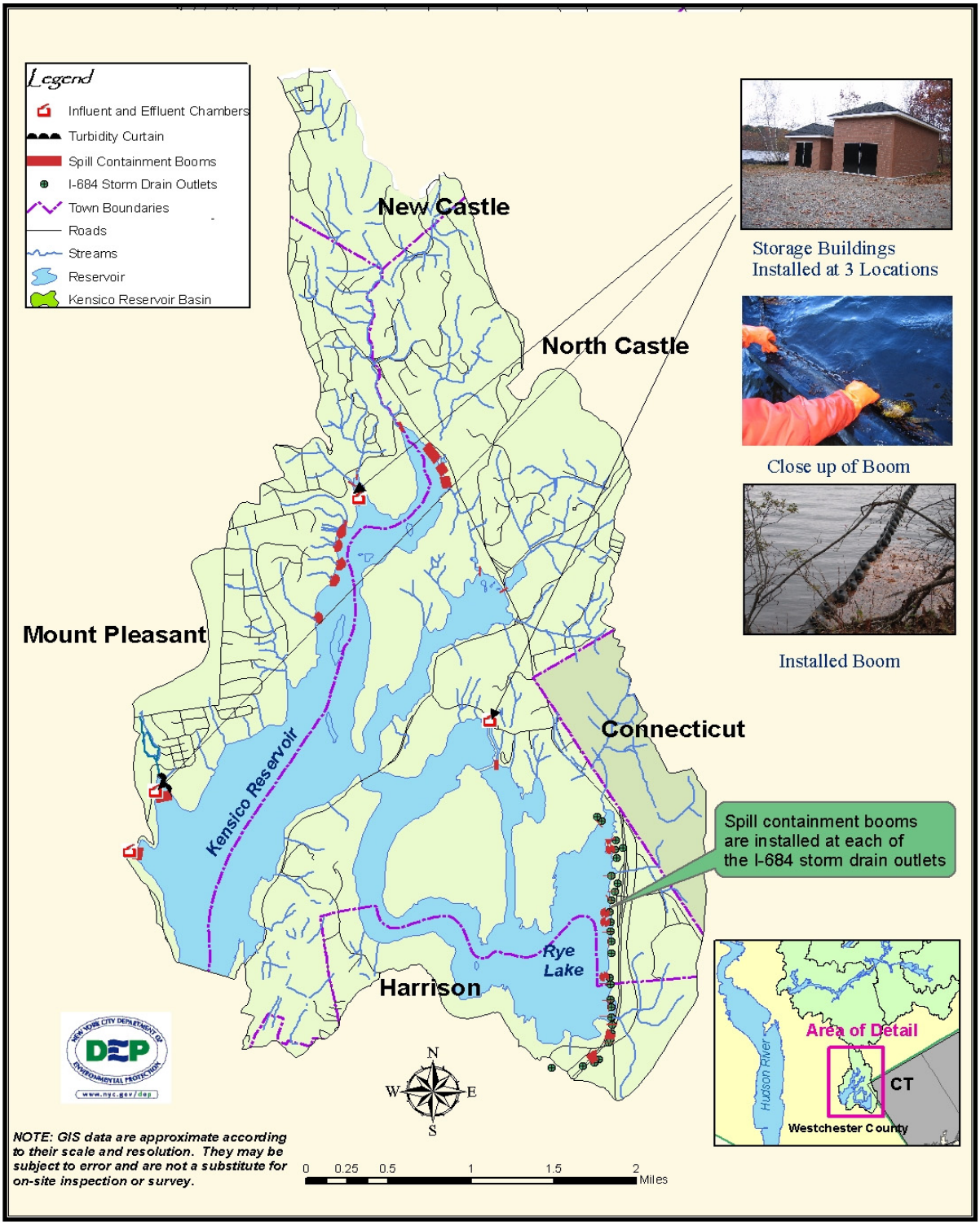

Figure 4.15. Spill containment facilities in the Kensico Reservoir.

Two storage buildings to house emergency response equipment were installed at Shaft 18 and Shaft 17. Permits for the third building were secured in 2006. In 2007, DEP anticipates that the third building and replacement boat dock will be installed at the CUIC and Shaft 18, respectively.

Although no spills were reported on Interstate 684 or the roads surrounding Kensico since the booms were installed, the booms have functioned as designed and have not contributed to floatable debris buildup. Temporary booms were deployed at the end of the boat ramp that can encircle the ramp in the event of a spill. No spills or discharges occurred, nor was boom deployment required.

4.8.4 Reservoir Dredging

Accumulated sediment was removed from the intake channels at the Catskill Upper Effluent Chamber and Shaft 18 in May 1999. The approximately 2,000 cubic yards of sediment was removed to prevent resuspension and increased turbidity in the water column. At that time, it was determined that dredging was not necessary at the mouths of the streams discharging to Malcolm Brook cove.

In 2006, DEP contracted with CR Environmental to perform sub-bottom profiling of the approaches to Shaft 18 and the CATUEC. In October, staff from CR Environmental deployed onto Kensico Reservoir with remote-sensing equipment to determine the depths of sediments at these approaches. While processing the data in November, they determined that an additional survey would be required, as the configuration of the approach channel to the CATUEC produced interference with the remote sensing signals. During this second visit, the remote sensing equipment was re-deployed, to minimize the interference. In addition, core samples were taken to document sediment depths, and video equipment was used to document the depths of sediments at the two approaches.

For Shaft 18, sub-bottom sonar data suggests minimal accumulation (less than 1 foot) of sediments within 100 meters of the building. For CATUEC, however, data suggest between 2.0 and 6.3 feet of sediment in the approach channel. This sediment is thought to be composed primarily of sandy slits and course organic detritus. Sediment thickness was greatest near the gate, and at an apparent mound which is present approximately 9 to 12 meters from the building. The nature of this mound cannot be determined from available data, but the presence of the feature is supported by weighted line sounds which suggest as much as 5.1 feet of sediment. Additional information on the intake channels will be included in the forthcoming Kensico Action Plan.

4.8.5 Wastewater Infrastructure Inspection and Mapping

Select portions of the sanitary sewer system were digitally mapped and video inspected in the Kensico Reservoir watershed. The purpose of the inspection was to evaluate the sewer system and identify defects that may result in exfiltration with the potential to contribute pollutants to the drinking water supply. The project's scope of work included videotape inspection and digital

mapping of segments of previously uninspected sewer pipe in the Kensico watershed. Any pump station failures and defects with the potential to contribute pollutants to the drinking water supply were also being located and reported.

Collection of digital map data is essential for system assessment and maintenance. Data being collected and stored in DEP's GIS library for multiple user access included:

- the location, size, age, and material composition of all sewer lines, manholes, pump stations, and any other sewer system components (appurtenances);
- the location of defects that result in exfiltration of wastewater;
- the location of pump station failures and other defects with the potential to contribute pollutants to the drinking water supply; and
- the location of any illicit wastewater connections found during the inspection program.

DEP's contract to video inspect, digitally map and clean certain sections of the sanitary sewer infrastructure in the Kensico Reservoir watershed is intended to supplement DEP's previous effort under which some 50,000 linear feet of sewer were mapped and inspected. Prior to initiating field work, the contractor searched municipal records for installed sanitary infrastructure and visually inspected the uninspected portions of the watershed. The largest uninspected segment is the Westchester County sewer line which parallels the reservoir's western shore. The entire length of County sewer was initially inspected in 2003, some 21,864 linear feet of sewer line and some 120 manholes. No defects were found that might result in exfiltration. Westchester County has continued to perform annual inspections and flushing of the pipeline to determine the structural integrity of the line.

In 2006, DEP contract digitally mapped and inspected the entire remaining sanitary infrastructure in the Kensico watershed, estimated to be some 40,000 feet. The inspection revealed that there were no defects within the sanitary sewer system that could result in exfiltration and subsequent discharge of wastewater into the water supply.

4.8.6 Turbidity Curtain

Since its installation in 1995, the 800 foot long turbidity curtain installed in the reservoir between the Catskill Upper Effluent Chamber and Malcolm and Young (N1) Brooks has effectively deflected discharges from the two watercourses away from the effluent chamber. Figure 4.16 shows the location of the turbidity curtain and its flow deflection function.

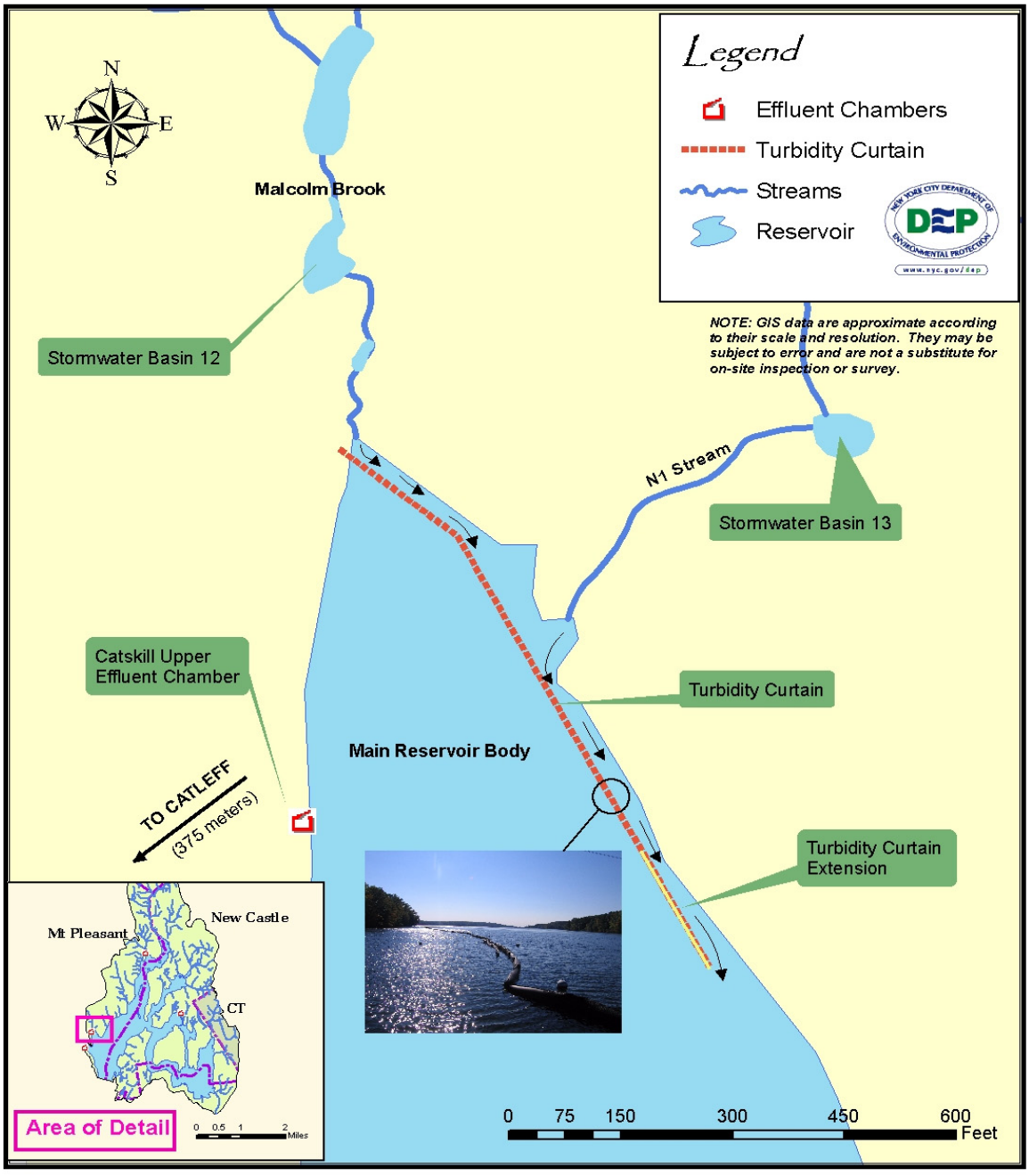

Figure 4.16. Turbidity curtain in the Kensico Reservoir.

DEP monitored the extended turbidity curtain, designed to direct flows from Malcolm Brook and Young Brook (N1) further out to the body of the reservoir and to provide enhanced protection of the water entering the Catskill Upper Effluent Chamber. DEP staff performed the following maintenance tasks for the turbidity curtain:

April 28, 2006 – Repaired a seam on the geotextile fabric. The seams in the fabric were tied and sewn by divers.

June 13, 2006 – Reattached the load line to the external or on-shore anchor.

June 29, 2006 – Repaired a tear in the geotextile fabric using an approved repair kit from the manufacturer.

August 6, 2006 – Repaired a seam in the Malcolm Brook Turbidity Curtain that holds a flotation section in place.

October 6, 2006 – Performed an inspection to determine if the maintenance performed on August 6, 2006 was effective. The curtain appeared to be functioning as intended.

4.8.7 KEEP

The Kensico Environmental Enhancement Program (KEEP) is a joint effort between DEP and Kensico Reservoir watershed communities to protect and enhance water quality in the Reservoir. KEEP involves coordinated surveillance of the reservoir, community education and outreach on issues related to the reservoir and its watershed, and environmental education programs for children. Joint efforts of DEP and the community to promote watershed protection provide opportunities for watershed residents to learn how they or their community can prevent nonpoint source pollution.

KEEP participated in several events throughout the year. They took part in the Pace University Environmental Center's Annual Harvest fair by providing educational materials highlighting KEEP's mission. KEEP sponsored a Trout in the Classroom Program at Westlake Middle School in Mt. Pleasant. In May, KEEP held a very successful Kensico Reservoir Watershed Water Conservation & Water Quality Preservation Art & Poetry Contest involving schools surrounding the Kensico Reservoir. The Art and Poetry contest was a culmination of classroom lessons, which focused on the history and present day New York City water supply system, the role that the Kensico watershed plays in the overall system, water quality, and the value of water and water conservation. KEEP co-sponsored its annual Take a Child Fishing Day in which parents and children are invited to learn about and fish in the Kensico Reservoir.

4.9 Catskill Turbidity Control

Due to the nature of the underlying geology, the Catskill watershed is prone to elevated levels of turbidity in streams and reservoirs. High turbidity levels are associated with high flow events, which can destabilize stream banks, mobilize stream beds, and suspend the glacial clays that underlie the streambed armor. The design of the Catskill System accounts for the local geology, and provides for settling within Schoharie, Ashokan West Basin, Ashokan East Basin and the upper reaches of Kensico

Reservoir. Under normal circumstances the extended detention time in these reservoirs is sufficient to allow the turbidity-causing clay solids to settle out, and the system easily meets turbidity standards at the Kensico effluent. Periodically, however, the City has had to use chemical treatment to control high turbidities.

DEP is engaged in numerous projects and studies under the Catskill Turbidity Control Study to analyze structural and operational alternatives to reduce turbidity levels in the Catskill System. A summary of the major efforts underway is provided below.

Analysis of Engineering Alternatives

DEP is undertaking a comprehensive analysis of engineering and structural alternatives to reduce turbidity levels in the Catskill System. DEP has engaged the Gannett Fleming/Hazen and Sawyer Joint Venture (JV) to conduct the engineering analyses. In addition, DEP has retained the Upstate Freshwater Institute (UFI) to enhance the existing water quality models for Schoharie, Ashokan, and Kensico Reservoirs to allow for full assessment of the effectiveness of potential engineering alternatives in reducing turbidity. As part of this effort, Hydrologics, Inc. has been retained by the JV to link UFI's water quality models to an updated reservoir operations model (OASIS) in order to determine how reservoir operations can be optimized to reduce turbidity in the Catskill System, and how optimization strategies to reduce turbidity will affect the water supply as a whole. Both UFI and HydroLogics have been working closely with the JV in this endeavor. The Catskill Turbidity Control Study is being performed in three phases and is discussed in greater detail in the sections below.

4.9.1 Catskill Turbidity Control Study: Phase I

The core goal of the Phase I study, completed in December 2004, was to identify potentially feasible, effective, and cost-effective measures for reducing turbidity levels entering Esopus Creek from water discharged via the Shandaken tunnel from Schoharie Reservoir . Temperature control performance was also considered in recognition of the Esopus Creek trout fishery and requirements in the then-draft SPDES permit for water releases from the Shandaken Tunnel to Esopus Creek. Turbidity control measures at Ashokan Reservoir were also screened in Phase I, due to the potential for effective Catskill System turbidity control at this location. This preliminary screening-level assessment focused on six major turbidity control alternatives at Schoharie and Ashokan Reservoirs:

- Multi-Level Intake
- Permeable Turbidity Curtain
- In-Reservoir Baffle
- Modification of Reservoir Operations
- Engineered Treatment Facilities
- Ashokan Reservoir Hydraulic Modifications

Preliminary conceptual designs were prepared and performance evaluations were conducted for each of these alternatives in Phase I, followed by a "pass-fail" screening to identify alternatives that merited further development. On this basis, the Permeable Turbidity Curtain and Engineered Treatment Facilities were eliminated, and the remaining four alternatives were recommended for further development and refinement.

4.9.2 Catskill Turbidity Control Study: Phase II

Phase II of the Catskill Turbidity Control Study, completed in September 2006, consisted of detailed engineering, conceptual designs, cost estimates, and performance evaluation to provide a solid foundation for identifying and selecting feasible, effective, and cost-effective measures from the three surviving Schoharie alternatives identified in Phase I for reliably improving turbidity and temperature control in diversions from Schoharie Reservoir to Esopus Creek. Under Phase III of the study, to be completed December 2007, similar analyses are being conducted for the turbidity control measures identified at Ashokan Reservoir. Summaries of the analyses performed for the alternatives at Schoharie under the Catskill Turbidity Control Study are described in the following sub-sections, along with key Phase II findings.

Modification of Reservoir Operations

The development of a linked water-quality water-supply modeling tool was proposed in Phase I to assess the feasibility and potential effectiveness of modifying the operation of Schoharie and Ashokan Reservoirs to control the turbidity of diversions to Esopus Creek and Catskill Aqueduct, respectively. In addition, alternative management strategies could also provide improved control over peak summer temperatures in water diverted to Esopus Creek. However, water quality-driven changes in the timing and magnitude of withdrawals have to be considered in the context of overall water supply needs. The linked model, as proposed in Phase I, would ultimately connect the two-dimensional CE-QUAL-W2 (W2) reservoir turbidity transport models for Schoharie, Ashokan, and Kensico reservoirs with the OASIS reservoir model of the DEP reservoir system. Phase I also identified the possibility of expanding the above OASIS-W2 analytical tool into an operator-friendly, system-wide real-time Operations Support Tool (OST).

In Phase II of this study, the concept of modifying existing operations at Schoharie Reservoir to provide additional turbidity and temperature control over Schoharie export was further advanced through the development of the linked water quality-water supply simulation tool, and use of this tool to test reservoir operating rules. The water supply model, OASIS, was substantially upgraded, tested and validated to represent current operating rules throughout the entire NYC reservoir system and Delaware Basin. In addition, the Schoharie Reservoir two-dimensional water quality model, W2, was rigorously developed to provide explicit simulation of temperature and turbidity within Schoharie Reservoir (see further detail below under Upstate Freshwater Institute Monitoring and Modeling). The upgraded OASIS model was linked to the Schoharie W2 water quality model. The linked tool was used to simulate operation of the reservoir system, and to make daily decisions about the quantity of water withdrawn from Schoharie Reservoir based on

turbidity, water temperature, physical constraints, regulatory requirements, demand, and water supply conditions in the rest of the system. These daily diversion and release decisions in turn affect the following day's turbidity and temperatures of the Schoharie withdrawals , thereby providing a dynamic simulation in which the reservoir is operated within the context of system-wide water supply needs and constraints, while taking into consideration daily water quality variations. In addition to testing the performance of water quality-based operating rules at Schoharie Reservoir, the linked OASIS-W2 model was used during Phase II to evaluate the performance potential of the baffle curtain and alternative multi-level intake configurations at various reservoir locations.

In the Phase II evaluation it was found that Modified Operations could be an effective means for reducing peak summer diversion temperatures and the incidence of elevated turbidity levels, and could substantially lower solids loading to Esopus Creek. Some of these Modified Operations could be implemented in the near-term, while full implementation would require development of an Operations Support Tool.

Multi-Level Intake

The existing Shandaken Tunnel Intake has a single withdrawal level at the intake invert, some 80 feet deep. A new MLI would enable operators to control the quality of water being withdrawn from the reservoir by selecting the withdrawal level with best water quality. Results of the preliminary, short-term two-dimensional model simulation performed in Phase I indicated that selective withdrawal capability through a multi-level intake could help reduce turbidity export from Schoharie Reservoir and provide additional control over diversion temperature. Four potential sites for a new multi-level intake structure were evaluated in Phase I, of which three were recommended for further analysis.

In Phase II, more advanced modeling was performed over longer simulation periods to better quantify the long-term performance of selective withdrawal structures under a wider range of demand and environmental forcing conditions and to optimize MLI structure design. In addition to modeling results, further design evaluation included comparison of hydraulic limitations between proposed locations, the identification of more suitable locations from a construction perspective, evaluation of benefits of onshore versus offshore intake structures, and evaluation of the feasibility of modifying the existing Shandaken Tunnel intake to provide selective withdrawal capability. Conceptual designs were developed for a total of seven MLI alternatives at Schoharie Reservoir, including onshore and offshore intake options located downstream (north) of the existing Shandaken Tunnel Intake, and modification of the existing Shandaken Intake. All MLI alternatives represent conventional structures that would be expected to provide long-term, reliable service.

In the Phase II evaluation it was found that the Multi-Level Intake alternatives could effectively control peak summer diversion temperatures and could reduce the incidence of elevated turbidity levels, particularly in May and June. MLI alternatives were found to provide minimal turbidity control benefit in the remainder of the year. The evaluation identified no significant benefits associated with the potential downstream locations for an MLI as compared with a retrofit of the existing intake structure with multiple intakes.

In-Reservoir Baffle

Inflows from Schoharie Creek tend to short-circuit into the Shandaken Tunnel Intake, located about a mile from the reservoir headwaters, without full benefit of the dilution and settling that occurs along the roughly four-mile path from the headwaters to Gilboa Dam. Preliminary three-dimensional modeling performed in Phase I indicated that an impermeable baffle curtain, placed in front of the existing Shandaken Tunnel Intake, could reduce the short-circuiting of Schoharie Creek inflows into the intake and increase mixing, dilution of inflows, and settling time prior to withdrawal. Preliminary design activities indicated that the baffle structure could be constructed using either a floating, anchored impermeable membrane material, or a more conventional concrete barrier; however, the latter was not recommended for further evaluation based on its complex structural requirements and associated high cost.

In Phase II, additional modeling with explicit turbidity/particle transport over longer simulation periods was performed to better quantify baffle performance under a wider range of conditions. The results suggest that an ideal baffle could reduce turbidity loading to the intake. Further research into baffle design with baffle manufacturers concluded that the installation of a baffle curtain of the required length and depth in Schoharie Reservoir was physically possible; however, conditions at the reservoir (e.g., wind and wave loads, reservoir depth, and ice, among other factors) presented a challenging environment for the curtain. Furthermore, there are no known permanent baffle curtain installations that are comparable to that being considered for Schoharie, with respect to similar design and operating conditions. Hence, the long-term performance, robustness and reliability of a baffle installation were determined to be questionable.

In the Phase II evaluation it was found that the Baffle alternative could reduce the incidence of elevated turbidity levels. The modeling supporting this conclusion assumes, however, a baffle that would never leak and never fail. These conclusions must therefore be considered in the context of the reliability concerns identified above. The Baffle would provide no control over peak summer temperatures, but could be implemented in combination with Modified Operations to control peak summer temperatures.

Phase II Implementation Plan

Based on use of the linked W2-OASIS model to compare water quality performance among the three alternatives, and taking comparative cost, constructability and reliability into account, DEP recommended implementing the Modified Reservoir Operations alternative as the

most feasible, effective, and cost-effective alternative for addressing turbidity and temperature issues at Schoharie Reservoir. Development of an Operations Support Tool (OST) was recommended to support DEP's efforts to optimize Schoharie operations for turbidity and temperature control.

4.9.3 Catskill Turbidity Control Study: Phase III

Phase III of the Catskill Turbidity Control Study focuses on modifications at Ashokan Reservoir and their potential turbidity control benefits through Kensico Reservoir. Phase III involves detailed conceptual design and performance evaluation of modifications to hydraulic control structures at Ashokan Reservoir identified in Phase I, including West Basin Diversion Weir, West Basin Increased Storage, and East Basin Baffle Wall. The analysis also includes evaluation of Intake Modifications and a new East Basin Intake, along with evaluation of water quality-based operating rules for the reservoir.

Phase III performance evaluation will be based on updated 2-D models of Ashokan and Kensico Reservoirs, and will to a large extent be conducted within the OASIS-W2 linked modeling framework that was used in Phase II. A 3-D model of Ashokan Reservoir is also being developed to support evaluation of the East Basin Baffle alternative. Completion dates for the Phase III Report and Phase III Implementation Plan are 12/31/07 and 3/31/08, respectively.

4.9.4 Upstate Freshwater Institute Monitoring and Modeling

Monitoring

In 2005, the Upstate Freshwater Institute (UFI) continued a comprehensive monitoring program of Schoharie Creek, Schoharie Reservoir, and Esopus Creek, that featured elements of robotic monitoring technology, deployment of recording instrumentation and rapid profiling instrumentation, as well as manual efforts. The monitoring effort is a key component of the initiative to develop mathematical models for temperature and sediment and turbidity transport to support related management initiatives for these systems. These activities were discontinued at the end of 2005 for Schoharie Creek and Schoharie Reservoir, consistent with meeting the goals of supporting related model development.

Monitoring activities by UFI expanded downstream into Ashokan Reservoir starting in 2005 to support modeling initiatives to meet Phase III requirements. These activities were expanded in 2006 with respect to spatial and temporal coverage to enhance the model testing process.

Robotic monitoring

Remote Underwater Sampling Station (RUSS) units continued to be deployed and operated in the Catskill System in 2005 and 2006 to provide near real time monitoring of turbidity and temperature and to collect these data at high frequency from locations well suited to support model calibration and verification. A single RUSS unit was deployed in 2005 (April - November)

adjoining the intake (site 3) in Schoharie Reservoir. Another unit was deployed in the West Basin of Ashokan adjoining the intake in 2005. During 2006 increased coverage in the Ashokan Reservoir was established by deploying three RUSS units to enhance support of model testing; two units were deployed in the West Basin and one in the East Basin.

Another robotic stream monitoring/sampling unit (Robohut), specially fabricated for this effort, adjoining Esopus Creek upstream of the Shandaken Tunnel input (AEAP), commenced operation in May 2005. Both this robohut and the downstream (Coldbrook, E16i) unit continue to be operated by DEP.

Non-robotic monitoring

UFI continues to conduct manual monitoring on these systems to provide ground-truth information for the robots and augment spatial characterization of water quality, particularly during and after [?] runoff events, in support of model development and testing. This effort featured the use of modern rapid profiling instrumentation in Schoharie Reservoir, and the deployment of a number of recording thermistors in Esopus Creek through 2005, consistent with monitoring goals to support model testing for those systems. In Ashokan Reservoir monitoring was regularly scheduled for the purpose ground-truthing during 2005. Starting in the fall of 2006, the effort in Ashokan was expanded to increase temporal and spatial coverage of impacts following runoff events to support model testing.

Modeling

Schoharie Reservoir

Mathematical models of transport, temperature and turbidity were further developed, tested, and applied by UFI in 2005 and 2006. These quantitative tools provided credible predictive capabilities to support deliberations by the Joint Venture and DEP managers in evaluating management alternatives for the system, as described in the Phase II Final Report.

Modeling products completed by UFI through 2006 for Schoharie Reservoir included:

- two-dimensional hydrothermal-transport model
  - -full testing for thermal stratification regime
  - -full testing for tracer transport
- two-dimensional turbidity model development and full testing
- optimization framework for two-dimensional model to guide operation of hypothetical multi-level intake, developed and applied
- probabilistic two-dimensional model for temperature and turbidity in the Schoharie Reservoir withdrawal; developed, tested and applied
- three-dimensional hydrodynamic-transport model set-up and full testing
- application of three-dimensional model to test performance of baffle adjoining the intake
- development and testing of a semi-empirical model to support long-term simulations of baffle performance

Progress in modeling by UFI was made on the following related elements:

- testing of a temperature model for Esopus Creek
- set-up and testing of a two-dimensional hydrothermal-transport model for both basins of Ashokan Reservoir
- set-up and testing of a two-dimensional turbidity model for both basins of Ashokan Reservoir

5. Watershed Monitoring, Modeling and GIS

5.1 Watershed Monitoring Program

An "Integrated Monitoring Plan" was delivered to EPA and DOH in October 2003. This report presented reviews of DEP's three key upstate water quality monitoring programs: Hydrology, Limnology, and Pathogens. These reviews were designed to meet the expanding scope of DEP's data uses including requirements for watershed and reservoir models, mandates, and regulations, as well as fulfilling data needs to ensure that management requirements are adequately addressed. The programs are designed to meet the current and future data requirements of DEP including the long-term evaluation of watershed protection programs.

The overall goal of the framework is to establish an objective-based water quality monitoring network, which provides scientifically defensible information regarding the understanding, protection, and management of the New York City water supply. The information needs required to achieve this goal are compiled as objectives, each of which is clearly defined (in statistical terms if possible). The list of objectives for each program was derived by compiling the information needs of existing and prospective DEP programs, and the review of legally binding mandates, agreements, and/or documents which pertain to New York City's Watershed Water Quality Monitoring Program. The definition of objectives was the starting point for this comprehensive review because, ultimately, the objectives define the temporal, spatial, and analytical requirements of the programs. Statistical features of the historical database were used to guide the sampling design.

To ensure the most efficient gathering of data, the monitoring programs are integrated with each other through common data requirements. Several data collection programs (e.g., Hydrology and Limnology) may contribute to a single objective (e.g., Reservoir Modeling) so it is essential that data from all collection programs be coordinated to avoid duplication.

Therefore, monitoring plans such as this one must be flexible to accommodate changes in information needs over time. Minor changes to any of these monitoring programs are being formally documented and maintained as an annual addendum to the Integrated Monitoring Plan (IMP). After a 5-year period, a new version of the IMR will be issued that incorporates the changes reported in the annual addenda. Major modifications in these monitoring programs will be documented in the annual addenda and revised IMP (due in 2008).

Pursuant to the City's Long-Term Watershed Protection Program, DEP now produces a Watershed Water Quality Annual Report which is submitted to EPA in July of each year. This document contains chapters discussing issues, including: water quantity (e.g., the effects of droughts during the reporting period); water quality of streams and reservoirs; watershed management; and water quality models (terrestrial and reservoir). For the 2006 report (due 2007), the limnology and hydrology components of the document will draw largely on information obtained

from approximately 250 routinely-sampled reservoir and stream sites resulting in over 7,500 samples and about 92,000 analyses. For the pathogen component, a total of 1352 routine samples were analyzed for *Giardia*, *Cryptosporidium*, turbidity, pH, and temperature (3770 analyses) at 103 sampling sites (including keypoints) and 312 samples were collected for human enteric virus examination.

With regard to protozoan pathogens, the following reports were issued in 2006: monthly Filtration Avoidance report, monthly Croton Consent Decree Reports, semi-annual reports of "DEP Pathogen Studies of *Giardia* spp. and *Cryptosporidium* spp. and Human Enteric Viruses". In addition, contributions to the Research Objectives Report, Kensico Reservoir Report, and Watershed Water Quality Annual Report were issued. Additionally, results from weekly *Cryptosporidium* and *Giardia* sampling at the three source waters were posted on DEP's web site.

Additional reports are submitted as part of FAD section 4.8, regarding Kensico's Water Quality Control Program. DEP submits a semi-annual "Kensico Watershed Management Report" to EPA in January and July. The report's January submission presents, discusses, and analyzes monitoring data from the Kensico watershed. This report contains information such as fecal coliform bacteria and turbidity results obtained at various keypoint, stream, and reservoir locations. Additionally, the document reports observations from assessment of Kensico BMPs, groundwater, toxic substances, as well as from employment of the Kensico water quality model.

The routine water quality monitoring program aided in the production of the 2006 Watershed Protection Program Summary and Assessment report. This comprehensive document reviewed the City's watershed protection programs and achievements to date, as well as provided a thorough evaluation on water quality status and trends. The document was submitted in compliance with the November 2002 FAD.

Finally, non-routine water quality monitoring is often conducted as a result of man-made or natural events occurring in the watershed. Sewage conveyance overflows and oil spills are anthropogenic events requiring monitoring. Major storm and runoff events that impact the water supply and which result in chemical treatments (e.g., alum) necessitate intense water quality monitoring to forecast the movement of the contamination and ensure the efficacy of treatment. Results from these events are documented in after-action reports. An Alum Post Treatment Report, for example, describing the extensive water quality and system operations following the Tropical Storm Tammy (October 2005) was issued in 2006.

5.2 WWTP Pathogen Monitoring

5.2.1 Pathogen Sampling

The purpose of the WWTP Pathogen Monitoring Program is to demonstrate that microfiltration, and technologies deemed equivalent, continue to perform well with respect to pathogen removal from the effluents of the plants. DEP has monitored ten waste water treatment plants

quarterly since July 2002, as described in the Integrated Monitoring Report. The following wastewater treatment plants are sampled: Hunter Highland (HHE), Delhi (DTP), Pine Hill (EPE), Hobart (HTP), Margaretville (MSC), Grahamsville (RGC), Grand Gorge (SGE), Tannersville (STE), Stamford (STP) and Walton (WSP) (Figure 5.1).

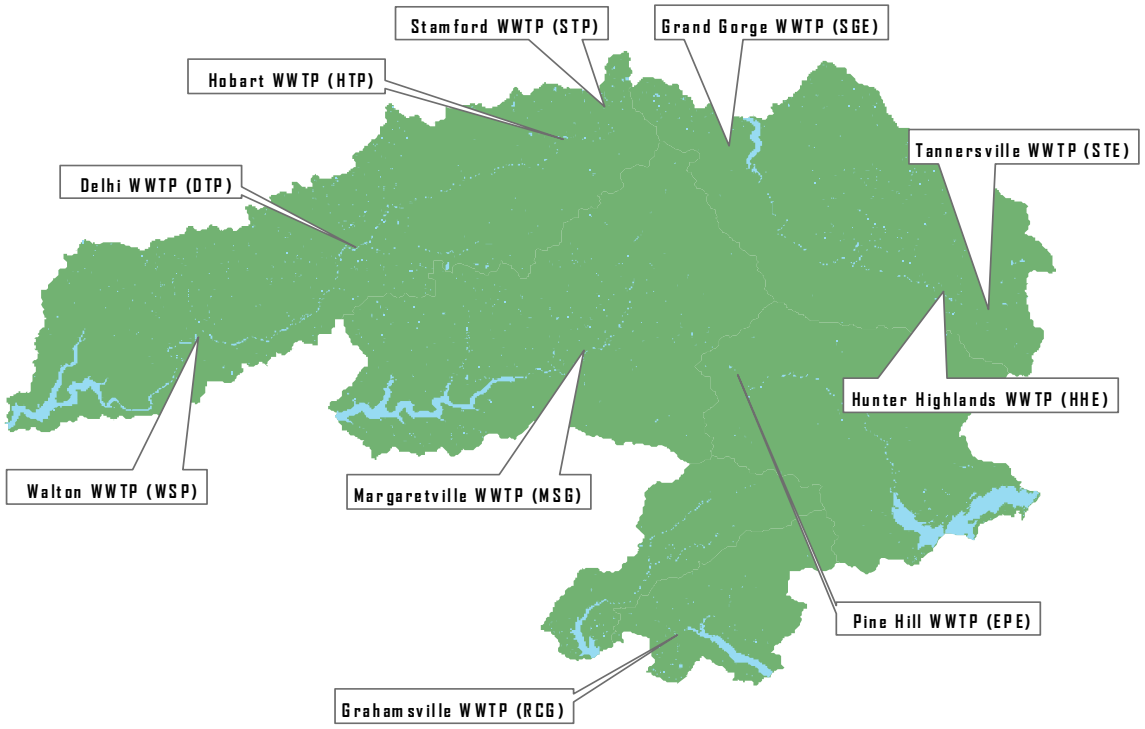

Figure 5.1. Wastewater Treatment Plant Pathogen Monitoring Program locations, NYC DEP 2006.

All plants were sampled at least four times in 2006 for *Giardia* and *Cryptosporidium*, with the exception of Grand Gorge which was sampled only three times due to a sampler error. Hunter Highlands, Pine Hill and Margaretville were each sampled five times in 2006. Pine Hill and Margaretville were sampled an additional time to replace samples discarded due to freezing. All ten WWTP plants were negative for *Cryptosporidium* oocysts in 2006, and eight of the ten WWTPs were negative for *Giardia* cysts (Table 5.1).

Table 5.1. Protozoan and human enteric virus results for the WWTP Pathogen Monitoring Program, 2006. Note:-110= sampling error; NI = non-isolated.

SITE	Date	Giardia /50L	Cryptosporid-ium /50L	Virus MPN/100L
DTP	24-Jan-06	0	0	NI (<1.02)
DTP	03-Apr-06	0	0	NI (<1.02)
DTP	29-Aug-06	0	0	NI (<1.03)
DTP	20-Dec-06	0	0	Pending
EPE	06-Feb-06	0	0	NI (<1.03)
EPE	26-Jun-06	0	0	NI (<1.0)
EPE	31-Jul-06	0	0	NI (<1.0)
EPE	27-Nov-06	-110	-110	NI (<1.02)
EPE	12-Dec-06	0	0	Pending
HHE	07-Feb-06	7	0	-110
HHE	14-Feb-06	0	0	NI (<1.03)
HHE	08-May-06	0	0	NI (<1.0)
HHE	26-Sep-06	0	0	NI (<1.02)
HHE	31-Oct-06	0	0	NI (<1.03)
HTP	09-Jan-06	0	0	NI (<1.03)
HTP	22-May-06	0	0	NI (<1.0)
HTP	30-Aug-06	0	0	NI (<1.03)
HTP	13-Nov-06	0	0	NI (<1.02)
MSC	06-Feb-06	0	0	NI (<1.02)
MSC	26-Jun-06	0	0	NI (<1.0)
MSC	31-Jul-06	0	0	NI (<1.0)
MSC	27-Nov-06	-110	-110	NI (<1.03)
MSC	12-Dec-06	0	0	Pending

Table 5.1. Protozoan and human enteric virus results for the WWTP Pathogen Monitoring Program, 2006. Note:-110= sampling error; NI = non-isolated.

SITE	Date	Giardia /50L	Cryptosporid-ium /50L	Virus MPN/100L
RGC	30-Jan-06	0	0	NI (<1.03)
RGC	01-May-06	0	0	NI (<1.0)
RGC	23-Aug-06	0	0	NI (<1.03)
RGC	02-Oct-06	0	0	NI (<1.03)
SGE	21-Feb-06	0	0	NI (<1.0)
SGE	30-May-06	0	0	NI (<1.02)
SGE	04-Dec-06	0	0	NI (<1.03)
STE	07-Feb-06	0	0	NI (<1.02)
STE	08-May-06	0	0	NI (<1.0)
STE	20-Sep-06	0	0	NI (<1.03)
STE	31-Oct-06	0	0	NI (<1.02)
STP	09-Jan-06	0	0	NI (<1.03)
STP	22-May-06	0	0	NI (<1.0)
STP	30-Aug-06	0	0	1.02
STP	13-Nov-06	1	0	NI (<1.03)
WSP	24-Jan-06	0	0	NI (<1.02)
WSP	03-Apr-06	0	0	NI (<1.02)
WSP	29-Aug-06	0	0	NI (<1.03)
WSP	20-Dec-06	0	0	Pending

Hunter Highlands had one occurrence of seven *Giardia* cysts on February 7, 2006. This concentration prompted an additional collection on February 14, which resulted in zero cysts. This second result, supported by no detection of *Giardia* for the rest of the year, indicates that the recovery on the 7th was an isolated incident. Stamford WWTP had one occurrence of one *Giardia* cyst in November 2006.

Although December 2006 HEV data are still pending, all results thus far from the WWTPs are negative for human enteric viruses for the year, with the exception of one sample collected at Stamford in August, when the result was 1.02/100L (Table 5.1).

Hunter Highlands had one occurrence of 7 *Giardia* cysts on February 7, 2006. This concentration prompted an additional collection on February 14, which resulted in zero cysts. This second result, supported by no detection of *Giardia* for the rest of the year, indicates that the recovery on the 7th was an isolated incident. Stamford WWTP had one occurrence of 1 *Giardia* cyst in November 2006.

Although December 2006 HEV data are still pending, all results thus far from the WWTPs are negative for human enteric viruses for the year, with the exception of one sample collected at Stamford in August, when the result was 1.02/100L (Table 5.1).

5.3 Multi-Tiered Water Quality Modeling Program

DEP's Multi-Tiered Water Quality Modeling Program develops, maintains, and applies integrated watershed and reservoir modeling tools to support both long-term watershed management and short-term operational strategies for maintaining high-quality NYC drinking water. The program has four major elements:

- Data Acquisition and Organization
- Model Development and Improvement
- Model Integration and Software Development
- Applications for Watershed/Reservoir Management

Progress was made in 2006 in these areas, as described below.

5.3.1 Data Acquisition and Organization

Watershed modeling data includes meteorological data to drive the models; stream flow and water chemistry data for watershed model calibration and testing; and spatial GIS data that characterize watershed land use and physiography. GIS data is organized in a GIS library. Time-series data for modeling is organized in a modeling time-series data library.

GIS data for watershed soils were updated or improved in 2006. Updates and new versions of Soil Survey Geographic (SSURGO) data in version 2 format were downloaded from the Natural Resources Conservation Service (NRCS) Soil Data Mart. Newly released spatial and attribute soil data for Greene, Schoharie, and Sullivan counties along with updated data for Delaware, Dutchess, Putnam, and Westchester counties were downloaded and used to develop a soil data layer of the watershed, including a 1000-meter buffer around its outer boundaries. SSURGO version 2 data in the GIS library is now complete for the NYC watershed, with the exception of Ulster County which has not yet been released by NRCS.

Land cover/land use data appropriate for modeling for east of Hudson was developed during 2006. A process similar to that previously used to create the west of Hudson modified product was utilized. Certain classes in the original material were set to NODATA and filled by passing a filter over neighboring cells. Water and wetland features found in National Wetlands Inventory (NWI) data were rasterized and included in the modified product. Estimates of impervious surface derived from 1:24,000-scale NYSDOT ALIS and Connecticut road data were incorporated as rural roads. The resulting land cover/land use raster map was reclassified to general categories appropriate for variable source area modeling.

DEP's GIS data is regularly used to derive necessary inputs for DEP's VSLF watershed model. Some examples of these uses are described below. The Soil Data Viewer extension for ArcView 3 was used with the soil data to calculate layers of soil depth and hydraulic conductivity in the derivation of the Soils-Topographic Wetness Index raster, which, in turn, is used in developing Wetness Index Zones. Areas of land use/land cover and wetness index zones were calculated for Conservation Reserve Easement Program (CREP) buffer lands in the Cannonsville and Pepacton basins, and for 300-foot buffers of these areas. Land use/land cover and wetness index zone areas were calculated for City acquired lands in the Horse Pound Brook drainage area. Percents of impervious surface within east of Hudson residential, church, and condominium parcels were calculated to derive typical values of imperviousness to associate with possible land use changes avoided through land acquisition. Another GIS activity supporting watershed modeling includes deriving Thiessen polygon area percents required to weight time-series precipitation data for particular catchments. Finally, the ArcGIS Modelbuilder was used to automate the creation of 100-, 250-, 300-, 500-, and 1000-foot buffers of hydrographic features derived from DEP stream and waterbody data, DEC wetland data, and National Wetland Inventory (NWI) data. The new coverages replaced earlier ones in the "buffer" directory of the GIS Library. One set of these buffers is used by the Model Inputs Tool to estimate number of septic systems within 300 feet of a water feature.

Many of the GIS based model inputs are derived using the Model Inputs Tool which has been updated and improved during 2006. The tool is updated regularly based on new requirements or changed formats for VSLF model input. In addition, it is now possible derive spatial parameters necessary to model any catchment in the east of Hudson and west of Hudson watersheds. Extension of functionality beyond West Branch Reservoir basin to the entire east of Hudson watershed became possible given development of enhanced east of Hudson 2001 land cover/land use data during the first half of 2006 and, more recently, the east of Hudson Soils-Topographic Wetness Index. Also, previously-derived sediment delivery ratios (SDR) for entire reservoir basins were incorporated as a lookup function in the tool.

Time series data used for modeling is collected at specific locations within the watershed and placed in a modeling data times series data library. The library is updated as new data became available. DEP now has the following time series data for watershed modeling applications in its data library:

- Meteorology data from Northeast Regional Climate Center (daily precipitation and min/max air temperature) – Pre. 1960-2005
- Stream flow data from USGS (daily) - Pre. 1960-water year 2005
- Stream chemistry data from DEP (routine and storm events) - 1987-2005
- Stream chemistry data from DEC (W. Br. Delaware River) – water years 1992-2005
- Wastewater Treatment Plant data from DEP (monthly phosphorus loads) - 1990-2005

Reservoir modeling data includes reservoir morphometry GIS data, and a daily time-series of meteorology, reservoir inputs and reservoir outputs. The input data include stream flows and nutrient loading, either estimated directly from measurements of stream discharge and chemistry, or taken from the output of the VSLF model. To calculate the outputs, information on reservoir operations is needed including: aqueduct flows, reservoir discharge, spillage, and water level (stage). To verify and calibrate the models, water column measurements of temperature, chemistry and phytoplankton biomass is needed. The modeling group now has the following data necessary for reservoir modeling in the data library:

- hourly meteorological data, 1994-2004
- daily water flow measurements of reservoir input (streams) and outputs (aqueduct discharge, dam releases, and spill), 1987-2005
- daily stream and aqueduct temperature data, 1987-2005
- reservoir water quality and temperature profiles, 1992-2005

These data are in addition to the model data that were obtained from the contractors that developed DEP's system of 1D and 2D reservoir models. Collection and archiving of these data is part of an ongoing effort to update reservoir modeling data to current conditions.

5.3.2 Model Development and Improvement

DEP completed its FAD requirement (Section 5.2 of the 2002 FAD) to complete calibration and validation of VSLF (formerly GWLF) models for Catskill and Delaware System watersheds. The model was successfully calibrated and tested for the major tributaries in these basins for hydrology (streamflow and runoff), dissolved nutrients, sediment and particulate phosphorus (DEP 2006b, DEP 2007c).

Also during 2006, DEP has continued to update and perform further testing of the latest version of the Variable Source Loading Functions (VSLF) model (Schneiderman et al., 2007). The VSLF model is a major improvement in the GWLF watershed model made to address the

growing body of evidence that the predominant mechanism for runoff generation in the NYC watersheds is saturation-excess on Variable Source Areas (VSAs), as opposed to an infiltration-excess runoff generating mechanism upon which the standard GWLF is based.

A comparison of runoff source areas predicted by GWLF versus VSLF models showed the implications of using infiltration-excess versus saturation-excess as the underlying runoff generation mechanism. In GWLF, runoff predictions are controlled by land use patterns, while in VSLF runoff predictions follow the pattern of soil wetness due to saturation as depicted in a wetness index. These differences in runoff source areas have important implications for phosphorus loading. In GWLF all areas of a particular land use generate phosphorus equally. VSLF simulates a more complex distribution of dissolved phosphorus generation in which the effects of both land use and topographic position (through the wetness index) result in phosphorus export. Due to these differences, VSLF highlights somewhat different areas for targeting of phosphorus management. For example, precision agricultural management can focus on reducing phosphorus availability in specific farm field areas that generate most of the runoff possible through selective fertilizer spreading practices.

While the addition of VSAs does not change the total volume of direct runoff predicted by the model, it does affect the simulated source location for the generation of direct runoff, as described above. Researchers from Cornell University working with DEP have attempted to test the predictions of locations of runoff generation predicted by VSLF, by investigating VSLF results against results for a more detailed process based model, SMDR, developed at Cornell; and by a comparison of VSLF predicted degree of surface soil saturation versus observed data. With both the VSLF and the SMDR models, similar areas were found to have higher probabilities of saturation with correspondingly higher runoff rates. Observed soil transect data was also used to test the patterns of soil saturation suggested by VSLF results. In general, the patterns of soil moisture observed in the data aligned well with those in the VSLF results.

Finally, the USDA Curve Number (CN) method for estimating direct runoff in VSLF was refined to better account for seasonal variability in watershed-scale runoff response to rain and snowmelt events (DEP 2007b). The refinement allows the minimum and maximum values on the CN corresponding to wet and dry conditions to be calibrated rather than be set to pre-defined values.

5.3.3 Applications for Watershed/Reservoir Management

Model applications to support watershed and reservoir management conducted during 2006 included an evaluation of watershed management and recent agricultural land use changes in the Cannonsville and Pepacton watersheds on reservoir water quality; an investigation of the potential impact of the land acquisition program on dissolved phosphorus runoff within a subbasin of the West Branch watershed; and reservoir model simulations of turbidity transport through the Kensico and Rondout Reservoirs to aid in operational decisions.

Evaluation of Watershed Management and Land Use Change in the Delaware System

The effects of nonpoint source management, point source upgrades, and land use change on eutrophication in the Cannonsville and Pepacton Reservoirs were evaluated using DEP's Eutrophication Modeling System. Output from the GWLF watershed model served to provide loading estimates to evaluate various watershed programs implemented as part of the MOA. Four watershed management programs were evaluated: WWTP Upgrades; Watershed Agricultural Program; Urban Stormwater Program and Regulations; and Septic System Rehabilitation Program. In addition, a significant decline in agricultural activity that occurred from *BASELINE* to post-2000 (independent of the effects of agricultural management program) was evaluated as a land use change scenario.

Calibrated and validated GWLF models for Cannonsville and Pepacton were used to estimate nutrient load reductions from different watershed sources due to non-point source management programs, WWTP upgrades, and under *BASELINE* vs. post-2000 land use conditions. Nutrient reduction factors due to each watershed management program were estimated from BMP nutrient removal and implementation data. These reductions were applied in management scenarios to estimate the effects of the land use change and the four watershed management programs on nutrient loading and eutrophication.

Land use change (decline in agriculture) and watershed management both produced substantial reductions in predicted phosphorus loading. Loading reductions due to land use change alone were ~20% for dissolved phosphorus and ~30% for particulate phosphorus in Cannonsville, and ~15% for dissolved phosphorus and ~25% for particulate phosphorus in Pepacton. The combination of land use change and watershed management produced reductions of ~46% for dissolved phosphorus and ~68% for particulate phosphorus in Cannonsville, and ~27% for dissolved phosphorus and ~58% for particulate phosphorus in Pepacton. Point Source WWTP upgrades and the implementation of agricultural BMPs by the Watershed Agricultural Program provided most of the loading reductions, followed by septic system remediation. Urban stormwater management provided insignificant reductions in both dissolved and particulate phosphorus, due to small urban land use areas in these watersheds that resulted in low contributions of urban sources to phosphorus loading under baseline conditions.

The effects of land use change, nonpoint BMPs, and point source management on the trophic status of the Cannonsville and Pepacton reservoirs were evaluated by driving reservoir water quality models with the different nutrient loading scenarios simulated using GWLF. For Cannonsville Reservoir, lower watershed loads due to the decline in farming that occurred between 1992 and 2004 resulted in considerable reductions of 13% for in-lake growing season chlorophyll *a* and 16% for total phosphorus. Greater reductions were predicted when nonpoint and point source watershed management in addition to land use change were considered (38% for chlorophyll *a* and 43% for total phosphorus). The response of Pepacton Reservoir (which exhib-

ited less eutrophication under baseline conditions) was similar, but the magnitude of the reductions was less, suggesting that reservoirs with higher eutrophic condition tend to benefit proportionately more from watershed load reductions.

Examination of daily, as well as long term mean reservoir chlorophyll levels, suggests that the occurrence of extreme "bloom-like" epilimnetic chlorophyll concentrations are also affected by the differing nutrient loading scenarios, and that the implementation of the watershed management programs greatly reduced the occurrence of these extremes. Implementation of non-point BMPs was most effective at reducing the frequency of "bloom-like" concentrations of chlorophyll. This is apparently related to the effects of nonpoint BMPs on the magnitude and timing of storm event runoff, and the phosphorus loads associated with it.

Effects on Dissolved Phosphorus of Land Acquisition Program in Horse Pound Brook.

The effect of possible land development that has been avoided due to DEP's Land Acquisition Program was evaluated with the use of the VSLF watershed water quality model. A watershed model is an effective tool for this type of analysis, as the model can be used to simulate dissolved nutrient loads for land use patterns which do not currently exist.

Two VSLF model runs were performed using a long term record (1966-2004) of meteorological input data. The two runs, or scenarios, represent current or "baseline" conditions (baseline scenario) and land use patterns associated with proposed developments that were avoided through land acquisition (development scenario). Running the watershed model produces a time series of predicted streamflow and dissolved phosphorus loads at the stream outlet. Comparison of results between the baseline and development scenarios shows the simulated effect of the potential development on dissolved phosphorus and streamflow under climate conditions representative of the last four decades.

For the development scenario, the land use was adjusted to add areas to residential and commercial/industrial land use categories. The changes in land use due to the potential development on acquired lands was based on projects actually proposed for the lands in combination with an analysis of land use patterns of already built developments within the watershed.

Simulated dissolved phosphorus loads under the baseline conditions for 1996-2004 averaged 39% less for the baseline scenario versus the development scenario. The increase in dissolved phosphorus load under the development scenario was due to a combination of increased concentration in surface (or direct) runoff due to development and an increase in the fraction of direct runoff in streamflow. This example is an extreme case, as the program has acquired a large percentage of land in the watershed with plans for development. Where development is not as prevalent, the results will not be as dramatic as shown here.

Reservoir Modeling Simulations of Turbidity Transport

In the last year DEP has used reservoir model simulations of turbidity transport through the Kensico and Rondout Reservoirs to aid in operational decisions related to these reservoirs (Table 1). In Kensico, simulations helped to minimize the use of alum while maintaining acceptable turbidity levels at the Kensico effluent withdrawal locations, or to determine the need for alum treatment in the first place. These simulations (DEP 2007a) were used to both determine the levels of Catskill turbidity that can be reasonably sustained under a given set of flow and mixing conditions, and as an aid in planning operational measures, such as limiting aqueduct flow or treatment of turbid water with alum, in response to extreme turbidity

During 2006, the Catskill reservoir system continued to be affected by high turbidity levels associated with storm events occurring in October-November 2005 (DEP 2006a) so that water entering the Catskill Aqueduct from Ashokan reservoir had a turbidity exceeding 10 NTU until early April and remained above 4 NTU until mid-May. As a consequence of the sustained input of turbid water from the Catskill system, alum treatment started during October of 2005 and continued until May 2006. Reservoir modeling simulations were first used during April and May to estimate the time at which ongoing alum treatment could be safely terminated, and then again for the same purpose following an extreme summer (June 26, 2006) event that drove Ashokan turbidity to unacceptably high levels (Table 5.2). Following these three sets of simulations, there was a series of additional storm events that increased Ashokan turbidity and caused concern that alum treatment might again be required. Simulations were preformed to access the impact of the elevated Catskill turbidity inputs to Kensico reservoir; however in this case the simulations suggested that dilution and settling of the turbidity in Kensico reservoir would be sufficient to attenuate the turbidity and maintain safe levels at the Kensico effluents.

Also in 2006, turbidity transport simulations were used to support decisions regarding the operations of Rondout Reservoir (DEP 2007b). In this case, an unusual mid-summer storm resulted in elevated turbidity levels in Cannonsville reservoir that persisted throughout the summer, and caused the reservoir to be taken off line (Table 5.2). Cannonsville reservoir is an important source of Delaware system water, and simulations were run to determine when turbidity levels had decreased sufficiently to allow this water to again be used. Simulations examined the effects of blending differing amounts of turbid Cannonsville water into Rondout Reservoir, and particularly the effects on the Delaware aqueduct effluent leaving Rondout Reservoir. Given ongoing turbidity problems in the Catskill system, it was essential to maintain low turbidity in the Delaware system water, which is used to dilute the more turbid Catskill water in Kensico Reservoir.

Three sets of simulations were run, using differing mixes of turbid Cannonsville water and high quality Neversink Reservoir water as inputs to Rondout Reservoir. From these simulations it became clear that the Cannonsville water could potentially have a severe impact on the Delaware aqueduct effluent from Rondout Reservoir. Using a mixture of 100% (300 MGD) of Cannons-

ville water resulted in Rondout effluent turbidity levels clearly exceeding the 5 NTU regulatory limit. Reducing the use of Cannonsville water to 200 MGD and finally 100 MGD led to progressively lower impacts, but even in the best case the effluent turbidity levels remained at 3 NTU or higher.

The same mid-summer storm also affected Catskill system turbidity levels (DEP 2007), driving Ashokan reservoir effluent turbidity, which enters the Catskill aqueduct, to peak values of over 150 NTU, and caused values of over 10 NTU to be measured for several weeks. This resulted in the need for alum treatment. In the presence of elevated Catskill system turbidity, the mixing of lower turbidity Delaware system water into Kensico Reservoir is needed in order to ensure that the Kensico effluent turbidity remains below the 5 NTU regulatory limit. In such a case DEP strives to maintain low turbidity in the Delaware system water drawn from Rondout Reservoir. Consequently, these simulations indicated that it was important to keep Cannonsville Reservoir off-line until turbidity levels declined significantly. The ability to selectively withdraw lower turbidity water from the other Delaware system reservoirs was a distinct benefit in this situation, and the modeling runs were able to demonstrate the importance of maintaining low turbidity in the Delaware input to Kensico.

During 2006, reservoir models were used to guide reservoir operations in both the Catskill and Delaware systems during times of elevated reservoir turbidity (Table 5.2). Simulations were successfully run for different reservoirs, for differing flow regimes and for different conditions of reservoir thermal structure. Models simulations proved to be a valuable source of information that helped DEP make decisions regarding reservoir operations, and also helped justify alum treatment, and define the period over which this treatment was required.

Table 5.2. Reservoir models were used in 2006 to guide reservoir operations in both the Catskill and Delaware systems during times of elevated reservoir turbidity.

Date	Reservoir	Event Description	Simulation Support
6-April	Kensico	Due to events in October-November of 2005, and January of 2006, Ashokan Reservoir effluent turbidity levels ranged between 40-10 NTU during the first three months of 2006. Consequently alum treatment was required	Estimate the time at which alum treatment could be safely discontinued, as Ashokan effluent turbidity levels dropped to levels at or below 10 NTU. Predictions of Kensico effluent turbidity in the absence of alum treatment were made to support the decision to briefly end treatment on April 10, 2006
18-May	Kensico	A large storm event caused the fourth highest Esopus Creek discharge recorded during 2006, and this in turn led to Ashokan effluent turbidity again increasing to levels greater than 10 NTU.	Make predictions of Kensico effluent turbidity in response to elevated Catskill aqueduct turbidity levels. Based on these simulations alum treatment was again used between May 15-24.

Table 5.2. Reservoir models were used in 2006 to guide reservoir operations in both the Catskill and Delaware systems during times of elevated reservoir turbidity.

Date	Reservoir	Event Description	Simulation Support
21-July	Kensico	On June 26 there was an extraordinary mid-summer event that led to the highest Esopus Creek discharges measured during 2006. The summer discharge exceeded 300 m^3s^{-1} as a result of this storm. Ashokan effluent turbidity levels briefly exceeded 100 NTU, and remained above 20 NTU for and extended period.	Given the high turbidity levels generated by this storm, simulations were not required to show the need for alum treatment. The simulations here were used to define the time at which alum treatment could be safely discontinued while ensuring acceptable Kensico effluent turbidity levels. Alum treatment was discontinued on August 2.
4-Aug	Rondout	On June 2,6 there was a large mid-summer storm event that led to extraordinarily high discharges in the West Branch of the Delaware River and extremely high turbidity levels in Cannonsville Reservoir. As a consequence of this event and its impact on Cannonsville water quality Cannonsville Reservoir was take off line due to high turbidity, which was found to persist over much of the entire summer.	The effects of mixing high turbidity Cannonsville Reservoir water with low turbidity water from Pepacton and Neversink Reservoirs on the turbidity levels entering the Delaware aqueduct was simulated. These simulations argued against using Cannonsville water until turbidity levels declined significantly.
28-Oct	Kensico	A series of storms beginning in early September led to a progressive increase in watershed wetness levels and Esopus Creek discharge. A storm on October 28, caused the discharge to reach the third highest level of the year and a moderate increase in Ashokan effluent turbidity to levels approaching 10 NTU	The consequences of increased Catskill aqueduct turbidity associated with this event on the Kensico effluent turbidity levels were examined, in order to judge the need for alum treatment. These simulations suggested that alum treatment was not needed. The turbidity increase was not that great and the isothermal condition of Kensico reduced the effectiveness of transport and increased the dilution of turbidity moving through the main branch of Kensico Reservoir.

5.4 Geographic Information System

DEP staff continued to develop the upstate Geographic Information System (GIS) and use it in support of Filtration Avoidance Determination (FAD) and Memorandum of Agreement (MOA) programs. The GIS was used for map production, geographic analysis, spatial data devel-

opment, visualization and analysis of remotely sensed imagery, and water quality modeling. Primary users of the upstate GIS were from the Divisions of Drinking Water Quality Control (DWQC), Engineering, and Watershed Lands and Community Planning (WLCP).

The BWS upstate GIS is comprised of networked Unix servers and Windows workstations at primary sites in Kingston and Valhalla. There are workstations for on-site GIS work at Shokan and Grahamsville. Additional equipment provides functionality for scanning documents and producing hardcopy maps on printers and large-format plotters. Users access spatial data libraries that are replicated from Kingston to the other sites. ESRI (ArcGIS) and Leica Geosystems (Imagine) develop the software used most frequently. Global Positioning System (GPS) technology is used for field data collection.

5.4.1 Utilizing GIS for Watershed Management Applications

Semi-annual progress reports in July 2006 and January 2007 indicated the extent to which GIS was used to support FAD and MOA programs. Numerous map products were produced and a diversity of projects utilized GIS technologies.

A sample of significant mapping projects includes: water quality monitoring site locations; status of FAD and MOA programs (Land Acquisition, Land Management, Watershed Agricultural Council, Forestry, Community Planning); emergency planning undertaken by DEP Police and the BWS Environmental Compliance, Health & Safety Unit; wetlands monitoring and change analysis; project site evaluation, preparation of site reviews, and SEQRA review; stream management programs, including those underway in the Esopus Creek and those proposed for the Neversink and Rondout basins; invasive species; and illustrations necessary for reports and presentations.

The upstate GIS played a significant role in program implementation and support during the reporting period. A sample of watershed management applications in which GIS was utilized includes: wetlands monitoring; watershed and reservoir modeling of nutrient loads; delineation of critical site features and protected areas; riparian vegetation classification; septic rehabilitation; conservation easements; forest management; Esopus Creek geomorphic assessment; stream management geodatabase; land acquisition re-solicitation; and the Watershed Lands Information System (WaLIS).

The GIS was used extensively to prepare the 2006 FAD annual report. Numerous map graphics displaying program status were included in the report, along with tables of summary statistics derived using the GIS. Spatial data were utilized as inputs to watershed and reservoir modeling scenarios indicating estimated effects of program implementation.

5.4.2 GIS Data Development, Management, and Dissemination

Recognizing the importance of a high-quality spatial data library as a fundamental component of the GIS, staff continued to upgrade, create, and obtain data products.

NYS 2004 orthoimagery for the east of Hudson watershed was downloaded and added to the image library. Hydrographic feature buffers of varying widths were recreated. National Wetland Inventory data were updated using Spring 2003 and 2004 color infrared aerial photography. NYS freshwater wetland updates were obtained. A dataset of New Infrastructure Program sewer district service areas was created, as was a dataset to aid in the ranking of farms that are applying to the Watershed Agriculture Council for benefits.

Additional spatial layers for watershed modeling were developed. Soil data in the SSURGO2 format were released for Greene, Schoharie, and Sullivan counties, leaving only Ulster as the "hole" in a watershed wide coverage. These soil data were used to develop layers of soil hydraulic conductivity and soil depth important for derivation of an enhanced Topographic Wetness Index dataset. Additional rasters of Topographic Wetness Index were created using 30-meter Digital Elevation Models and SSURGO2 data. A 10-meter raster of 2001 modified land cover/land use was created for the east of Hudson watershed and placed in the modeling portion of the GIS Library.

Work continued on improving links between GIS and modeling. The ArcView Inputs Tool for the VSLF (formerly GWLF) model was improved to utilize the modified 2001 land cover/land use and wetness index data for any catchment in the watershed. The tool was modified to output the hydrology Constants Input (CIN) file in a simplified format. Previously-derived sediment delivery ratios for entire reservoir basins were incorporated as a lookup function. The Inputs Tool was utilized throughout the reporting period to produce CIN files for a variety of drainage areas in the east of Hudson and west of Hudson watersheds.

Many layers in the library were updated during the reporting period. These included: City lands newly-acquired by fee or easement; snow monitoring sites; wastewater treatment plants; pathogen program monitoring sites; MOA west of Hudson designated areas; Amawalk Reservoir bathymetry; keypoint water quality monitoring sites; hydrography; and tax parcel boundaries of pre-MOA City-owned lands. Metadata were created and revised, as necessary.

The semi-annual reports detail the extent to which data were shared with stakeholders and the public according to data sharing policies developed in cooperation with DEP Legal staff. In lieu of not having a data dissemination internet site due to security concerns, staff reviewed outside requests for spatial data, forwarded requests for data deemed "sensitive" to management for approval, and transferred approved GIS data to CDROM for distribution. Data were shared with contractors, research institutions, local/county/state/federal agencies, environmental non-profits, and regulators.

5.4.3 GIS Infrastructure

Work continued throughout the reporting period on deploying and maintaining the geodatabase, utilizing ArcSDE as a gateway for the storage of attributed spatial data in an Oracle relational database management system. Servers were upgraded to Solaris 8, Oracle 10.1.0.2, and

SDE 9.1. Testing began on upgrading to Oracle 10.2.0.2 and ArcSDE 9.2 and on geodatabase replication using ArcSDE 9.2 on SQL Server 2005. Staff continued to update the coverage and geodatabase versions of the GIS Library. The geodatabase was replicated from Kingston to Valhalla regularly; the coverage library was replicated to Valhalla, Shokan, and Grahamsville regularly, ensuring that BWS GIS users access a common spatial data library. Versioned and disconnected geodatabase editing were implemented for the Stream Management Program geodatabase.

Other efforts during the reporting period focused on upgrading four UNIX servers at two sites (CPU, memory, interface, disk storage), upgrading individual workstations to Windows XP Professional, installing ArcGIS 9.2, and enhancing backup processes. Workstation hardware upgrades included Gb Ethernet cards, larger internal hard drives, and external drives for purposes of mirroring and/or backup.

Kingston GIS and Modeling staff participated in a presentation for the DEP Director of the Office of Information Technology, showcasing the structure and functioning of the BWS upstate GIS. Two staff members attended the NYSGIS Conference in Lake Placid, NY; a few participated in meetings of the Catskill GIS User Group. Several staff continued to offer training and assistance on an informal basis to GIS users throughout the BWS.

6. Regulatory Programs

6.1 Watershed Rules and Regulations and Other Enforcement/Project Review

6.1.1 Regulatory Review and Enforcement

Watershed Regulations

A primary component of DEP's overall watershed protection strategy is the enforcement of applicable environmental regulations, which include the revised Watershed Rules and Regulations (WR&Rs), also promulgated as state law, the federal Clean Water Act, NPDES and SEQRA, as well as local ordinances. Of these, the primary mechanism for protection of the water supply are the WR&Rs. DEP's enforcement efforts are focused on three major areas: review and approval of projects within the watershed; regulatory compliance and inspection of wastewater treatment plants; and environmental law enforcement.

Project Review

Each project proposed in the watershed, including those designed or sponsored by DEP, is reviewed to ensure compliance with the WR&Rs, as well as federal, State and local laws. Projects that require DEP review and approval include all wastewater treatment systems, including wastewater treatment plants (WWTPs), the installation of subsurface sewage treatment systems (SSTSs), the preparation of stormwater pollution prevention plans (SPPPs), and the construction of certain impervious surfaces. In addition, DEP reviews and issues permits for Individual Residential Stormwater Plans (IRSPs) and for impervious surfaces associated with stream diversions or pipings. DEP also ensures that during and after construction, projects that require SPPPs or IRSPs have the necessary BMPs installed, and that erosion controls are properly sited and maintained. DEP also reviews applications that have been sent to DEC for special permits involving mining operations, timber harvesting, stream crossings and wetland issues. These applications are forwarded to DEP for review and comment as provided for in the DEP/DEC MOU.

Table 6.1 list project applications received in the Boyd Corners, West Branch, Croton Falls, Cross River and Kensico Reservoir basins for 2006. The new, delegated and remediated individual septic systems are listed in Table 6.2. The project locations are depicted on Figures 6.1 and 6.2.

Table 6.1. Boyd CornersBoyd Corners, West Branch, Croton Falls, Cross River and Kensico Reservoirs new projects for 2006.

Map #	Reservoir Basin	Project Name	Town	DEP Approval Required	Project Status as of 12/31/06
1	Boyd Corners	Avatrice (Woman's Resource Center)	Kent	Comm. SSTS Repair	Approved
2	Boyd Corners	Seven Hills Lake Lot 61/ O'Mara	Kent	Varaince	New
3	Cross River	Bell Subdivision/3 Lots	Lewisboro	Other	No Application
4	Cross River	Benton Property-3 Lots	Bedford	SPPP	Approved
5	Cross River	Bocklet Residence	Lewisboro	Other	No Application
6	Cross River	Farrell Residence	Lewisboro	Individual SPPP	Approved
7	Cross River	Fryer Residential Renovation	Lewisboro	Other	No Application
8	Cross River	Leitner/Hubsher Subdivision/2 Lots	Lewisboro	SPPP	Incomplete
9	Cross River	Lewisboro Park Swimming Pool	Lewisboro	Intermediate SSTS	Closed
10	Cross River	Patricia Simpson Residential Addition	Lewisboro	Other	No Application
11	Cross River	Ward Pound Ridge Landfill Closure	Lewisboro	SPPP	Approved
12	Croton Falls	Albano Estates IV	Carmel	Sewer Collection	Approved
13	Croton Falls	Dominger/Lockwood Subdivision	Carmel	SPPP	Incomplete
14	Croton Falls	Putnam Hospital Center	Carmel	SPPP	Approved
15	Kensico	Con Edison Transition Line Maintenance	Mount Pleasant	Other	No Application
16	Kensico	Kensico Tornado Salvage	North Castle	Other	No Application
17	Kensico	Trunk Sewer Rehabilitation/ Westchester County	Multiple	SPPP	Approved

Table 6.2. Boyd Corners, West Branch, Croton Falls, Cross River and Kensico Reservoirs individual SSTSs for 2006.

Reservoir	Town	# of Delegated Septics	# of New Septics	# of Septic Repairs	# of Approvals	# of Constructions
Boyd Corners	East Fishkill	NA	3	0	0	0
Boyd Corners	Kent	4	0	4	0	0
Boyd Corners	Putnam Valley	0	0	0	2	0
Cross River	Bedford	7	0	0	4	0
Cross River	Lewisboro	5	0	0	3	0
Cross River	Pound Ridge	3	0	0	3	1
Croton Falls	Carmel	8	0	7	9	0
Croton Falls	Kent	0	0	1	2	0
Croton Falls	Southeast	0	0	0	0	0
Croton Falls	Somers	0	0	0	0	0
Kensico	Mt. Pleasant	0	0	0	0	0
Kensico	New Castle	1	0	0	0	0
Kensico	North Castle	2	0	0	0	0
Kensico	Harrison	0	0	0	1	0
Kensico	Greenwich Ct.	NA	0	0	0	0
West Branch	Carmel	5	0	2	0	0
West Branch	East Fishkill	NA	0	0	0	2
West Branch	Kent	6	0	6	0	0
West Branch	Putnam Valley	0	0	0	0	0
Totals		**41**	**3**	**20**	**24**	**3**

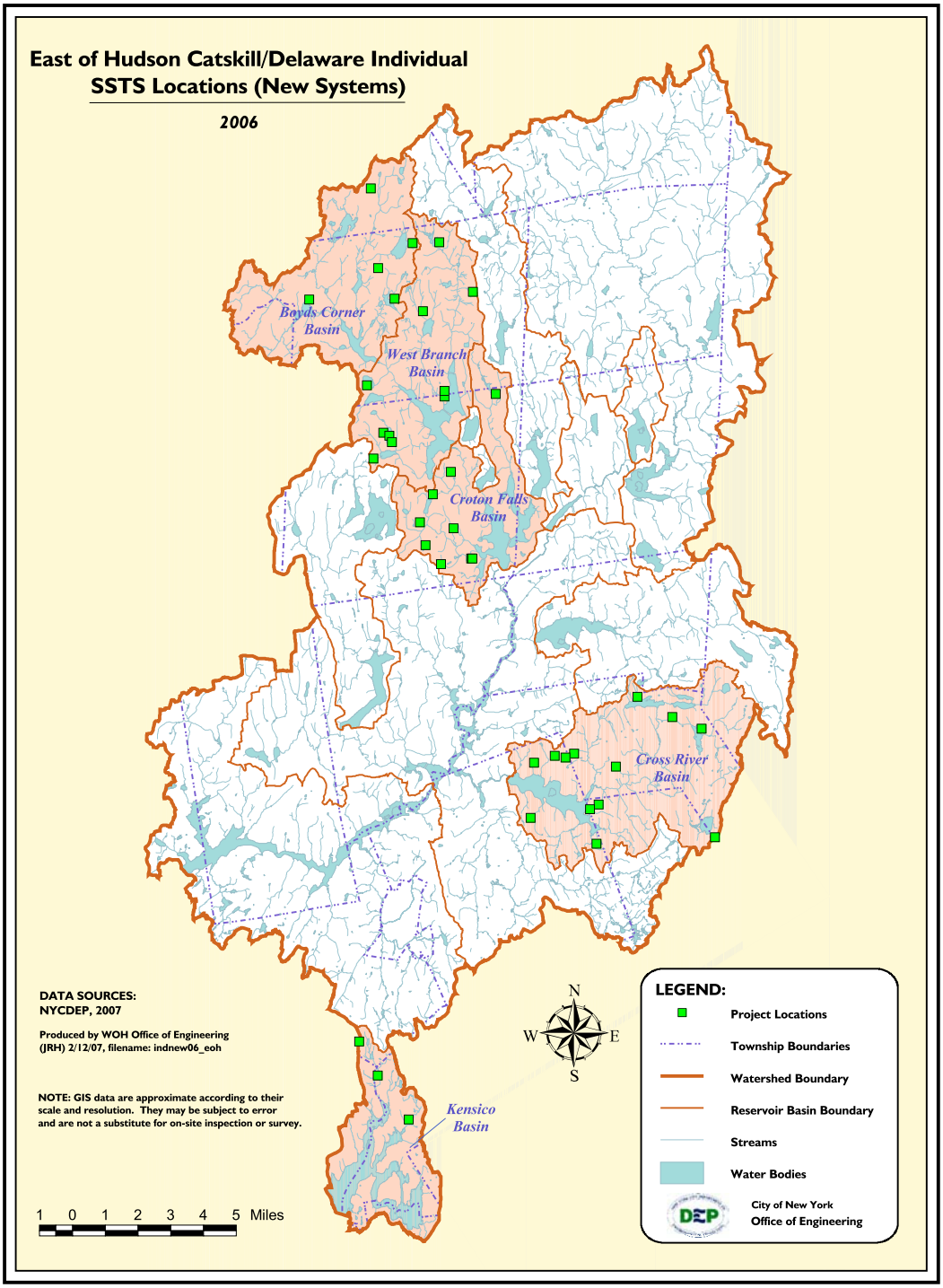

Figure 6.1. East of Hudson Catskill/Delaware new individual SSTS locations.

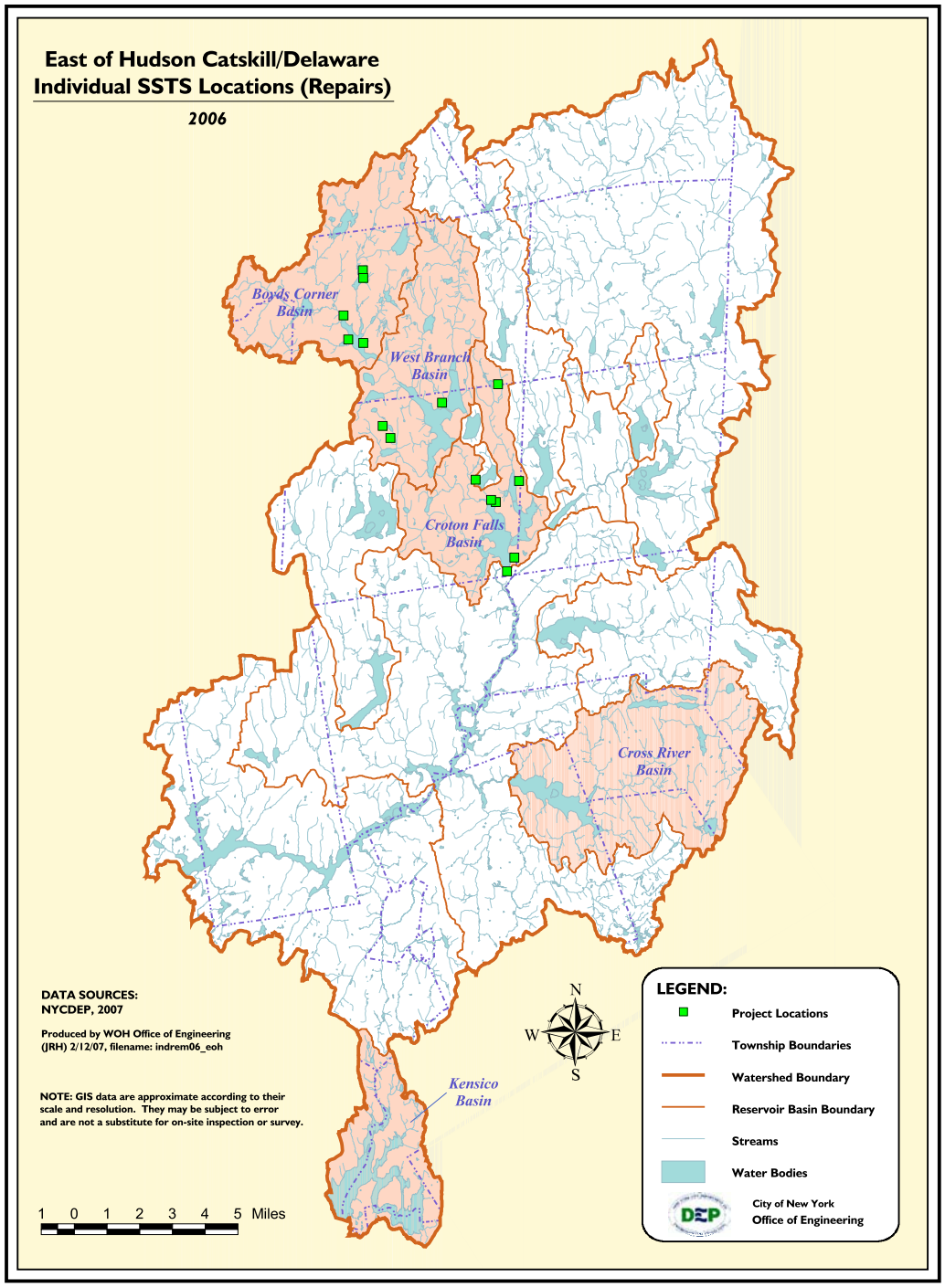

Figure 6.2. East of Hudson Catskill/Delaware repair individual SSTS locations.

Table 6.3 lists all projects received in 2006 in the Cannonsville, Pepacton, Rondout, Neversink, Schoharie and Ashokan basins in the Delaware and Catskill systems. The "Other" projects consist of DOT projects, wetland and stream disturbances, mining applications from DEC, timber harvesting and Stormwater Retrofit projects. The projects listed below are new or repaired commercial, institutional and multi-family septics, or individual advanced aerobic treatment units (ATU). The new, delegated and remediated individual septic systems are listed in Table 6.4. Figures 6.3 and 6.4 show the locations of these projects.

Table 6.3. Ashokan, Cannonsville, Neversink, Pepacton, Rondout, Schoharie Reservoirs new projects for 2006.

Reservoir Basin	Project Name	Town	DEP Approval Required	Project Status as of 12/31/06
Out	Horton Brook Bank Stabilization - Not Mapped	Colchester	Stream Disturbance	New
Ashokan	Brio's Restaurant (Michael Ricciardella)	Shandaken	Comm. SSTS Repl.	Approved
Ashokan	Emerson 2005	Shandaken	Intermediate SSTS	Approved
Ashokan	First Spanish Bapt Church of S. Baptist Convention	Shandaken	Comm. SSTS Repl.	Complete
Ashokan	Peter & Lillian Cross Timber Harvest	Woodstock	Timber Harvest	No Application
Ashokan	Phoenicia-Stormwater Infrastructure Planning & Assessment	Shandaken	Other	Closed
Ashokan	T/Hurley Highway Facility & Transfer Station	Hurley	Other	Closed
Ashokan	Ulster County Highway & Municipal Facility Stormwater Retrofit Grant	Multiple	Other	Closed
Ashokan	Ulster County Stormwater System Planning	Multiple	Other	No Application
Cannonsville	Bloomville Stormwater Retrofit	Kortright	Other	Closed
Cannonsville	Bridge Replacement - CR 2 over Bagley Brook	Hamden	Other	No Application
Cannonsville	DCSWMF - 1st quarter 2006	Walton	Other	No Application
Cannonsville	DCSWMF - 2nd quarter 2006	Delhi	Other	No Application
Cannonsville	DCSWMF - 3rd quarter 2005	Delhi	Other	No Application
Cannonsville	DCSWMF - 4th quarter 2005	Walton	Other	No Application
Cannonsville	Delaware Street Quarry	Walton	Other	Closed
Cannonsville	Gibbons, Michael	Franklin	Intermediate SSTS	Approved
Cannonsville	Highway Maintenance Plan	Hamden	Other	No Application
Cannonsville	Kelly Gravel Bank	Kortright	Other	Closed
Cannonsville	Lewis, Ron	Delhi	Individual SPPP	Approved

Table 6.3. Ashokan, Cannonsville, Neversink, Pepacton, Rondout, Schoharie Reservoirs new projects for 2006.

Reservoir Basin	Project Name	Town	DEP Approval Required	Project Status as of 12/31/06
Cannonsville	NYSDOT - Pavement Recycling	Walton	Other	Closed
Cannonsville	NYSDOT - Rt. 28, Honest Brook	Delhi	Other	No Application
Cannonsville	Palmatier Property	Stamford (V)	Stream Disturbance	Closed
Cannonsville	Railroad Crossing of Kerr's Creek	Walton	Stream Disturbance	Closed
Cannonsville	Rama Stream Disturbance	Kortright	Stream Disturbance	Closed
Cannonsville	Route 10 Culvert Replacement - Delhi	Delhi	Other	Closed
Cannonsville	Seiden Stream Disturbance	Walton	Stream Disturbance	Closed
Cannonsville	Sewer Extension for the Wilbur Bank Branch	Delhi	Sewer Connection	Complete
Cannonsville	Sheffield Estates Senior Housing	Walton (V)	Sewer Conn/SPPP	Approved
Cannonsville	Town Brook Road	Stamford (V)	Stream Disturbance	Closed
Cannonsville	V/Walton Floodplain Analysis	Walton	Other	No Application
Cannonsville	West Brook Stream Disturbance	Walton	Stream Disturbance	Closed
Neversink	Frost Valley - Mitchell Lodge	Denning	SSTS/SPPP	Approved
Neversink	Frost Valley - Wellness Center	Denning	SSTS/SPPP	Complete
Neversink	Neversink Tunnel Outlet Hydroelectric Plant	Neversink	Other	No Application
Pepacton	Barkaboom Road Stream Disturbance	Andes	Stream Disturbance	No Application
Pepacton	Collins and Kopcienski Property	Andes	Stream Disturbance	No Application
Pepacton	Delgrange Property	Colchester	Stream Disturbance	No Application
Pepacton	Dry Brook Road Stream Disturbance	Middletown	Stream Disturbance	Closed
Pepacton	Emory Brook Stream Disturbance	Middletown	Stream Disturbance	Closed
Pepacton	Gould Stream Disturbance	Hardenburgh	Stream Disturbance	No Application
Pepacton	Holiday Brook Road Stream Work	Colchester	Stream Disturbance	Closed
Pepacton	Hydo, Charles	Roxbury	Variance	Approved
Pepacton	New York Spring Water, Inc.	Halcott	Comm. SSTS Repair	Approved
Pepacton	Newman, Daniel Individual Residence	Middletown	Variance	Approved
Pepacton	NYS Route 28 Rehabilitation	Andes	Stormwater	Approved
Pepacton	NYSDOT Rt. 28 Slope Failure	Andes	Other	Closed
Pepacton	Orchard Street at Bull Run Creek	Margaretville (V)	Stream Disturbance	No Application
Pepacton	Richard Gulde Property	Middletown	Stream Disturbance	No Application

Table 6.3. Ashokan, Cannonsville, Neversink, Pepacton, Rondout, Schoharie Reservoirs new projects for 2006.

Reservoir Basin	Project Name	Town	DEP Approval Required	Project Status as of 12/31/06
Pepacton	Route 28 Slope Failure - Andes	Andes	Other	Closed
Pepacton	Schwartzberg Property	Middletown	Stream Disturbance	Closed
Pepacton	Structure Removal of E. Branch Delaware River	Roxbury	Other	Closed
Pepacton	Tuscarora Club Property	Middletown	Stream Disturbance	Closed
Pepacton	V/Margaretville Comprehensive Plan	Margaretville (V)	Other	No Application
Pepacton	Vly Creek Stabilization	Fleischmanns (V)	Stream Disturbance	Closed
Pepacton	Walsh, Terrence & Kathleen, Report No 4304	Middletown	Land Management	Closed
Rondout	Bokowski Timber Harvest	Wawarsing	Timber Harvest	Closed
Rondout	Bridge Washing - 980505	Neversink	Other	Closed
Rondout	County Route 42 Stream Disturbance	Denning	Stream Disturbance	No Application
Rondout	Joseph Hufnagel Timber Harvest	Wawarsing	Timber Harvest	Closed
Rondout	Lands of Mirando Timber Harvest	Wawarsing	Timber Harvest	Closed
Rondout	Lands of NYC Timber Harvest	Wawarsing	Timber Harvest	No Application
Rondout	Lands of Osgood Timber Harvest	Wawarsing	Timber Harvest	Closed
Rondout	NYSDOT Guide Rail Requirements Contract	Neversink	Other	No Application
Rondout	Orrino, Victor Timber Harvest	Wawarsing	Timber Harvest	No Application
Rondout	Reassignment for Tri-Valley Little League #3211	Neversink	Land Management	Closed
Rondout	Robert Osgood Timber Harvest	Wawarsing	Timber Harvest	Closed
Schoharie	Ashland Connector Stream Permits	Ashland	SPPP/Stream Distur	No Application
Schoharie	Bono Property Stream Disturbance	Hunter	Stream Disturbance	Closed
Schoharie	Bridge Replacement- Church Street over Batavia Kill	Windham	SPPP	Approved
Schoharie	Champlin Road Bridge Repairs	Conesville	Other	Closed
Schoharie	Colgate Lake Dam Rehabilitation	Jewett	Other	Closed
Schoharie	Cortina Mountain Estates LLC	Hunter	SPPP	Complete
Schoharie	County Route 56 Stream Disturbance	Windham	Stream Disturbance	No Application
Schoharie	County Route 6 Stream Disturbance	Lexington	Stream Disturbance	Closed
Schoharie	DelMonaco, Antoinetta	Windham	Comm. SSTS Repair	Approved
Schoharie	Elm Ridge Home Owner's Association	Windham	Other	Closed

Table 6.3. Ashokan, Cannonsville, Neversink, Pepacton, Rondout, Schoharie Reservoirs new projects for 2006.

Reservoir Basin	Project Name	Town	DEP Approval Required	Project Status as of 12/31/06
Schoharie	Evergreen Mountain Contracting	Hunter	Stream Disturbance	No Application
Schoharie	Finazzo, Russell	Jewett	Intermediate SSTS	Approved
Schoharie	Fisher Property	Jewett	Stream Disturbance	Closed
Schoharie	Generic Environmental Impact Statement	Windham	Other	No Application
Schoharie	Gilboa Dam Emergency Work	Gilboa	Other	No Application
Schoharie	Greene County Planning & Economic Development	MULTIPLE	Other	Closed
Schoharie	Halcott Land Use Regulations Update	Halcott	Other	No Application
Schoharie	Hariton, David (Krueger, Tom)	Hunter	Individual SPPP	Complete
Schoharie	Hitchcock Property	Jewett	Stream Disturbance	Closed
Schoharie	Kissley Road Stream Disturbance	Hunter	Stream Disturbance	Closed
Schoharie	Lake in the Sky - Lot #12 (Adler)	Gilboa	SPPP/SSTS	Complete
Schoharie	Lake in the Sky - Lot #13 (Walla)	Gilboa	SPPP-/SSTS	Complete
Schoharie	Liftside WWTP	Hunter	Stream Disturbance	Closed
Schoharie	Masonic Temple Parking Lot	Windham	Other	Closed
Schoharie	NYSDOT Bridge Cleaning	Multiple	Other	No Application
Schoharie	NYSDOT Route 23 Slope Failure	Prattsville	Other	No Application
Schoharie	Oorah Catskill Retreat (Kiruv Rechokim)	Gilboa	SPPP	Approved
Schoharie	Prattsville Stormwater Improvements	Prattsville	Other	Closed
Schoharie	Rappleyea Mine Permit	Lexington	Other	Closed
Schoharie	Santos, Frank	Jewett	Intermediate SSTS	Complete
Schoharie	Schoharie #2 Shale Mine	Conesville	Other	Closed
Schoharie	T/Jewett Infrastructure Study	Jewett	Other	No Application
Schoharie	The Diamonds at Windham Mountain	Windham	SPPP/Sewer Collect	Approved
Schoharie	Twin Maples Lake Subdivision	Gilboa	SPPP	Incomplete
Schoharie	V/Hunter Stormwater Assessment	Hunter	Other	Closed
Schoharie	V/Tannersville Highway Maintenance Plan	Tannersville (V)	Other	No Application
Schoharie	Von Aweyden, LLC - Phase II	Jewett	Interm SSTS/SPPP	Incomplete
Schoharie	Windham Mountain	Windham	SPPP	Approved

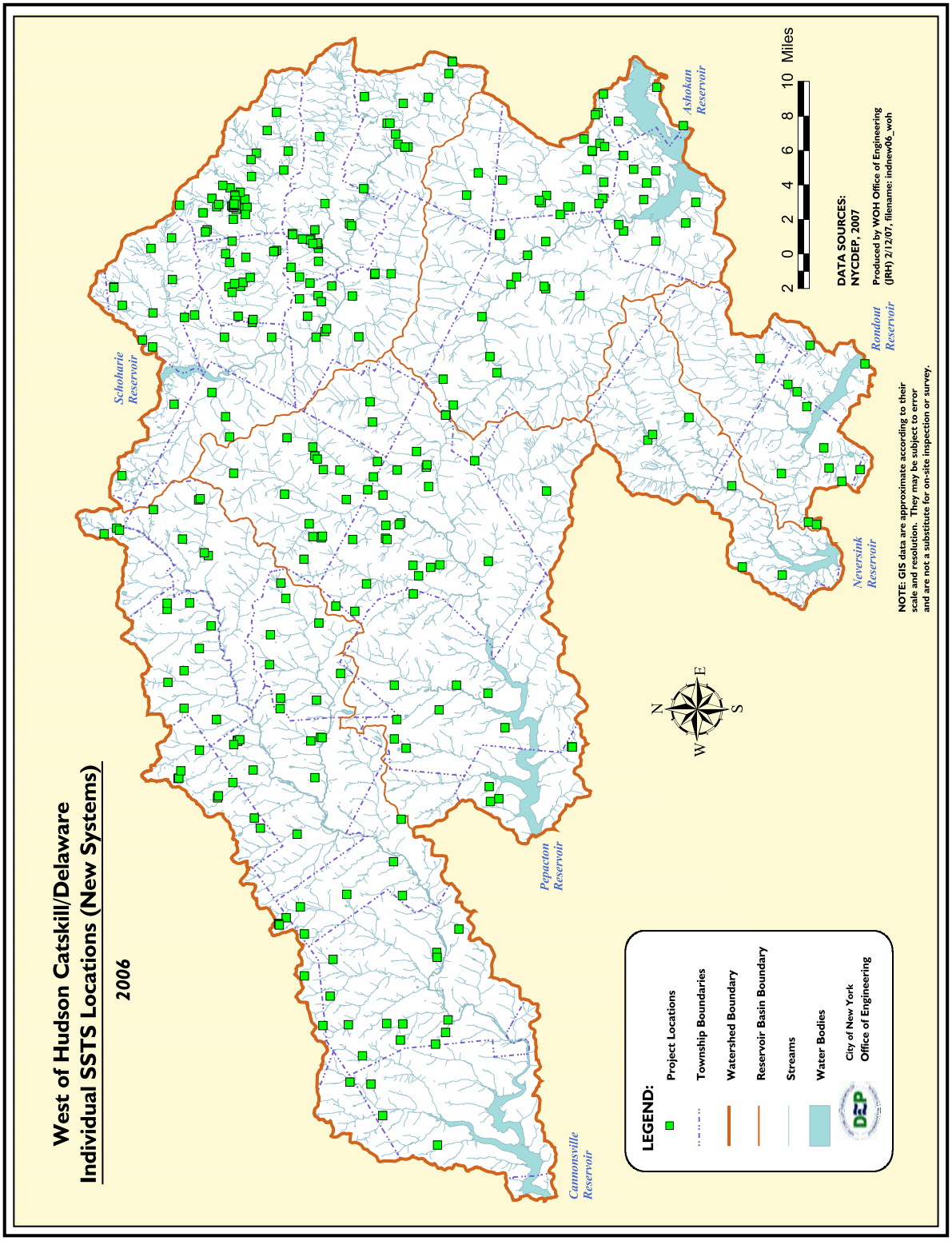

Figure 6.3. West of Hudson Catskill/Delaware individual SSTS (new systems) 2006.

Table 6.4. Ashokan, Schoharie Cannonsville, Pepacton, Rondout, Neversink Reservoirs individual SSTSs for 2006.

Reservoir	Town	# of Delegated Septics	# of New Septics	# of Septic Repairs	# of Approvals	# of Constructions
Ashokan	Hurley	2	N/A	11	12	19
Ashokan	Marbletown	1	N/A	0	0	0
Ashokan	Olive	12	N/A	22	28	42
Ashokan	Shandaken	19	N/A	17	25	49
Ashokan	Woodstock	18	N/A	11	25	20
Schoharie	Ashland	N/A	13	1	14	16
Schoharie	Conesville	N/A	8	1	10	30
Schoharie	Gilboa	N/A	2	0	4	7
Schoharie	Halcott	N/A	1	2	4	0
Schoharie	Hunter	N/A	20	8	25	21
Schoharie	Hunter (V)	N/A	0	0	0	0
Schoharie	Jewett	N/A	18	11	30	31
Schoharie	Lexington	N/A	13	3	18	17
Schoharie	Prattsville	N/A	5	0	9	10
Schoharie	Roxbury	N/A	4	1	1	4
Schoharie	Stamford	N/A	0	0	0	0
Schoharie	Tannersville (V)	N/A	1	0	1	0
Schoharie	Windham	N/A	36	4	41	34
Cannonsville	Bovina	N/A	12	1	14	19
Cannonsville	Delhi	N/A	11	13	24	28
Cannonsville	Franklin	N/A	4	0	3	10
Cannonsville	Hamden	N/A	6	7	14	16
Cannonsville	Harpersfield	N/A	0	2	2	3
Cannonsville	Hobart (V)	N/A	0	0	0	0
Cannonsville	Jefferson	N/A	2	1	3	2
Cannonsville	Kortright	N/A	9	2	9	14
Cannonsville	Masonville	N/A	1	2	3	8
Cannonsville	Meredith	N/A	10	3	13	23
Cannonsville	Sidney	N/A	0	0	0	2
Cannonsville	Stamford	N/A	6	3	7	11
Cannonsville	Tompkins	N/A	3	5	5	12
Cannonsville	Walton	N/A	18	11	31	37

Table 6.4. Ashokan, Schoharie Cannonsville, Pepacton, Rondout, Neversink Reservoirs individual SSTSs for 2006.

Reservoir	Town	# of Delegated Septics	# of New Septics	# of Septic Repairs	# of Approvals	# of Constructions
Neversink	Denning	4	N/A	4	3	3
Neversink	Hardenburgh	1	N/A	0	1	1
Neversink	Neversink	N/A	11	9	16	39
Pepacton	Andes	N/A	9	12	26	34
Pepacton	Bovina	N/A	0	0	2	0
Pepacton	Colchester	N/A	4	2	6	1
Pepacton	Fleischmanns	N/A	0	0	0	0
Pepacton	Halcott	N/A	1	2	3	12
Pepacton	Hamden	N/A	0	0	0	2
Pepacton	Hardenburgh	N/A	0	0	2	2
Pepacton	Middletown	N/A	18	20	39	79
Pepacton	Roxbury	N/A	17	8	28	36
Pepacton	Wawarsing	N/A	0	0	0	1
Rondout	Denning	0	N/A	2	2	12
Rondout	Fallsburg	N/A	1	1	3	1
Rondout	Hardenburgh	0	N/A	0	0	
Rondout	Neversink	N/A	1	3	7	31
Rondout	Rochester	1	N/A	0	0	0
Rondout	Wawarsing	3	N/A	1	1	2
Totals		**61**	**265**	**145**	**424**	**611**

***** DEP has an agreement with Ulster County to review new individual SSTS applications

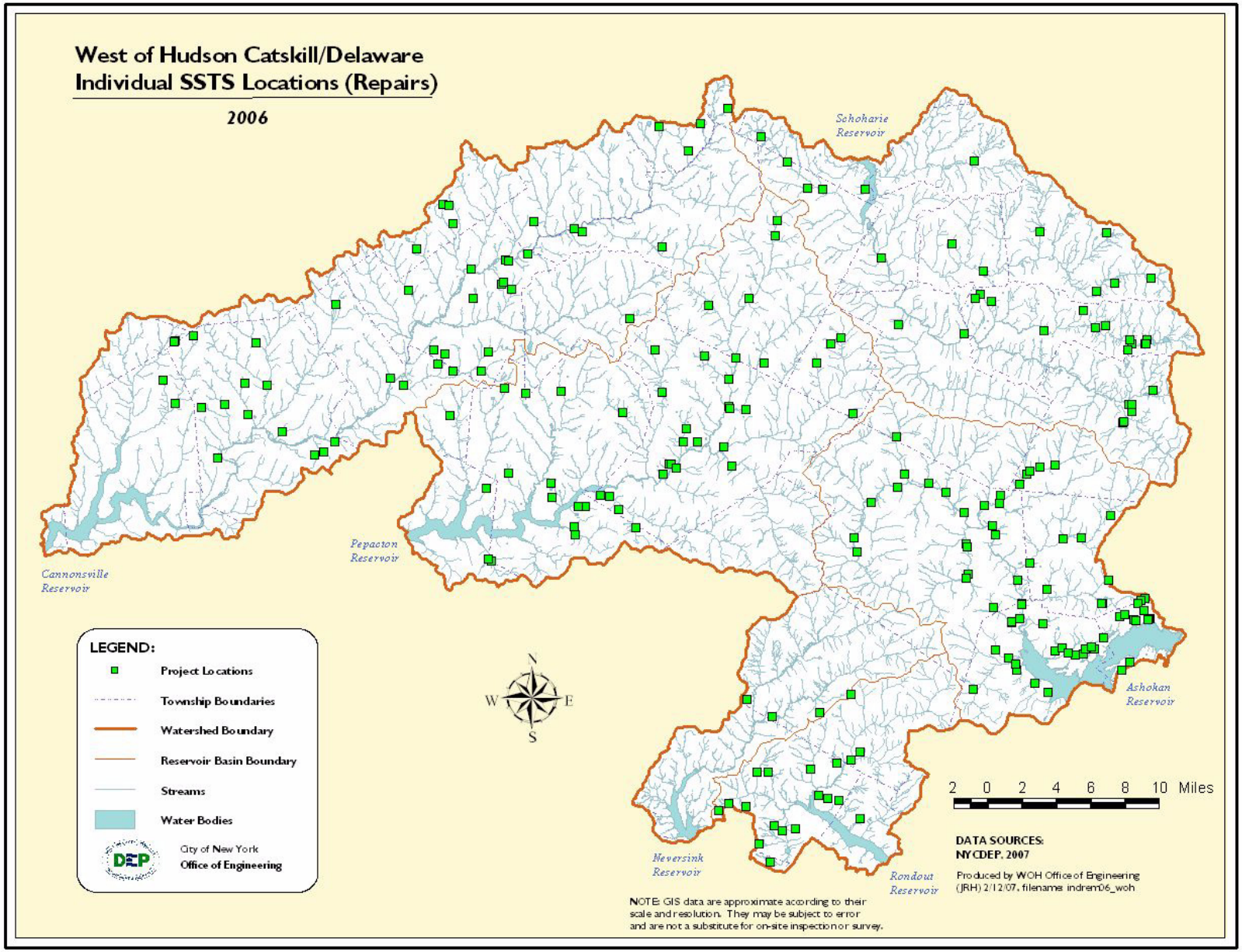

Figure 6.4. West of Hudson Catskill/Delaware repair individual SSTS locations.

6.1.2 Enforcement Activities

DEP continues to monitor activities in the watershed to ensure water supply protection. Part of that effort focuses on the management and protection of City-owned water supply lands. DEP inspects and maintains boundary limits on all City lands and conservation easements; prepares properties for purchase by the City; issues public access and boating permits; and refers violations to DEP Police.

DEP is responsible for reviewing applications, conducting site visits, witnessing soil tests and inspecting construction of all new individual septic systems in the Catskill and Delaware Districts. On a limited basis, DEP staff also performs discovery and confirmation of septic failures, issues Notices of Violation (NOV), pursues enforcement actions on failed Subsurface Sewage Treatment Systems, and refers other criminal activity to the DEP Police. Additionally, these activities are coordinated with DEP Legal and Corporation Counsel, local County Health Departments, local building inspectors, and the Catskill Watershed Corporation if the activity is in an MOA program area.

The mission of DEP Police is to preserve and protect the New York City water supply from pollution, crime and terrorism. DEP Police have taken a much larger role in the surveillance, detection and investigation of violations of the WR&Rs. In 2003, the DEP Police created The Environmental Police Academy the first of its kind in the nation. The Environmental Police Academy is an accredited 1,000 hour police training academy certified by the New York State Division of Criminal Justice Services. Academy training includes 510 hours of training in law and police science, 320 hours of training in fish and wildlife enforcement as well as environmental conservation law and 170 hours of training in environmental and infrastructure protection. All recent graduates of the Environmental Police Academy receive 40 hours of OSHA approved Haz Mat training. The Environmental Police Academy also provides an aggressive in service training program for veteran police officers featuring state of the art techniques, tactics and technologies. The DEP Police provides coordination activities among various other DEP bureaus and divisions to ensure that the highest levels of safety, security and surveillence are maintained 24 hours per day 7 days per week.

In 2006, the Police Bureau conducted 11,337 hours of training and investigated 3,660 complaints consisting of 228 instances of illegal disposal of hazardous and non hazardous waste, 36 stream violations, 46 sewer discharges and 70 environmental conservation complaints. These complaints resulted in 236 summonses/arrests for ECL violations, 225 arrests for penal law violations and 37 Environmental Control Board summonses. Bureau of Police personnel patrolled more than 2 million miles and conducted 154,724 security inspections of critical infrastructure facilities. Police personnel also conducted 263 environmental sector patrols.

Table 6.5. 2006 Land Management activities.

	East of Hudson	Catskill	Delaware
Properties fully inspected (acres)	33976	32839	34293
Properties partially inspected (#)	94	49	20
Miles of boundary painted	128.5	113.8	122.6
Miles of boundary posted	127.5	91.7	122.8
Site visits (#)	196	224	183
Pre-closing site inspections (acres)	134	1529	2161
Debris/hazards identified (#)	79	3	21
Debris/hazard cleaned/resolved	73	6	18
Encroachments identified	5	7	19
Encroachments referred (#)	1	4	7
Encroachments resolved	5	1	19
Road/access areas secured (#)	6	1	23
Contacts with NYC neighbors (#)	234	124	381
Contacts with NYC Recreational users (#)	2250	2989	2061
Number of non-compliant boats removed (#)	135	22	265
Number of boats steam-cleaned (#)	685	149	259

The 2006 Engineering Activities for the east of Hudson are specific for the following basins: Boyd Corners, West Branch, Croton Falls, Cross River and Kensico:

Table 6.6. 2006 Engineering activities.

	East of Hudson	Catskill	Delaware
New or Delegated Onsite SSTSs Design Approved	37	141	153
Remediated Onsite SSTSs Design Approved	7	112	127
SSTSs Construction Approved (New, Remediated or Delegated)	6	203	253

Table 6.6. 2006 Engineering activities.

	East of Hudson	Catskill	Delaware
SPPP, IRSP and CPDP Approvals	13	12	6
WWTP or Sewer Connection, Sewer Extension Approved	3	2	3
NOVs/NOFs for SSTS	0	16	6
NOVs/NOFs for SPPP	2	2	1
Other Application Received (Non Regulated)	20	51	59

6.1.3 Delegation Agreements

In 2006, Westchester, Putnam and Ulster County Health Departments all negotiated new delegation agreements that are valid for five years. Each county continued to perform reviews of septic systems in accordance with the delegation agreements. DEP received documentation concerning the review of 228 delegated systems during the calendar year 2006. Of the total 228 delegated septic systems, a total of 102 systems were reviewed by county health departments in the Catskill and Delaware Systems.

6.1.4 Winter Road Deicer Policy and Protection Development

DEP continues to offer the opportunity to provide laboratory analysis of deicers should samples be received to compare total phosphorus concentrations to the ranges listed in the advisory posted on the website of the Watershed Inspector General (http://www.oag.state.ny.us/environment/ deicer.html). In 2006, there were no requests for analysis.

As a part of the Northern Westchester Watershed Committee, DEP is a member of the deicing task force. This group is currently working to develop a set of best management practices for deicing strategies in the Croton watershed.

6.2 Wastewater Treatment Facility Compliance Inspection Program

At each surface discharging wastewater facility that operates on a year-round basis, DEP's Wastewater Treatment Facility Regulatory Compliance Inspection (RCI) Sections conducts a quarterly compliance inspection. At seasonal surface discharging facilities, a minimum of two compliance inspections are conducted during the operating season per year. Similarly, at least two compliance inspections per year are conducted at non-contact cooling water discharges to surface waters, groundwater remediation systems, landfills, and oil/water separators. Treated industrial waste discharges to groundwater, via ground surface application, are inspected four times per year.

In addition to compliance inspections, RCI also conducts reconnaissance inspections at facilities to meet with owners and/or operators to address special problems and provide operations assistance when necessary. Reconnaissance inspections may be prompted by violations or sampling results from biweekly DEP sampling and analyses. When needed, DEP laboratories are asked to collect samples and conduct special analyses to identify violations and assist in resolving operational issues.

When violations are identified at WWTPs, DEP coordinates enforcement activities with DEC through the quarterly Watershed Enforcement Coordination Committee (WECC) meetings. At these meetings, the compliance status of watershed WWTPs is discussed and steps are taken to ensure that adequate enforcement activities are pursued to achieve compliance. Staff from EPA, DOH, and the NYS Attorney General's Office also participate in the WECC proceedings.

In 2006, eight Compliance Assistance Conferences were held between DEP, WWTP owners and other interested regulatory agencies. Seven DEC Orders of Consent were initiated with fines. Two Notices of Violations (NOVs) were issued by DEP.

Facility Compliance in Catskill/ Delaware Watershed

Not including the new but unfinished New Infrastructure Program (NIP) WWTPs, a total of 42 west of Hudson wastewater treatment facilities were inspected by RCI on a regular schedule. Of those, 33 facilities are permitted for year-round discharge and 9 are permitted for seasonal discharge. Of this overall total, three are wastewater treatment facilities permitted to discharge to groundwater. These are the Hamlet of Chichester, Mountainside Farms, and Hanah Country Club. Three other dischargers are industrial non-contact cooling water discharges. These include Ultra Dairy, DMV, and Kraft Non-Contact Cooling Water discharges. Of the inspections conducted in 2006, approximately 230 were follow-up inspections, which were made at various facilities throughout the year. In addition, there were approximately 350 site inspections related to DEP's Regulatory Upgrade Program construction work.

Wastewater treatment plants in the Catskill/Delaware watershed continue to show improvement in compliance with their State Pollutant Discharge Elimination System (SPDES) Permits. This is due in large part to DEP's Wastewater Treatment Facility Compliance Inspection Program. Several facilities showed improvements in compliance in 2006 including, Regis Hotel, Onteora High School, Mountain View Estates I & II and Mountainside Farms. For Regis Hotel, DEP rented a mobile treatment unit called STEP 3, to further enhance the facility's poor quality sand filter effluent via additional micro, sand and carbon filtration along with enhanced ultra-violet radiation. DEP Regulatory Compliance and Inspection personnel and the STEP 3 owner discussed strategies to improve the treatment units' performance prior to the Hotel's 2006 operating season. These strategies were implemented resulting in a much improved effluent quality. For the Mountain View and Onteora HS facilities, DEP RCI personnel met with each operator to discuss more aggressive operational and maintenance approaches. That is, increase sand filter surveil-

lance and septic tank pump outs, better flow monitoring and record-keeping. This resulted in much improved O&M and effluent quality. For Mountainside Farms, a subsurface lagoon system, DEP RCI staff met regularly throughout the year with the facility owner, operators and engineer to determine the best approach to increase phosphorus removal, monitor flow, improve sludge removal and reduce odor. Through DEP RCI efforts the operator was able to achieve a much improved effluent quality by enhancing phosphorus removal via chemical addition. RCI staff was able to further assist the facility by communicating with DEP Operations at the Margaretville WWTP facility and having this municipal facility accept sludge from the Mountainside Farms facility, on a temporary basis. Mountainside Farms is currently undergoing a Phase 2 upgrade.

Notification by the inspection personnel required several facilities to take immediate corrective actions during specific instances of acute operational or equipment failures. This resulted in reduction, avoidance, or elimination of non-compliant discharges at Onteora High School, Camp L'man Achai, Roxbury Run Village, Camp Timberlake and the Village of Andes WWTP. For Onteora, DEP RCI staff was alerted to a possible lightning strike at the WWTP which resulted in a loss of control from the plant EQ tank to the CBUDSF unit. RCI staff immediately responded and determined that an electrical conduit needed to be replaced. RCI instructed that the facility operator pump down the EQ tank and had the school also contact an electrician. Within several days, the conduit was replaced and the plant proceeded to run normally. No spill occurred due to RCI's quick action. Similar, but less critical action was taken at the other named sites. At Camp L'man Achai, spider distribution valves became separated from the sand filter system. RCI staff responded and had the operator excavate the valves and reconnect. As this occurred just before camp opening season, no spills occurred. At Roxbury Run, sporadic flow was causing operational problems at the secondary treatment end. RCI staff instructed that the operator install a weir at the new EQ tank in order to control flow. This resulted in a more laminar flow effect, better detention times in the secondary and a better effluent quality to the facility's upgraded components. At Camp Timberlake, RCI staff had the operator make changes to the sludge pumps due to their poor performance and constant failure. This change resulted in a much smoother plant performance in terms of sludge handling. Effluent quality was also improved as sludge wasting was enhanced. For the Village of Andes, RCI staff discussed the effluent violations of this new facility with facility owner and engineer. Equipment improvements were suggested and implemented resulting in a much improved effluent quality.

Several facilities made construction remediations or improvements to their wastewater treatment facilities to reduce risks of non-compliant discharges. These were initiated by DEP through the inspection program and/or by DEC in cooperation with DEP. These included Elka Park, Hunter Highlands, and Crystal Pond. At Elka Park, DEP RCI staff had the facility owner install insulated covers over their exposed secondary treatment in order to maintain the facility's biology during the winter months. The facility was able to maintain its biology during the winter months and meet its SPDES permit parameters. This facility has recently had its SPDES permit modified to operate all year. This insulated covering approach was similarly done to the Hunter

Highlands facility. In both cases, intermittent stream limits were maintained during the winter months. At Crystal Pond, a non-discharger, an alarm was installed on the wastewater storage tank as well as an aeration system to keep the wastewater from becoming septic. Due to DEP's efforts, a daily inspection log book and a pump out log book and hauling manifest are now maintained.

RCI staff also hold Compliance Assistance Conferences (CAC) with those facilities that continue to violate their SPDES permit limits and/or monitoring requirements. CAC's are usually conducted after repeated attempts by RCI staff to remediate the problem with the facility owner and/or operator have failed. RCI staff usually sends out a Notice of Violation (NOV) letter prior to calling for a CAC meeting. Due to the fact that many outdated facilities which exceeded their permits on a regular basis have been either connected to another upgraded facility, upgraded as a stand-alone facility, converted to subsurface discharge or totally abandoned, the number of these failed WWTPs has decreased greatly. Therefore, subsequently, the number of CAC's have also decreased. A CAC was held in November for the Oorah-Golden Acres Farm WWTP. Although this facility was upgraded in 2006 and operated under an interim SPDES permit during the Startup and Performance testing (SPT) period, it was evident that extreme flow violations and chronic and acute ammonia, BOD and TSS violations required immediate attention. In a pre-emptive move for the 2007 operating season, RCI staff had the facility owner, engineer and operator, NYSDEC, DEP legal, Schoharie County Health Dept. attend the CAC. A plan was discussed to control flow via population reduction, adding and improving water-saving equipment and methods and infiltration investigation. Additionally, legal action was discussed if the facility fails to meet its SPDES permit limits, which may also include closing down the facility for the 2007 operating season.

RCI personnel reviewed, approved and monitored the implementation and construction of the connections several WWTPs to NIP facilities. These facilities were Colonel's Chair, Forester Motor Lodge, Liftside at Hunter, Snowtime/ Ski Windham, Thompson House, Frog House and Whistletree. Regis Hotel is slated to be connected to the new Fleischmanns WWTP this summer. At Regis Hotel an interim supplemental treatment system including a portable WWTP with UV has been utilized over the past several years. Camp Loyaltown's connection to the Hunter NIP has been approved and the construction should be completed by the start of their 2007 operating season.

RCI personnel were instrumental in the progress made in DEP's Regulatory Upgrade Program. During 2006, more stringent SPDES limits were almost immediately met at wastewater treatment plants that completed their upgrades including Camp Timberlake. DEP's RCI staff performed construction inspections, start-up surveillance, performance testing data and review of operating and maintenance manuals and record drawings. Currently, Mountain View I & II are being upgraded into one common facility and Elka Park is currently under construction. Both facilities will be completed in 2007.

In 2006, two WWTPs were converted from surface dischargers to subsurface disposal systems or were approved for conversion. Mountainside Restaurant has been fully converted to subsurface disposal. Camp Nubar is currently being converted to subsurface disposal and is anticipated to be on-line before the start of their 2007 operating season. The SEVA WWTP conversion to subsurface disposal is currently under review and is anticipated to be approved my mid-2007.

Facility Compliance in East of Hudson Watershed

The east of Hudson (EOH) RCI Section ensures that adequate measures are taken to enforce compliance with the SPDES permits issued to the 72 WWTPs and the 38 groundwater remediation systems, landfills, oil/water separators and wastewater collection systems that discharge into the EOH watershed. The EOH RCI Section conducted 593 scheduled compliance, emergency response and WWTP upgrade construction inspections in 2006. The following EOH reservoir areas are of special interest because they contribute to waters of the Delaware system: West Branch, Boyd Corners, Croton Falls, Cross River and Kensico Reservoir basins.

The following is a summary of the WWTPs and collection systems inspected within the West Branch, Croton Falls and Cross River basins. There are nine WWTPs that discharge treated effluent into these basins. There are no WWTPs in the Kensico and Boyd Corners basins, but DEP does perform inspections of the collection system/pump stations maintained by Westchester County and the Towns of North Castle and Harrison within the Kensico basin.

Of the nine active WWTPs that discharge in the West Branch, Croton Falls and Cross River basins, six continued to show improvement in the quality of the effluent discharged. Clear Pool Camp, Carmel Sewer District #2, The Fairways at Hill and Dale, Lake Plaza, City-owned Mahopac plant and the Meadows at Cross River WWTPs were all operating satisfactorily during the 2006 monitoring period. Two of the remaining wastewater treatment facilities, Fulmar Road Elementary School and Waccabuc Country Club, experienced consistent exceedances related to their respective disinfection process. For each case, the DEP recommended that the operator provide increased attention to the disinfection process and to perform more frequent maintenance of the chlorine contact tanks, chemical feed lines and the effluent discharge line to improve the disinfection process. These recommendations did improve the plants' performance. The Fulmar Road Elementary School has received approval to move forward with diversion of their wastewater to the City-owned Mahopac plant while the Waccabuc Country Club will design and construct a stand alone upgraded facility.

The Lewisboro Elementary School continued to experience problems maintaining the effluent pH within its SPDES permitted range. The DEP requested a Compliance Asssitance Conference, held on October 12, 2006, at the Lewisboro Elementary School. The following were in attendance: Andrew Stor and Tom Baremore - DEP; Armand DeAngelis - NYSDEC; Tom Psomas - Katonah/Lewisboro School District. The source water for the school was tested and

reads a low pH. The school district believed this was due to the salt intrusion within the schools aquifer. There are no chemicals that were used by the school's custodian that would flow into the sewage system and force the pH to remain below the SPDES permitted range. The facility experiences problems with groundwater infiltration during rainstorms within the buried sand filters but this has not had a serious effect on any of the school's parameters, except for effluent pH. The school routinely adds sodium bicarbonate when the pH readings are below the range and then several samples are collected and analyzed during the day to average the reading within the permit limit. RCI recommended to install a flow paced bicarbonate feed system to inject the chemical within the contact tank to add alkalinity and constantly maintain the pH levels within compliance. The new chemical feed system would be connected to the plant flow meter. The operator stated that the flow meter had not been calibrated in some time. RCI provided the school district with contact information for several control technicians to have the flow meter properly calibrated and certified and to connect the bicarbonate feed system. A site inspection of the facility was conducted yielding the discovery of a supplementary conduit to run an additional tube into the chlorine contact tank for the bicarbonate feed lines. RCI suggested that the facility take several samples from the distribution box to check the pH readings of the septic tank supernatant to determine if the pH continues to drop within that point of the treatment process. Several dry weather and wet weather samples should be collected and the readings should be forwarded to DEP and the school's facility upgrade consultant, O'Brien and Gere. The school district was given a deadline date of December 31, 2006 to complete installation of this new pH adjustment and the school district completed the installation ahead of schedule.

There were three (3) sewage overflows from the collection system as part of the Carmel Sewer District #2 in 2006. In each case, the cause of the spill was debris or grease blockages within the sewer lines that lead to an overflow from an up flow manhole. Each event was assigned a NYSDEC Spill Response Number and was reported to all the relevant regulatory agencies. The combined overflow for each of the three spills totaled 2,000 gallons of septage discharged.

RCI performed compliance inspections of the Town of North Castle and Harrison pump stations and collection system throughout the 2006 monitoring period and each station was operating in an acceptable manner and no overflows were reported.

6.2.1 Sampling of Wastewater Treatment Plant Effluents

Sampling of surface-discharging wastewater treatment plant (WWTP) effluents is conducted by DEP's District Laboratories. West of Hudson sampling and analyses are performed by the Grahamsville Laboratory in the Delaware District and the Ben Nesin Laboratory in the Catskill District. east of Hudson sampling and analyses are performed by the Brewster Laboratory. Non-City-owned WWTPs are sampled twice monthly. City-owned WWTPs are sampled in accordance with State Pollutant Discharge Elimination System (SPDES) permit monitoring requirements.

At all non-City-owned WWTPs, grab samples are taken, and in addition a composite sample is collected once a year from those plants that have composite sample monitoring requirements on their SPDES permits. The non-contact cooling water discharge at Kraft is sampled just twice yearly, by composite sample. In the Catskill District in 2006, composite samples were collected from Hunter Highlands, Village of Hunter, and Village of Windham WWTPs. In the Delaware District, composite samples were collected from Village of Walton, Village of Delhi, Village of Hobart, Village of Stamford, Village of Andes, Mountainside Farms, and Kraft.

Sampling data are shared regularly with DEP's Wastewater Treatment Facility Regulatory Compliance Inspection Section for the purpose of tracking compliance with SPDES-permitted effluent limits. Total phosphorus concentration data are used to develop point-source phosphorus loads. At City-owned plants, DEP laboratories analyze compliance samples, including grab and composite samples, for reporting on Discharge Monitoring Reports (DMRs).

In 2006, the Ben Nesin Laboratory conducted 3,682 analyses on 581 effluent samples and the Grahamsville Laboratory conducted 3,251 analyses on 447 effluent samples from WWTPs (and non-contact cooling water discharges) discharging within the watershed. For plants in the east of Hudson FAD basins (West Branch, Cross River, and Croton Falls), the Brewster Laboratory collected 227 effluent samples and conducted 2,211 analyses.

6.3 SEQRA Coordination

To better coordinate SEQRA activity in the watershed, DEP created the SEQRA Coordination Section in January 2004. This DEP Section is charged with successfully executing the duties outlined below.

Staff ensure timely, thorough, and effective SEQRA environmental reviews in the watershed. To manage these often large and often complex projects, and the accompanying SEQRA environmental reviews, DEP tracks all SEQRA projects in the watershed; maintains a database of new projects and development trends in the watershed; interacts with local, State and federal officials and other parties interested in DEP's involvement in SEQRA environmental reviews; and makes certain that the appropriate levels of DEP management are kept apprised of the presence, and status, of potentially controversial SEQRA reviews.

Table 6.7. SEQRA Actions 2006.

Received	Reviewed	Comment Letters Issued	Ongoing Reviews	SEQRA Process Closed
165	165	103	68	97

SEQRA Actions include Notices of Intent to Act as Lead Agency; Determinations of Action Types; Environmental Assessment Forms; Scoping Documents; Draft Environmental Impact Statements; Final Environmental Impact Statements; Supplemental Environmental Impact Statements; and Findings to Approve or Deny.

Ongoing reviews and process closures include certain actions that DEP received prior to the beginning of the reporting period.

The following table provides a brief overview of the nature and status of significant, privately sponsored, SEQRA Type I actions that are currently undergoing, or have undergone, SEQRA environmental reviews during the reporting period.

Table 6.8. 2006 SEQRA activity and status for Type I actions.

Project	Description	Town/County	Reservoir Basin	Project Status
Burdick Farm	Subdivision of a ~163 acre parcel into 37 residential building lots. Lead Agency re-opened previously completed SEQRA process to address traffic concerns.	Patterson/ Putnam	East Branch	DEP reviewed and commented on circulated SEQRA materials. Town review ongoing.
Chappaqua Crossings	Proposed redevelopment of former Reader's Digest site to include 348 senior housing units.	New Castle/ Westchester	New Croton	DEP reviewed and commented on initial plans, EAF, and scoping documents. Lead Agency subsequently voted to reject the site plan.
Coulter Brook Meadow	Proposed 18-lot residential subdivision on a ~263 acre parcel.	Bovina/ Delaware	Cannonsville	DEP reviewed and commented on initial site plans and EAF. Town review ongoing.
Crossroad Ventures/ Belleayre Resort	Mixed use development including 400 hotel rooms, 351 additional hotel and housing units, a 21 lot single family residential subdivision, two 18 hole golf courses, and two WWTPs.	Shandaken/ Ulster	Pepacton	DEP continued to meet with the applicant and review/ comment on proposed project modifications. Review ongoing.
Gateway Summit/the Fairways	Multi-use development including a 150-unit senior housing complex, hotel, conference center, YMCA, and commercial space.	Carmel/ Putnam	Middle Branch, Croton Falls	DEP reviewed and commented on the FGEIS. Lead Agency issued its findings to approve in September.

Table 6.8. 2006 SEQRA activity and status for Type I actions.

Project	Description	Town/County	Reservoir Basin	Project Status
Hamlet of Bloomville Wastewater Treatment Facility Upgrade	NYC MOA provision for a program to construct and install WWTP or community septic systems with collection systems or septic districts.	Kortright/ Delaware	Cannonsville	DEP reviewed and commented on various submissions by the Lead Agency and applicant within the context of SEQRA. Town issued Negative Declaration in October.
Hamlet of Boiceville Wastewater Treatment Facility Upgrade	NYC MOA provision for a program to construct and install WWTP or community septic systems with collection systems or septic districts.	Olive/ Ulster	Ashokan	DEP reviewed and commented on various submissions by the Lead Agency and applicant within the context of the SEQRA environmental review. Town and DEP review on-going.
Hillcrest Commons	Construction of six senior residential buildings including community center, 60,000 s.f. of office space in five buildings, and associated driveways and parking.	Carmel/ Putnam	Croton Falls	DEP reviewed and commented on the FEIS. Lead Agency issued findings to approve in October.
Hilltop Association	Proposed 3-lot subdivision of a ~13.08 acre parcel. Sites will be serviced by individual septic systems and municipal water.	Yorktown/ Westchester	Muscoot	DEP reviewed and commented on initial site plans and EAF. Town review on-going.
Hog Hill Properties	Proposal to rezone ~93 acres to permit construction of 51-building senior housing complex.	Yorktown/ Westchester	New Croton	DEP reviewed and commented on initial site plans and EAF. Lead Agency issued a positive declaration in August. Applicant to prepare DEIS.
Lakeview Estates	Proposed 11-lot residential subdivision with an on-site wastewater treatment system.	Cortlandt/ Westchester	New Croton	DEP reviewed and commented on the FEIS and alternate site plans developed to further reduce water quality impacts. Town review on-going.
Legionnaires of Christ's Westchester University	New university containing buildings and facilities having a total floor area of 1,053,400 s.f. and accommodating a total enrollment of 3,000 students.	Mount Pleasant/ Westchester	Kensico	DEP staff met with applicant to discuss preliminary designs. Revision of site plans and Town review on-going.
Meridale Farms, Land & Lakes Subdivision	Proposed subdivision of a ~1,100 acre parcel into 120 building lots ranging from 5 to 30 acres.	Meredith/ Delaware	Cannonsville	DEP reviewed and commented on initial site plans and scoping documents. Town review on-going.

Table 6.8. 2006 SEQRA activity and status for Type I actions.

Project	Description	Town/County	Reservoir Basin	Project Status
Mountain Lakes Park, Spruce Camp Renovations	Renovation of campground including demolition of 30 cabins, renovation of 5 existing buildings, and construction of new camp facilities including a new septic system.	North Salem/ Westchester	Titicus	DEP reviewed and commented on initial site plans and EAF. DEP conducted/ observed field site/soil evaluation in December.
North Castle Greenway Compact Plan	Amendment of Zoning Ordinance and Subdivision Regulations to allow participation in the Westchester County Greenway Compact Plan.	North Castle/ Westchester	Kensico	DEP reviewed and commented as an interested agency on the potential water quality impacts of the proposed amendments.
North Castle Moratorium and Planning Study	Adoption of zoning map amendments and other planning and regulatory changes designed to implement the Town's 1996 Comprehensive Plan update.	North Castle/ Westchester	Kensico	DEP reviewed and commented on the DGEIS and FGEIS as an interested agency. Lead Agency issued findings to approve in December.
Patterson Crossing Retail Center	Proposal to construct ~439,000 s.f. of retail space and 2,097 parking spaces on a ~90 acre parcel.	Patterson/ Putnam	East Branch	DEP reviewed and commented on the DEIS. Town review on-going.
Putnam Community Foundation	Construction of 60 apartment units and 60 townhouse units, community center, tennis courts, and multi sport courts.	Carmel/ Putnam	Croton Falls	DEP reviewed and commented on initial site plans and scoping documents. Lead Agency issued final scope in December. Applicant to prepare DEIS.
Salem Hunt	Proposal to construct 75 condominium units in 15 buildings, a community building, pool, and associated parking.	North Salem/ Westchester	Muscoot	DEP reviewed and commented on initial site plans, EAF, and scoping documents. Final scope adopted by Lead Agency in June. Applicant to prepare DEIS.
Somers Realty Planned Hamlet Development	Mixed use development including 154 residential units, congregate care living space, professional office space, medical offices, retail/ restaurant space; and a public park.	Somers/ Westchester	Amawalk	DEP received the final scope from Lead Agency. DEP reviewed and commented on preliminary plans and scoping documents in previous reporting periods. Applicant to prepare DEIS.

Table 6.8. 2006 SEQRA activity and status for Type I actions.

Project	Description	Town/County	Reservoir Basin	Project Status
Stateline Retail Center	Retail development including ~180,000 sq ft of retail space and 900+ parking spaces.	Southeast/ Putnam	East Branch	DEP reviewed and commented on initial plans, EAF, and scoping documents. Final scope was completed by Lead Agency in September. Applicant to prepare DEIS.

7. Catskill/Delaware Filtration/UV Disinfection Facilities

Since 1993, the City has maintained a dual track approach for meeting the goals of the Surface Water Treatment Rules of the federal Safe Drinking Water Act. Accordingly, preliminary designs were prepared for an Ozone/Direct Filtration facility that could treat water from the Catskill and Delaware Supplies in the event that filtration is someday deemed necessary. Based on the continued high quality of the City's drinking water and the success of an extensive Filtration Avoidance Program, the City has been relieved of the need to advance the drawings and specifications to the final design stage. To ensure that these designs do not become stale, design updates are completed biennially. The most recent update was completed in September 2005.

In late 1997, the treatment objective for the Catskill/Delaware supplies switched from Filtration to Ultraviolet Light (UV) Disinfection. By designing and constructing an UV Disinfection facility to meet or exceed the goals of the Long Term II Enhanced Surface Water Treatment Rule (which calls for a second method of disinfection for the unfiltered supplies) the City will be better equipped to maintain Filtration Avoidance.

7.1 Ultraviolet Disinfection Facilities

Prior to 2006, the City completed full-scale bioassay validation of UV equipment from two vendors and developed facility designs based on the selection of Trojan Technologies Low Pressure High Output equipment. In an effort to expedite completion of the project, DEP developed a two-phase (Site Preparation & Facility Construction) construction process.

Though DEP had previously selected Granite Halmar Construction as the contractor for the site preparation contract, prolonged delays in acquiring a Section 404 “Protection of Waters” permit from the US Army Corps of Engineers (ACOE) resulted in the withdrawal of Granite Halmar’s bid in December 2005. In January 2006, DEP decided to negotiate a contract with the second lowest bidder, Ecco III Enterprises, for the site preparation work.

7.1.1 Site Preparation

The new contractor was awarded the contract in February 2006. Discussions and negotiations led the execution of a contract agreement with Ecco III. A Notice to Proceed for the site preparation contract was given to Ecco III Enterprises in mid-June and followed by a pre-construction meeting on June 16, 2006.

Equipment and installation details for the security systems for both the Eastview and Kensico sites were presented to the contractor. The installation of site perimeter security features and a multi-lane security entrance were among the highest priority tasks at the start of the site preparation activities. Other tasks include installing stormwater control measures; clearing the site; and

installing an internal roadway to support the ultimate goal of excavating a substantial portion of the footprint for the proposed UV facility. By the close of the 2006 more than 200,000 cubic yards were excavated and stockpiled on site.

Detailed specifications relating to the remediation of the Catskill and Delaware aerators at Kensico and other necessary site modifications were transmitted to the contractor as a change order for the project. Efforts to begin draining the aerators at Kensico Reservoir have begun. Remediation of the aerators is expected to be complete by mid-2007.

7.1.2 Final Design

A letter was sent by DEP to NYSDOH (DOH) summarizing the validation results and indicating that the equipment from Trojan Technologies, the recommended UV system supplier (UVSS), met the design criteria in the validation testing conducted at the Northeast Regional UV Validation and Research Center located at the Johnstown/Gloversville Joint Wastewater Treatment Facility. This correspondence was followed by a package of design documents featuring this equipment. DOH endorsed these designs in February 2006.

A final report on the condition of existing Shaft 19 structures was prepared as a result of inspections last year. A report on the findings of the inspections at Delaware Shaft 19 was submitted for DEP review on May 26, 2006. Overall, the structure was found to be in good condition. The report recommended some structural and mechanical rehabilitation, which has been incorporated into the design documents for the UV facility, and also provided documentation of as-built dimensions and current condition of the substructure.

Following an unsuccessful attempt in October 2006 to operate the blow-off valve at Shaft 19 of the Delaware Aqueduct, DEP continues to investigate methods for modifying the connection between the uptake and downtake shafts in the Shaft 19 substructure.

A Minor Modification has been drafted to address significant project changes that have occurred since the publication of the Final Environmental Impact Statement in November 2004. This document will be released to interested parties for review and will not require a public hearing.

7.1.3 Facility Construction Contracts

To avoid a substantial delay between the opening of bids for the facility construction contract and the period when work could begin – in addition to the associated risks of having a bid go stale – the City postponed advertising the facility construction contracts from the FAD due date of March 31, 2006. DEP and their design consultants continued to develop and refine the project drawings and specifications as well as other bid related documents in anticipation of an early 2007 advertisement date. By the close of the year the contract documents were under review by the City's Law Department. This is the final step in the approval process prior to contract advertisement.

7.1.4 Permitting

Permit related activities for the project continued through 2006. DEP has been working with affected utilities and with regulatory and approval agencies including the town of Mount Pleasant, NYSDOT, NYSDEC, ACOE, Westchester County agencies, and others to obtain the permits necessary to complete construction of the UV facility.

DEP has continued to meet and exchange correspondence with NYSDOT concerning the plans to perform an open-cut crossing of Route 100-C for the purpose of installing treated water conduits, utility crossings, and an emergency access roadway. NYSDOT has issued an extension of time for the permit associated with the maintenance and protection of traffic that may be affected by the proposed transfer of soil from the Eastview project site to the aerators at Kensico Reservoir. In addition, NYSDOT has indicated that they are satisfied with the plans for the improvements to the Grasslands Road/Bradhurst Avenue Intersection that will facilitate the transfer of soil to Kensico.

The State Historic Preservation Office (SHPO) determined that the transfer of soil from the Eastview site to Kensico would result in impacts that would require DEP to secure clearance for this work. A Letter of Resolution (LOR) between DEP, SHPO and DOH was prepared regarding the proposed partial demolition, filling and landscaping of the Catskill and Delaware aerators. The LOR grants approval for this work provided that the work is undertaken in substantial compliance with plans that are on file for the project. DOH, the third of the three parties signed the LOR in April.

Surveys of the wetland mitigation areas in the towns of Greenburgh and North Castle were completed and used to develop designs for these areas in accordance with the Memorandum of Agreement (MOA) that was appended to the US Army Corps of Engineers Section 404 Permit. Designs for constructed wetlands that will mitigate the effects on the area's natural resources as a result of building the UV facility were submitted to ACOE on March 21, 2006.

Historical Perspectives, Inc.(HPI) performed the Phase III recovery of artifacts in the areas on the Eastview site which were the subject of the MOA. The investigation of these areas commenced in July 2006 and included hand excavation and mechanical land stripping. The investigation was completed in October 2006. Following the completion of the final recovery effort at the Eastview project site, DEP submitted an End of Field (EOF) letter to SHPO on October 27, 2006. SHPO subsequently approved the EOF letter which satisfied another requirement of the MOA. Once the laboratory analyses of the recovered material is completed, HPI will prepare a final report presenting the research results, including figures illustrating the distribution of material and material types across the two study areas, discussions of the research goals and conclusions of the cumulative fieldwork.

The Phase 1B archaeological field testing program at the off-site wetland mitigation area in North Castle was completed by the Public Archeology Facility on October 2006. The completion of the Phase 1B archaeological field testing program demonstrates compliance with another condition of the MOA associated with the Section 404 permit, which required completion of field investigations by November 2006.

In addition to the aforementioned archeological and wetland work, DEP and their design consultants began preparing a draft of the State Facility Registration application for the boilers and the emergency and life safety generators and the related Westchester County Department of Health application for the approval to construct an air emissions source. A submittal for town of Mount Pleasant Architectural Review Board will be prepared to reflect the New York City Art Commission findings and current landscaping plans for the project site.

DEP continues to develop an appropriate legal agreement with Westchester County to enable a temporary connection to the Westchester County Water District No. 3 distribution system. In the interim, Westchester County has issued a permit for a well to be drilled on the project site to supply water to the project trailers during construction. The county also approved the use of a holding tank for sanitary wastewater on site during the construction period.

Though all of the stated permit requirements have been met since early 2006, DEP continues to work with the town of Greenburgh to attain the permits necessary.

7.1.5 Pilot Studies (UV Lamp Fouling Study)

At the turn of the year, construction of the UV pilot facility was nearly completed. Flow testing of the piping network and the installation of the UV lamps occurred in early January. Once the lamps underwent a 100-hour burn in period, and minor weatherproofing and electronic improvements were complete, test runs of the data collection equipment were performed. The pilot suffered minor delays related to the installation of new data logging and level sensor equipment as well as an in-line strainer on the influent line. Influent piping was also modified to ensure adequate mixing of the sodium hypochlorite in the lines that feature upstream chlorination. By May 2006, operation of the equipment had commenced. The first test runs ran through September and were followed by a second test run that will continue through February 2007.

Testing of the UV pilot units continue with weekly sleeve evaluations. Differing results in the data between the first two evaluation periods were reviewed. A plan has been developed for future test runs, including a short run to help determine if repeatability can be achieved for one of the two initial runs and an evaluation with increased chlorine detention times. Opportunities for maintaining proper quality assurance for future runs are in the process of being implemented.

7.1.6 Project Schedule

In late 2005, EPA issued a public notice citing draft modifications to the FAD which included a revised schedule of deliverables for the project. Due to the uncertainty surrounding the timing for the start of work for the site preparation activities and the subsequent effects on the overall project schedule, DEP indicated that additional schedule modifications would be necessary once site preparation contract construction was underway.

Due to recent increases and construction costs, DEP has become concerned with the possibility of securing competitive bids on a project of this magnitude and duration. In recent years there has been a drastic increase of construction projects in the tri-state area, affecting material prices and the availability of labor. Accordingly, it has become an increasing concern to DEP that few contractors would be able to meet the bonding requirements for such a large and long term project. To address these concerns, an alternate contracting scenario, featuring multiple smaller structures and equipment contracts was evaluated. Such a scenario was thought to widen the pool of potential bidders, increase the likelihood of receiving multiple competitive bids for the facility construction effort and avoid the need to rebid the project.

In conjunction with this exercise, DEP completed a risk analysis for the construction of the UV facility. Through this exercise, participants identified factors that had the potential to adversely affect the project cost and schedule. Working with consultants, DEP established a distribution analysis addressing the probability of meeting specific construction milestones and developed mitigation strategies to reduce delays for the remainder of the project. Highlights of this analysis were shared with EPA and DOH during a FAD negotiation session in late 2006.

Due to the likely additional impacts to the project schedule and budget, DEP determined that a traditional contracting program would be more appropriate than developing several smaller structures and equipment contracts for this project. As 2006 came to a close, the need for schedule revisions and the nature of the modifications remained under discussion. Revisions to the remaining project deliverables and related due dates will be incorporated into an Administrative Consent Order. This change will be reflected in the next FAD.

7.2 Filtration Planning Design Update

The most recent filtration design update was completed in September 2005. That update presented changes to the facility site plan which were primarily related to the elevations within the process train and related building enclosures. These changes were developed based on hydraulic assessments that provided for the potential presence of a Cat/Del water filtration facility on the site at some point in the future. The site plan was modified to account for planned construction of a DEP police administration facility at the site and the decision to begin construction of a water treatment facility for the Croton supply at a location in the Bronx. Provisions were also made to

accommodate future connections to the Kensico City Tunnel as this site falls along one of the routes under consideration for that project. The next filtration design update will be submitted in September 2007.

8. In-City Programs

8.1 Waterborne Disease Risk Assessment Program

New York City's Waterborne Disease Risk Assessment Program (WDRAP) is a joint agency program involving the Department of Health and Mental Hygiene (DOHMH) and DEP. WDRAP was initiated in 1993 and has been modified over the years to incorporate new elements and address new priorities. The program was initiated to address these key goals:

- obtain data on the rates of giardiasis and cryptosporidiosis, along with demographic and risk factor information on case-patients;
- provide a system to track diarrheal illness to assure rapid detection of any outbreaks; and
- determine the contribution (if any) of tap water consumption to gastrointestinal disease.

In 2006, active surveillance for giardsis and cryptosporidiosis continued as in prior years. Forty-seven clinical laboratories located in New York City currently performing parasitology examinations for *Giardia lamblia* and *Cryptosporidium*, as well as seven laboratories in the NYC vicinity are contracted on a regular basis to solicit case reports on all positive specimens. For all cryptosporidiosis cases, and as needed for giardiasis cases, public health epidemiologists contact patients to verify the data collected on the case report, to collect additional demographic and clinical information, and to identify possible sources of exposure. At the time of this writing, the 2006 *preliminary* count of cases reported to DOHMH among NYC residents is 912 cases of giardiasis, and 149 cases of cryptosporidiosis. While the sources for exposure for NYC cases is unknown, national and international data indicates that exposure sources for these infections include: foreign travel, person-to-person contact, contact with animals, certain sexual practices, contaminated food or water, and recreational water contact.

With regard to outbreak detection systems, New York City currently has four types of systems in operation, each one tracking a different indicator of gastrointestinal illness (GI) in the community. These systems are not specific to giardiasis or cryptosporidiosis nor are they specific for waterborne illness. One system involves the tracking of chief complaints from hospital emergency department logs; under another system DOHMH monitors and assists in the investigation of GI outbreaks in sentinel nursing homes; and a third system tracks the number of stool specimens submitted to clinical laboratories for microbiological testing. The fourth type of outbreak detection system includes monitoring of sales of anti-diarrheal medications (ADMs). The City's ADM monitoring activities include three components: one in which the weekly volume of sales of non-prescription ADMs at a major drug store chain are monitored; a second, involving another major drug store chain, in which daily sales of non-prescription medications are monitored; and a third in which DOHMH receives data from a national retail data source.

Additional results and program information can be found in the WDRAP semi-annual and annual reports.

8.2 Cross Connection Control Program

Enforcement efforts continued by DEP during 2006 and a formal unit was created within DEP's Bureau of Water and Sewer Operations to handle enforcement issues. Staff members of the enforcement unit consult with DEP's Bureau of Legal Affairs as well as property owners.

Complaints from property owners continued to be received in 2006 regarding the high cost of installing cross connection control containment devices. To help lessen the time-consuming and costly plan review process, DEP developed a self-certification program in September 2006. The concept was approved by the New York State Department of Health in October 2006. This self certification program, which began on January 1, 2007, is expected to result in cost reductions for property owners who are required to install cross connection control containment devices.

A decrease in complaints from property owners who felt that they were being "singled out" was seen in 2006. This decrease resulted from the work of the enforcement unit staff, which patiently explained to property owners the benefits to be derived from the installation of cross connection control containment devices.

At current staffing levels, it is expected that DEP's inspection of all "high hazard" premises will be complete by 2015 or 2016. Achievement of compliance can be expected approximately one year after inspections of "high hazard" premises have been completed.

9. Education and Outreach

9.1 WOPA Education Program

Through the Watershed Office of Public Affairs (WOPA), DEP takes a comprehensive approach to watershed education. DEP visits schools in New York City and watershed counties and offers students an educational, action-oriented, multi-disciplinary curriculum. DEP programs promote investigation, allowing students to analyze factors, past and present, human and nonhuman, which affect the entire watershed. DEP also organizes staff development for teachers, providing them with an opportunity to meet and work with DEP scientists, engineers, and environmental educators. DEP continues to design and implement watershed education programs, including symposiums for children, young people and teachers; watershed forestry institutes for educators; and programs related to specific water bodies. DEP also works to improve public awareness of water resources, water quality and watershed protection through exhibitions in museums, libraries and educational institutions in and near the watershed

In 2006, *Trout in the Classroom* continued to be one of the most effective and popular classroom programs. DEP environmental educators visited over 40 schools in both east and west of Hudson watersheds. This program teaches stewardship and science through the rearing of brown trout. Classes receive hatchery-bred eggs in the fall and students monitor the life cycle of the fish and water quality until the end of the school year when the fish are then released into an appropriate stream. Through the aquaculture of brown trout, students discover the connections between aquatic systems, life cycles, water quality and drinking water.

DEP's watershed education program includes participation in major events in the region, especially county fairs. DEP's education staff provides visitors of these events with valuable information; offers workshops and demonstrations; and explains the role of DEP as a cooperative partner with its upstate neighbors and environmental groups. A variety of materials are distributed to the public including booklets, pamphlets and fact sheets about the water supply system, drinking water quality, the Whole Farm Program, wetlands, land acquisition and conservation easements, as well as other related materials. During the summer months, thousands of watershed residents visit the DEP education display booth, where they are presented with materials that explain the agency and its programs. In 2006, DEP participated in more than 100 events throughout the watershed.

9.2 CWC Education Program

In January 2006, DEP conducted a presentation for the CWC Public Education Committee regarding the DEP's role in supporting watershed education programs. The presentation highlighted professional development training programs, providing speakers for watershed bus tours, conducting classroom visits, facilitating tree planting activities and other stewardship projects, and contributing staff assistance for upstate/downstate student learning projects.

In February, CWC received seven proposals submitted in response to a Request for Proposals to develop and produce a promotional video in support of CWC watershed programs. CWC contracted with Galene Studios in Treadwell, NY to film the video, with numerous location shoots taking place throughout the watershed during 2006.

In March, CWC's Public Education Advisory Group (PEAG) recommended 35 projects (out of 40 applicants) totaling $162,564 (out of $200,000 available) under Round 9 of CWC's Public Education Grants Program. Following CWC's approval of these projects, DEP issued formal approval in April. To date, CWC has awarded 223 public education grants totaling more than $1.1 million during the first nine grant rounds. A budget of $175,000 has been approved for the Round 10 grants to be awarded in early 2007. Of this amount, $150,000 is reserved for traditional grants and $25,000 is earmarked for special projects that do not meet traditional grant guidelines. At the request of PEAG, the CWC Public Education Committee voted in October to include a new project option called "Catskill Tales and Tunes" in future grant funding rounds.

Also during 2006, CWC collaborated with DEP and other watershed partners on two significant educational initiatives. First, CWC contributed to the development and publication of a new resource guide for landowners called *Catskill Streams and You: Living Streamside in the Catskill Region*. CWC paid for the printing of 10,000 copies in addition to issuing a press release promoting the guide. Second, CWC has been participating in a newly-formed regional partnership called the Watershed Environmental Education Alliance (WEEA). WEEA is an alliance of environmental facilities, organizations and agencies based in and around the New York City water supply watersheds who develop, support and implement school-based education programs. The mission of WEEA is to reinforce watershed education programs, enhance professional development opportunities for school teachers and environmental educators, and encourage partnerships that provide New York City and watershed students with inspirational environmental learning experiences. During 2006, WEEA conducted a comprehensive survey of more than 40 educational entities in the Catskill Mountains and Hudson Valley region, and the results of these surveys were used to compile a New York City Watershed Environmental Education Resource Directory for school teachers and other educators. With DEP support, this brand new resource directory will be published in time for the 2007-2008 school year.

In terms of public outreach, CWC participated in the following events during 2006: Mountain Culture Festival, Pakatakan Farmers Market, Watershed Forestry Institute for Teachers, Catskill Regional Teachers Conference, and a Trout in the Classroom teacher conference. CWC staff also conducted presentations for Bard College and Syracuse University graduate students, as well as several town boards.

9.3 Publications

The Bureau's publications program continued to produce materials in 2006 that describe, support, and explain watershed protection programs to the general public.

DEP's recreation program, which has opened much of the land newly-protected by the City through the Land Acquisition Program for public recreation, received multi-media support in 2006. For the fourth year, DEP Access Permit holders, totaling more than 105,000 by the end of 2006, received spring and fall editions of *Watershed Recreation*,

An eight-page newsletter produced to spotlight various activities and users of City-owned land as well as inform permit holders of special activities and information and rules DEP wants them to know. For example, in the fall issue, a summary of the first comprehensive recreation regulations covering the City's watershed properties appeared. Readers who wanted to have the entire 40-page set of rules had the option of contacting DEP for a printed version or downloading them from DEP's recreation Web site, www.nyc.gov/watershed, which includes updates on recreation activities and other timely information.

In 2006, DEP produced its annual Hunting Guide for Hunt Tag holders using designated City-owned lands. The format was simplified to 16 pages, and the 10,000-plus hunters used DEP's recreation Web site to download maps of specific hunting areas.

As part of the ongoing series of brochures about special watershed programs, new versions of the Land Acquisition, Conservation Easement and Stream Management brochures were produced in 2006.

9.4 Lawn Fertilizer Reduction

In 2006, DEP worked with Cornell Cooperative Extension offices in Westchester and Putnam Counties to complete a survey of residential fertilization practices in the east of Hudson watershed. The project was funded through a Safe Drinking Water Act grant obtained by DEP.

While previous studies have attempted to characterize residential pesticide applications (NYS Water Resources Institute, 2000), no comparable studies attempting to characterize fertilization practices were identified. As such, this study was undertaken to better understand these practices on private property in the east of Hudson watersheds. Specifically, the objectives of the study were to:

- Characterize existing residential lawn care practices in the east of Hudson watershed;
- Assess the potential for adverse water quality impacts due to over-application of lawn care products and the potential for improving lawn management practices to mitigate any adverse impacts to water quality; and
- Gauge residents' and landscaping professionals' knowledge of existing lawn care resources and interest in additional educational/outreach programs.

A total of 496 responses were received from individual residents (~15% response rate). The results indicated that the majority of individual residents maintain their own lawn (74%) as opposed to contracting with a landscape professional. Approximately 60% of all residents indi-

cated that they apply fertilizer. A total of 27 responses were received from commercial landscaping firms. Twenty-two of the 27 respondents indicated that they fertilize their clients' lawn, with 75% indicating they test the soil prior to fertilizer application.

In short, it appears that fertilization is a wide-spread practice in the east of Hudson watershed. Landscaping professionals appear to rely more on soil test results in determining when to apply fertilizer when compared to individual residents, and as such, are less likely to apply fertilizer unnecessarily.

10. Miscellaneous Reporting Provisions

10.1 Water Conservation

Water demand in the City of New York had been increasing at a rate of more than 1% per year through the 1950s, 1960s, 1970s and early 1980s. Since the late 1960s the City's water consumption has been beyond the "dependable yield" of the reservoir system. Three drought warnings or emergencies occurred during the 1980s. At the same time, wastewater flows to the Wards Island, Newtown Creek, North River and Coney Island wastewater treatment plants either exceeded or approached permit levels. Avoiding the capital cost of expanding the water supply and wastewater treatment infrastructure and the costs incurred by droughts led New York City to develop a lower cost plan for providing water/sewer services.

The best proof of the success of these programs is the drop in New York City's water consumption. From an average of 1450 - 1500 million gallons per day (MGD) in 1990 - 1991, consumption has dropped continuously in the 1990s to under 1250 MGD since 1996, under 1200 MGD since 2001 and under 1150 MGD since 2002 with three out of the last four years under 1000 MGD, even through some of the hottest summers on record. Wastewater flows have been decreasing consistently every year since the early 1990s.

Highlights of DEP's ongoing water efficiency program include leak detection, water metering, a major toilet replacement program (1994-1997), locking hydrant caps, educational programs and other efforts. Events and advancements during 2006 include:

- DEP's program has addressed improved water efficiency in the distribution system and at the end use:.
- Each year DEP surveys approximately 4,000 miles (or 59% in FY06) of the distribution piping for leaks, repairing leaks which prevented the continued loss of 5.5 MGD in FY06. The entire city is on a three-year survey schedule while the drainage areas for the Wards Island, Newtown Creek and North River Wastewater Treatment Plants are on a nine-month schedule. This area of concentrated attention covers all of Manhattan, half of the Bronx and about one-quarter of Brooklyn. This leak detection survey program is in addition to repairs of leaks from customer complaints. Leaks discovered through complaint repairs totaled 39.36 MGD for FY06. The leak detection program has brought the distribution system leak rate to about 10-15% of what it was in the 1980s.
- Each year DEP replaces an average of 55-60 miles of old water mains, equal to 2-3% of the old cast iron mains in the system.
- DEP has substantially completed the largest water meter installation program in North America and is moving during the 2007-2010 period toward radio-based Automatic Meter Reading ("AMR") providing at least daily readings and eventually, monthly billing.
- The water/sewer system was financially internalized in the mid-1980s virtually ending cross subsidies with the City's general revenue budget and placing the cost of operating and main-

taining the system on users.

- DEP completed the world's largest toilet replacement program during 1994-1997 resulting in 70-90 MGD of savings through the replacement of 1.3 million toilets. The New York City Housing Authority further contributed approximately 100,000 replacements through their own effort. DEP intends to implement upgraded fixture replacement incentives during the period of 2008-2010 including toilets, urinals and some clothes washers. Other end-use programs are under consideration.
- DEP has upgraded its demand analysis and study capabilities with a new demand study in 2004-2005, addition of full-time staff dedicated to this function and beginning the integration of water use data into City-wide GIS functions.
- Since 1990 the group of water conservation programs implemented by DEP has resulted in a decrease in in-City water consumption and wastewater flow of approximately 23%, at a time when the City's population increased by approximately 7.9%. The three wastewater treatment plants that were exceeding dry weather flow limits in the 1980s are all operating well under their allowed flow rates.

Plans for Future Programs

The eventual need to temporarily close the Delaware Aqueduct to allow repair of the leak has led DEP to study a wide variety of possible demand reduction and supply diversification projects to prevent supply shortfalls during the period of the Delaware Aqueduct outage. New incentive programs to replace additional existing toilets, existing urinals and to provide an incentive to install higher-efficiency toilets and urinals in new construction are amongst the most cost-effective options studied. DEP plans to begin offering a voucher-based toilet replacement program to high-density apartment buildings by the end of 2007 or beginning of 2008 and expand the program citywide by 2009. Incentives aimed at clothes washers in apartment building laundry rooms and laundromats are also being planned.

Table 10.1. Currently planned fixture/appliance incentive programs (estimated) 2008-2011.

Project Description	Estimated Savings (MGD)	Estimated Cost ($000,000)	$M/MGD
Toilet Replacements (Phase I, 2008)	10	26	2.60
Toilet Replacements (Phase II, 2009-2010)	30	99	3.30
Clothes Washers	10	35	3.50
Cost-Sharing ICI Program	4.5	16	3.60
School-Public Building Replacements	5.5	16	2.88
Subtotal	60 MGD	157	2.62

Phase I of the toilet replacement program is fully funded and DEP is developing the specifications for an Administrative Project Management Contractor in early 2007. Funds for Phase II and the Clothes Washer effort should be added to the capital budget in January 2007. A program to replace old fixture in public schools and other public buildings is currently under discussion, as is a performance-based program to co-fund water saving projects in non-residential properties. By comparison to the under $3 million per MGD cost of the efficiency programs, the lowest capital cost for supply projects is approximately $10 million per MGD.

Public Buildings (NYCHA)

As part of the wastewater consent decrees, the New York City Housing Authority replaced 103,432 toilets in buildings located in the Newtown Creek, North River and Wards Island drainage areas during the 1990s through 2004 representing almost 99% of the fixtures in NYCHA buildings within the drainage area. NYCHA's periodic bathroom renovation projects throughout their system continue to add to their savings through the present day.

Public Buildings (Non-NYCHA)

DEP is in the early planning stages of a project for fixture replacements in City schools and other public buildings. DEP contracted with a water/energy engineering firm to perform detailed non-residential water audits of both private and public commercial-industrial buildings. Several New York City schools and hospitals were surveyed and data collected on the potential cost and savings of fixture replacements in these buildings. With cooperation from the Department of Education and School Construction Authority, DEP hopes to identify buildings which do not have water-saving fixtures and are not scheduled for capital upgrade projects in the next several years. These buildings would then be the subject of a fixture replacement program.

10.2 Updates to Drought Management Plan

In 2006, it was not necessary to invoke any of the components of the City's Drought Management Plan, as precipitation, runoff and storage levels all remained high.

The Drought Management Plan has three phases - Drought Watch, Drought Warning and Drought Emergency - that are invoked sequentially as conditions dictate. The Drought Emergency phase is further subdivided into four stages with increasingly severe mandated use restrictions. Guidelines have been established to identify when a Drought Watch, Warning or Emergency should be declared and when the appropriate responses should be implemented. These guidelines are based on factors such as prevalent hydrological and meteorological conditions, as well as certain operational considerations. In some cases, other circumstances may influence the timing of drought declarations.

- Drought Watch – Drought Watch is declared when there is less than a 50% probability that either of the two largest reservoir systems, the Delaware (Cannonsville, Neversink, Pepacton, and Rondout Reservoirs) or the Catskill (Ashokan, and Schoharie Reservoirs), will fill by

June 1 - the start of the water-year.

- Drought Warning – A Drought Warning is declared when there is less than a 33% probability that either the Catskill or Delaware Systems will fill by June 1.
- Drought Emergency – A Drought Emergency is declared when there is a reasonable probability that, without the implementation of stringent measures to reduce consumption, a protracted dry period would cause the City's reservoirs to be drained. This probability is estimated during dry periods in consultation with the New York State Drought Management Task Force and the New York State Disaster Preparedness Commission. The estimation is based on analyses of the historical record, the pattern of the dry period months, water quality, subsystem storage balances, delivery system status, system construction, maintenance operations, snow cover, precipitation patterns, use forecasts, and other factors. Because no two droughts have identical characteristics, no single probability profile can be identified in advance that would generally apply to the declaration of a drought emergency.

DEP continues to encourage consumers to conserve water and to observe the City's year-round water use restrictions, which remain in effect. These restrictions include prohibition on watering sidewalks and lawns between November 1 and March 31 and illegally opening fire hydrants.

10.3 Delaware Aqueduct Leak

Efforts to evaluate the condition of, and to develop unwatering and repair plans for, the Rondout-West Branch Tunnel (RWBT) have been ongoing in 2006 and involve the following components:

- Hydraulic Investigations of the Rondout-West Branch Tunnel (RWBT)
- Autonomous Underwater Vehicle (AUV) Inspection of the RWBT
- Remote Operated Vehicle (ROV) Inspection of the RWBT
- Tunnel and Shaft Rehabilitation Program

The following is a description of the activities on these projects during 2006:

Hydraulic Investigations of the RWBT

Investigations of the Rondout-West Branch Tunnel helped DEP assess the nature and degree of leakage stemming from the aqueduct. Various efforts to study the nature of the leak are described below.

- The Tunnel Monitoring Program was continued in 2006. The object of this program is to determine if tunnel conditions are changing. On a routine basis the DEP monitors tunnel flow rates, operational trends and the surface expressions to determine the quantity of the leak.

- The Tunnel Testing Program is also underway. During 2006, the DEP conducted two hydrostatic tests and three backflow tests. The hydrostatic test involves shutting down the tunnel and isolating it from the reservoirs at each end. The water level in the tunnel drops due to the

leakage. This is measured, and an accurate leakage rate is calculated. The backflow test involves shutting down the tunnel to allow water to flow backwards into the tunnel from West Branch Reservoir. Water flowing past the downstream flow meter to 'feed-the-leak' is measured as a negative number, and is interpreted as the net leakage.

- During 2006, the Tunnel and Shaft Rehabilitation Program construction contract design was completed, and the bidding process was initiated (bids were taken in February 2007). The design includes: (1) upgrades to the tunnel unwatering station at Shaft 6, at the Hudson River; (2) site improvements at Shaft 6; site improvements at other shafts to provide improved access to and ventilation of the tunnel; (3) procurement of 'long-lead' items, that would be required for a tunnel emergency (such as steel liner and special vehicles for use in the tunnel); (4) and installation of tunnel hydraulic grade line measurement equipment.

Autonomous Underwater Vehicle (AUV) Inspection of the RWBT

The AUV program allows for an independent robotic vehicle to completely photograph the interior surface of the RWBT in one inspection lasting 12 hours. A new contract with Woods Hole Oceanographic Institute (WHOI) to perform additional inspections of the RWBT was negotiated in 2006. The contracted work is expected to begin by July 2007.

These new inspections will be used to determine conditions in the tunnel and compare the findings to the AUV inspection in 2004.

Remote Operated Vehicle (ROV) Inspection of the RWBT

DEP is continuing its efforts to develop an ROV to inspect the RWBT. Unlike the AUV, the ROV will allow capture of real time tunnel data, and provide the ability to perform detailed, close-up investigations of suspect areas of which the AUV could not perform. The ROV inspections will be performed under four 10-day shutdowns.

Currently, DEP is working on assembling an ROV team for operations, design, and construction of the custom vehicle.

In 2006, the ROV program was used to perform a short-notice inspection of the Kensico-Hillview tunnel of the Delaware Aqueduct.

Water Supply Dependability Analysis

In 2006, DEP continued its evaluation of the dependability needs for the water supply system. The RWBT was identified as a critical element of the system needed to meet the annual average water demand for the City and portions of the upstate community.

The amount of additional water required during a tunnel repair has been evaluated by computer simulation using the OASIS model. The model uses 77 years of past data from the water supply system, and can be modified to reflect current system infrastructure and proposed infrastructure to calculate properties such as water shortfall throughout the system, watershed run-off from storms, and reservoir storage.

Initially, over 60 dependability projects were identified that, individually or in combination, could enable the system to meet demand during a planned or an emergency repair of the RWBT. Over the past year, this list of projects has been reduced to 39 projects by further analysis and peer review. In the coming year, these 39 projects will undergo further, more in-depth, screening and analysis to target the most promising 20 – 21 projects to carry forward. Although all of these remaining projects will not be needed to meet the shortfall calculated by the OASIS model, design will be initiated, and all projects will proceed until such time as sufficient supply to meet the shortfall can be assured by projects going forward to construction. Uncertainty in design, siting, permitting, and environmental impact may require some projects be dropped because of these issues.

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