New York City
Department of Environmental Protection

Filtration Avoidance Annual Report
For the period January 1 through December 31, 2007

March 2008

Prepared in accordance with the July 2007 Filtration Avoidance Determination

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1. Introduction

In 2007, New York City celebrated its sixteenth year of watershed protection. The City first applied for a 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 (DEP), has committed over $1.5 billion and countless staff hours to maintain the pristine quality of the source waters of the Catskill and Delaware watersheds. 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 of samples are collected throughout the watershed. 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 initiatives that are both protective (antidegradation) and remedial (specific actions taken to reduce pollution generated from identified sources).

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 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 December 2006 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 for the current Filtration Avoidance Determination, issued by EPA in July 2007.

Some noteworthy achievements in continuing DEP's commitment to preserving the quality of the New York City water supply in 2007 include:

- development of a strategy to solicit the assistance of land trusts to enhance land acquisition in the watershed
- completion of stream management plans for the East Branch Delaware, Esopus Creek, Schoharie Creek, and East Kill
- completion of several stream restorations
- update of the Wetlands Protection Strategy
- establishment of an initial framework to develop the Streamside Assistance Program
- development of strategy documents for managing City-owned lands and conservation easements

- establishment of a program framework for a residential septic repair program for the Kensico Reservoir watershed
- continuation of successful engagement and participation of watershed residents in various waste- and stormwater programs, land acquisition, and the Watershed Agricultural and Forestry Programs
- completion of expansion of the Nutrient Management Eutrophication Modeling System capabilities to the Neversink, Rondout, West Branch, Ashokan, and Schoharie Reservoirs
- completion of Phase III of the Catskill Turbidity Control Study
- continuation of extensive education and outreach efforts for most of the programs covered in this document.

In fiscal year 2007, DEP disbursed over $140,000,000 in support of Filtration Avoidance Programs.

2. Federal and State Objective Water Quality Compliance

During 2007, DEP continued its comprehensive water quality monitoring efforts. The City's sampling program is far more extensive than is required by federal or state law. Each year, the City collects tens of thousands of samples in the watershed and in the distribution system. In 2007, DEP collected a total of 49,647 samples and conducted a total of 612,098 analyses. Of these, 30,635 samples were collected and 426,872 analyses were completed within the City. Once again, the results are impressive. Of the 10,070 in-City compliance samples analyzed pursuant to the Total Coliform Rule in 2007, only 0.22% were total coliform positive, of which two samples were also *E. coli* positive. All resamples were negative for total coliform. Since November 1994, DEP has collected more than 141,595 compliance samples and only 14 of those samples have tested positive for *E. coli*.

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

Surface Water Treatment Rule monitoring includes raw water monitoring for fecal coliform concentrations, turbidity, and disinfection/contact time (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. In 2007, all monitoring samples complied with thresholds defined by the SWTR.

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 $100ml^{-1}$ in at least 90% of the samples collected during the year, for six-month running percentages. In fact, the running percentage of samples for the Catskill System never fell below 98.34%, and in the Delaware System the running percentage was 100%.

As shown in Figures 2.1 and 2.2, in 2007 the six month running percentages of positive raw water fecal coliform samples at both the Catskill and Delaware Aqueducts effluent from Kensico Reservoir were well below the maximum percentage of positive samples allowed under the Surface Water Treatment Rule. In fact, only one raw water fecal coliform sample with > 20 cfu/

100 mL was detected in the month of October for the Catskill System. In the Delaware System, there were no fecal coliform samples with > 20 cfu/100 mL, and the six month running average remained at 0.00% for the entire 2007 calendar year.

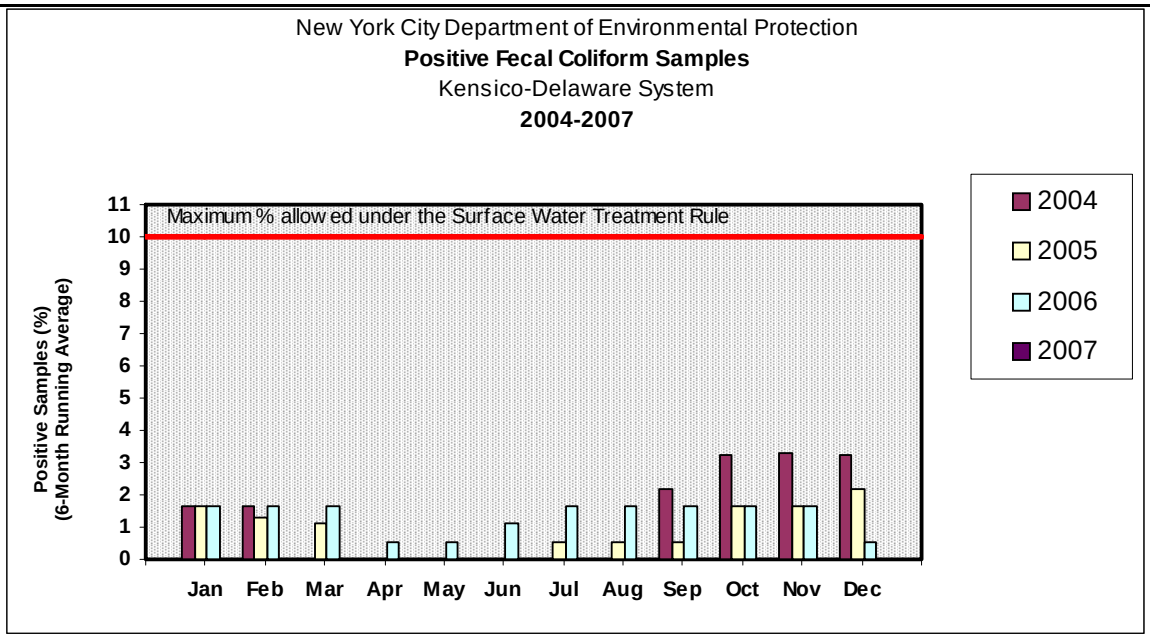

Figure 2.1. Positive fecal coliform samples, Kensico-Delaware System, 2004 - 2007.

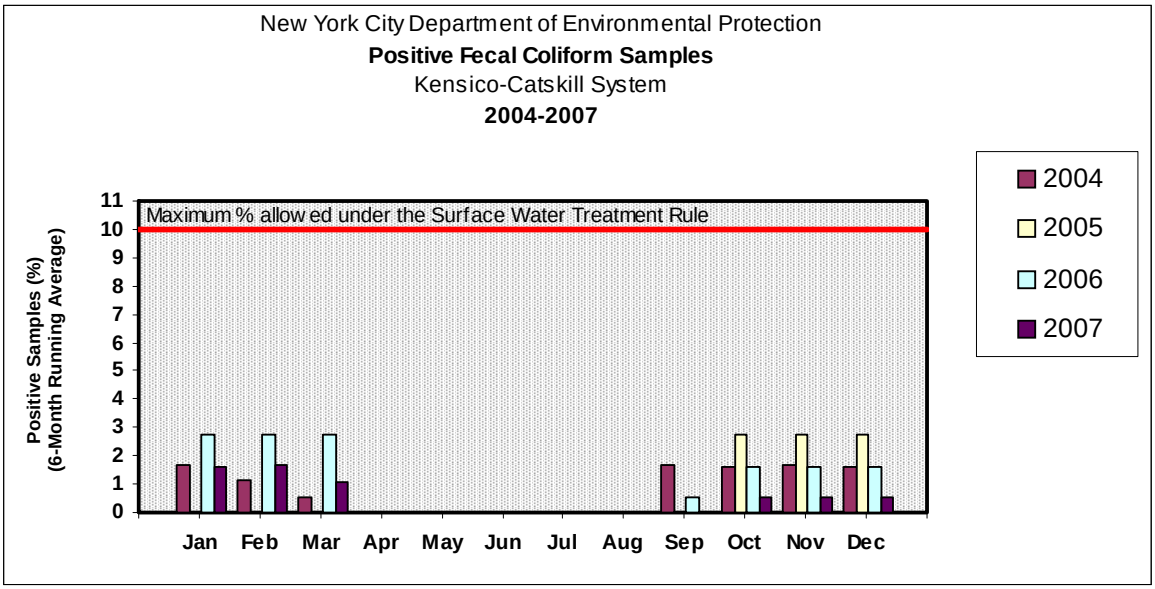

Figure 2.2. Positive fecal coliform samples, Kensico-Catskill System, 2004-2007.

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 for the entire 2007 calendar year.

On April 15, heavy rainfall (5.99" recorded at DEL18) led to turbidity alerts (turbidity > 1.5 NTU) in both the Catskill and Delaware Systems, and eventually to an emergency shutdown of the Catskill Aqueduct at approximately 3:30 pm. The aqueduct was re-started at approximately 5:00 pm on April 16. The rain of April 15 also created elevated turbidity levels in the Ashokan Reservoir. DEP responded by reducing the flow from the Ashokan Reservoir to the Kensico Reservoir. This event did not result in any monitoring violation or MCL violation for a turbidity reading exceeding 5 NTU.

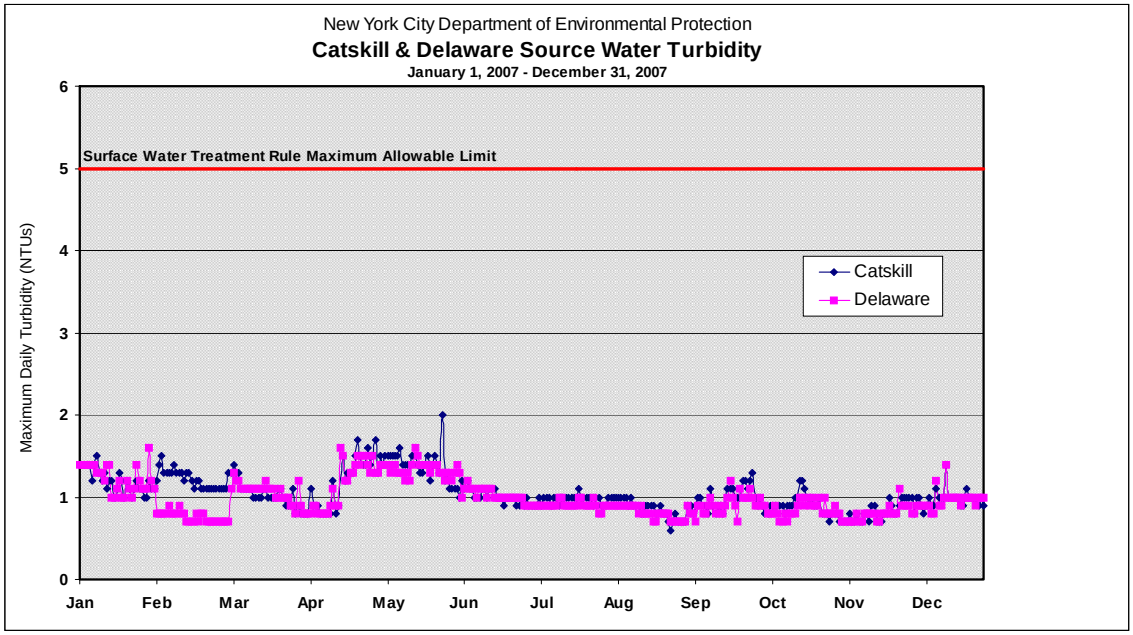

Figure 2.3. Catskill and Delaware source water turbidity, January 1, 2007 through December 31, 2007.

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 1.6 for the Catskill System and 1.2 for the Delaware System.

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^{-1} at all Catskill/Delaware entry points during the year. The lowest chlorine residual measured at an entry point was 0.30 mg L^{-1}.

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^{-1}, i.e., free chlorine residual concentrations were measurable/detectable during each sampling event.

Trihalomethane Monitoring (40 CFR Section 141.71(b)(6))
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 59 µg L^{-1} 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 62 µg L^{-1} in the Catskill/Delaware Distribution Area.

The highest TTHM quarterly running average during the year recorded during the first and second quarter was 40 µg L^{-1} for the Catskill/Delaware Distribution Area, a level below the regulated level of 80 µg L^{-1}. The highest HAA5 quarterly running average during the year recorded during the first, second, and third quarter, was 44 µg L^{-1} for the Catskill/Delaware Distribution Area, a level below the regulated level of 60 µg L^{-1}.

2.2 Total Coliform Monitoring

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 10,070. Of these compliance samples, 22 were total coliform positive, of which two were also *E. coli* positive. All resamples were negative for total coliform. The actual percentage of compliance samples that were total coliform positive was 0.22%.

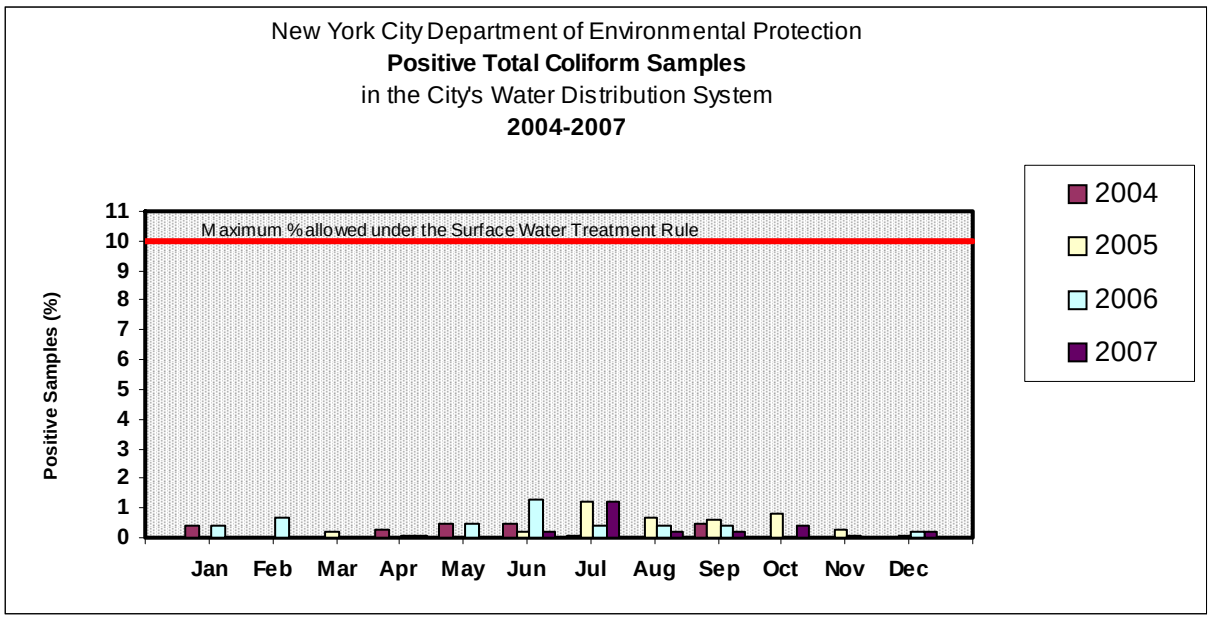

Figure 2.4. Positive total coliform samples, NYC Distribution System, 2004-2007.

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 10,070 compliance samples analyzed pursuant to the Total Coliform Rule.

3. Environmental Infrastructure

3.1 Septic Programs

3.1.1 Septic System Rehabilitation and Replacement Program

Since 1997, the City has committed $54.6 million in funding to rehabilitate, replace, and upgrade septic systems serving single or two-family homes in the West of Hudson Watershed.

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 is a geographically-based program which funds inspection and repair of septic systems for those residents and businesses whose septic system falls within a certain distance of reservoirs and watercourses in the Catskill and Delaware watersheds. 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 2007, CWC funded the repair or replacement of 234 failing septic systems under the Priority Area Program. A total of 742 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 2007, CWC funded the repair or replacement of eight failing septic systems under the Hardship Program. A total of 53 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: Aerobic Treatment Units (ATUs), sand filters with leach fields, peat filters with leach fields, raised systems, and conventional systems. CWC and Environmental Facilities Corporation continue to conduct field sampling at the sites. The data are being analyzed for a final report. A total of 38 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, 2007, are eligible for reimbursement.

Under the various sub-programs discussed above, CWC funded the repair or replacement of 272 septic systems in the West of Hudson Watershed in 2007. Since program inception, the number of failing septic systems repaired, replaced, or managed totals 2,616.

3.1.2 Septic Maintenance Program

The Septic Maintenance Program is funded for $1.5 million over 10 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.

CWC subsidized a total of 60 septic tank pump-outs in 2007**.** Since program inception a total of 295 septic tank pump-outs have been subsidized.

3.1.3 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 construction of a septic system where required solely by DEP or its delegate in order to comply with the Watershed Rules and Regulations.

No applications were processed under the Alternate Design Septic Program in 2007.

3.2 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.

The Roxbury pump station and force main from the Hamlet of Roxbury to the Grand Gorge WWTP is complete.

The Hunter WWTP and collection system have been constructed. During 2007, the sanitary sewer force main was extended to connect Dolan Lake Park. Lateral connections continued in 2007 and are approximately 90% complete.

The Windham WWTP and collection system are complete. Approximately 65% of lateral connections were complete by the end of 2007.

The Fleischmanns WWTP and collection system are complete. Approximately 80% of lateral connections were completed through 2007.

The Prattsville WWTP and collection system are complete. Approximately 30% of lateral connections were completed through 2007.

The Phoenicia WWTP and collection system completed designs and specifications were approved in 2006. Construction bids for the WWTP and collection system were subsequently awarded. However, on February 3, 2007, residents rejected the referendum on the proposed sewer district formation. DEP, in coordination with state and federal regulators, extended until June 30, 2008, the deadline for Shandaken/Phoenicia to establish a sewer district. This timeframe will allow the town to work with constituents to gain the support needed for the project. Funding for the project is being maintained by DEP.

3.3 Community Wastewater Management Program

The Community Wastewater Management Program (CWMP) provides funding for the design and construction of community septic systems, including related sewage collection systems, and/or the creation of septic maintenance districts, including septic system replacement, rehabilitation and upgrades, and operation and maintenance of the district.

As a requirement of the 2007 EPA Filtration Avoidance Determination, DEP agreed to provide an additional $37.2 million in funding to complete existing CWMP projects and fund three additional CWMP projects. This brings total program funding to $53.2 million.

CWMP projects have been completed in the hamlets of Bovina and DeLancey to date and are underway in the hamlets of Bloomville, Hamden, Boiceville, and Ashland. CWMP projects are slated for three additional communities.

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

The Septic Maintenance District project for the hamlet of DeLancey is complete. The new district will be responsible for scheduling regular inspections of the 59 septic systems located within the district and contracting for their repair as necessary. Out of an overall block grant of $2.2 million, approximately $630,000 was spent to set up the district, pump, and inspect all of the onsite systems, and replace the 16 systems found to be substandard. The balance of the block grant, $1,589,558, will be used to fund the continued operation and maintenance of the DeLancey Septic Maintenance District.

In the hamlet of 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 approved the 100% design plans for the sanitary collection, wastewater treatment facility, and stormwater systems on October 12, 2007. Construction bids were awarded on October 15, 2007. Construction will commence in spring 2008.

The recommended project for the hamlet of Boiceville is a centralized wastewater treatment system with large diameter gravity collection sewers. The approved service area has been expanded to include the Onteora School District and to provide service out to Bread Alone

(including DeSilva Road). DEP issued comments January 23, 2007 on the 65% design submittal on the sewage collection system plans. The Facility Plan Report issued in December 2007 proposes sequencing batch reactors (SBRs) as the secondary treatment process. Sixty-five percent WWTP drawings and specifications are being developed.

The recommended project for the hamlet of Hamden is a community septic system with shallow cut-and-fill beds preceded by a sand filter. Sewer District Formation was completed in 2006. One hundred percent design drawings and specifications were submitted in July 2007. The variance for the intermittent sand filter was issued by DEP on December 24, 2007. Construction is scheduled for 2008.

The Preliminary Engineer's Report for the hamlet of Ashland was issued in December 2007. The report recommends a sand filter WWTP as the best wastewater solution for the hamlet.

3.4 Sewer Extension Program

DEP continued to work with participating municipalities to advance the Memorandum of Agreement's (MOA's) Sewer Extension Program during the 2007 calendar year. The main successes of the past year included commencing construction on sewer extensions selected for funding in the Town of Neversink, moving forward with planning and design activities for a planned sewer extension in the Town of Shandaken near the Hamlet of Pine Hill, and taking preliminary steps for the planning and design of a new sewer extension being funded in the Town of Hunter.

The following summarizes the program's highlights for the past year for each of the participating communities.

Town of Roxbury (Planned Sewer Extension to the City's Grand Gorge Sewer System)

During the first half of 2007 DEP staff were involved with the bid process for selecting a contractor for the construction of a sewer extension west of the Hamlet of Grand Gorge along NYS Rte. 23. These activities included finalizing the bid documents, holding a Pre-Bid Meeting on March 6, awarding the bid on March 27, and conducting a background check of the low bidder.

It was found during the background check that the low bidder was not going to be able to comply with Local Law 77 requirements, which mandate that off-road vehicles used for the project utilize ultra low sulfur diesel fuel and that all equipment used on the project for more than 20 consecutive days be equipped with best available technology exhaust filters to reduce particulate emissions. The contractor was unwilling to comply with these standards, stipulated in NYC contracting rules, and announced on July 31 that it was withdrawing its bid.

As a consequence of the contractor withdrawing its bid, DEP staff compiled and prepared the necessary documents to re-bid the project as soon as possible. This work included coordinating with other DEP offices to ensure that any revisions to the project's plans and specifications would be included with the re-bid documents.

DEP anticipates that bids will be let on this project in January 2008 and that construction of the planned extension will commence in spring 2008.

Town of Neversink (Planned Extensions to the City's Grahamsville Sewer System)

There were two major events during the past year with respect to implementing the Program in Neversink. One important event was that on February 27 the Town Board awarded the bid to construct the extensions to the low bidder.

The other significant event was the commencement of construction of the planned extensions in June. As of the end of 2007 considerable progress had been made, including completion of the construction of a force main along NYS Rte. 55A between NYS Rte. 55, east of the Hamlet of Grahamsville, and Rocky Hill Road, where an extension is planned. Construction was also completed on two lengthy sewer mains that run along state highways. One of the extensions is along NYS Rte. 55 west of Grahamsville, which terminates at its intersection with Armstrong Drive, while the other extension is along NYS Rte. 42 from Grahamsville heading south to just beyond its intersection with Bob Walker Road.

It is currently anticipated that construction of all of the planned extensions will be completed by December 31, 2008.

Village of Margaretville & Town of Middletown (Planned Sewer Extensions to the City's Margaretville Sewer System)

The Village of Margaretville and Town of Middletown continued the implementation of the program in 2007. Most notably, both village and town, in consultation with DEP staff, adopted new sewer use laws during the past year. The village adopted a new sewer use law on December 3, while the town adopted a new sewer use law on December 11.

In addition to adopting new sewer use laws, the village and town have continued to pursue easements needed to construct new sewer mains in areas outside of public right-of-ways. Altogether, approximately 30 easements are needed in order to finalize the routing of the extensions planned along Bull Run Road, Harold Finch Road, and Academy Street. As of the end of the year only approximately half of the easements DEP needs had been obtained.

It should be noted that since the time DEP provided the village and town with sample easement documents in September 2005 to assist them with obtaining easements, they have made very little progress in providing DEP with the easements it requires to advance the program. As a consequence, DEP is currently reassessing whether to continue the program in these communities.

Due to the uncertainty involved with the time frame for obtaining the easements that would enable the design of the extensions to be completed, it is not possible to estimate when construction of the extensions is likely to commence.

Town of Shandaken (Planned Extension to the City's Pine Hill Sewer System)

There were two important events in the Town of Shandaken that took place during this period to advance the program.

One of the significant events was that the town and DEP signed an agreement to commit to implementing the program. The agreement authorizes design and construction to proceed for a planned sewer extension along NYS Rte. 28, from a location adjacent to the NYC-owned Pine Hill Wastewater Treatment Plant south for approximately three-quarters of a mile, up to and including the Bedding Barn business property.

The other notable event that took place to advance the project was that DEP staff commenced planning and design activities for the extension. As of the end of the year the project plans were approximately 60% complete and SEQR compliance was nearing completion.

It is now expected that construction of the planned extension will commence in spring 2009 and be completed by December 31, 2009.

Town of Hunter (Planned Extension to the City's Tannersville Sewer System)

The 2007 FAD authorized the design and construction of a new sewer extension in the Town of Hunter, with funding from the MOA's Sewer Extension Program. The new extension, known as Showers Road, will be located north of the Village of Tannersville in Greene County along NYS Rte. 23C (Hill Street). The project will result in the addition of 30 properties/residences to the current sewer service area.

During the fall months initial steps were taken to commence the preliminary planning and design of the extension. DEP staff conducted windshield surveys of the site and met with the town supervisor to discuss the project. As requested by the supervisor, all efforts will be made to coordinate fully with the town—particularly with affected residents—on the status and progress of the project.

During this period, DEP staff also began coordinating with other offices involved in implementing the project to commence initial planning and design activities.

It is expected that preliminary planning and design activities will move forward in earnest beginning in February 2008. At this time, construction of the extension is anticipated to commence in spring 2010.

3.5 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. 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. The upgrades, the majority of which are complete, provide highly advanced treatment of WWTP 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 City's Watershed Rules and Regulations (WR&R). Treatment technologies covered 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 2007 efforts continued to focus on completing upgrades for WWTPs, as well as authorizing WWTP Start Up and Performance Testing (SPT), negotiating SPT budgets, negotiating O&M Agreements and processing O&M payments. By the end of 2007, 97% of the total West of Hudson (WOH) flow had achieved Functional Completion and begun operations and 2% was in the construction phase. Two projects represented the remaining 1% of the flow, one of which was finalizing design, while the other was awaiting the completion of the Boiceville Community Wastewater Project so that it could be connected to it.

By the end of 2007, the nine WWTPs in the Upgrade Program scheduled to connect to New Infrastructure Program (NIP) facilities all had been connected. 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 2007, the last three facilities had completed construction and connected to local NIP collection systems.

Notable progress was made in upgrading the nine WWTPs discharging into the Croton Falls-Cross River reservoir basins. One of these plants, representing 82% (1.1 MGD) of the Croton Falls-Cross River basin flow, was completed. Four others, accounting for 11% (0.15 MGD) of the flow, were in the construction phase. One WWTP, accounting for 4% (0.059 MGD) of the flow, was in the final stage of planning board approval before going out to construction bid. The remaining three WWTPs, representing 3% (0.03 MGD) of the flow, were in the design phase.

In 2007, approximately 35 disbursements were made to WOH WWTP owners, valued at $9.4 million. Of this amount, $6.60 million was disbursed for construction costs, $1.6 million was for engineering costs, and the balance was for miscellaneous charges that included legal and administration activities. An additional $1.05 million in disbursements were made to the nine WWTPs in the Croton Falls-Cross River basin.

By the end of 2007, DEP had committed more than $116 million to FAD-related projects. These include the 37 WOH facilities and the 9 EOH facilities in the Croton Falls and Cross River basins.

In addition, DEP had committed a total of $151 million to the 60 non-FAD projects in the East of Hudson watershed, disbursing $26.96 million in 2007 alone.

3.6 Stormwater Programs

3.6.1 Stormwater Cost-Sharing Programs

Costs of stormwater measures incurred as a result of complying with the Watershed Rules and Regulations are paid for by the Future Stormwater Controls Program to the extent they exceed costs sustained because of compliance with state and federal requirements. The program provides

funding 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.

Two separate programs have been developed to offset additional compliance costs incurred as a result of the implementation of the WR&R. 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 10 years, and is administered by the 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, which reimburses low income housing projects and single family home owners 100% and small businesses 50% for eligible costs.

The City, through the West of Hudson Future Stormwater Controls Program, has fulfilled its funding obligations to CWC by paying it the full $31.7 million. From this allotment, CWC has funded $2,630,233 for construction projects and $113,750 for maintenance projects, while $10,132,451 has been transferred to other eligible watershed protection programs and $18,823,564 plus interest income remains to be allocated. See listing below.

Table 3.1. 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	$2,000	50% by NYC
	Subsurface Infiltration	8/24/99	$3,562.98	50% by NYC
		4/29/00	$ 440.50	50% by NYC
		5/23/00	$5,176.07	50% by NYC
		6/27/00	$7,921.04	50% by NYC
		8/22/00		
Delaware National Bank of Delhi	New Margaretville Branch Office	12/17/98 1/26/99	$43,120.26	50% by NYC
	Water Quality Inlet			
	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			

Table 3.1. Future Stormwater Controls Projects. (Continued)

Applicant	Project	Approval Date	CWC Funding	Other Funding
Town of Halcott	Sand and Salt Storage Bldg. *Extended Dry Detention Basin* *Stabilized Channel*	11/23/99	$19,000	None
Hamden Garage and Tire	Garage Expansion–design only	4/24/99	$1,735	50% by NYC
Town of Hurley	Highway Storage Facility Sand and Salt Facility *Sedimentation Basin*	4/24/99 11/23/99	$24,610 $5,130	None None
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 *Water-Bars* *Flow-Levelers* *Stabilized Out-Fall* *Slope Stabilization*	4/24/99	$30,209.29	None
Stucki Embroidery Works, Inc.	Building Addition *Subsurface Infiltration*	7/27/99	$9,769.29	50% by NYC
Town of Windham	Soccer Field in C. D. Lane Park *Erosion Control and Sedimentation*	9/28/99	$4,815	None
Ulster County	Shandaken Sand & Salt Facility *Extended Dry Detention* *Stabilized Outlet*	11/23/99	$20,210	None
Verona Oil	Verona Service Station–Walton *Oil/Water Separation*/ *Subsurface Infiltration* Maintenance	2/22/00 2/22/05	$95,448 $20,000	None
Stamford Farmers Cooperative	New Building Construction *Subsurface Infiltration*	3/28/00	$3,970	50% by NYC

Table 3.1. Future Stormwater Controls Projects. (Continued)

Applicant	Project	Approval Date	CWC Funding	Other Funding
Town of Middletown	Highway Complex (New) *Erosion Control and Sedimentation* *Extended Dry Detention*	6/27/00	$77,280	None
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	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	50% by NYC
Village of Hunter	Dolan Park Project *Subsurface Infiltration* *Slope Stabilization*	11/27/01	$33,898	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	New Building Construction *Sedimentation/Detention*	3/25/03	$254,691	None

Table 3.1. Future Stormwater Controls Projects. (Continued)

Applicant	Project	Approval Date	CWC Funding	Other Funding
Tri-Valley Central School	New Building Construction *Sedimentation/Constructed Wetland*	3/25/03	$6,890	None
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	None
Cannie D's	New Building Construction *Subsurface Detention/ Infiltration*	1/25/05	$29,772	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	New Building Construction *Sedimentation/Detention/ Infiltration*	4/26/05	$367	50% by NYC
Timber Lake Corporation	Camp Timber Lake	4/26/05 7/26/05	$12,026 $600	50% by NYC

Table 3.1. Future Stormwater Controls Projects. (Continued)

Applicant	Project	Approval Date	CWC Funding	Other Funding
Verona Oil	Verona Service Station–Windham *Oil/Water Separation* *Subsurface Infiltration* Maintenance	5/24/05 7/25/06	$145,000 $40,000	None
Frosty Land	Kaatskill Mountain Club Condos *Sedimentation/Detention/ Infiltration* Maintenance (Contract expires 9/07) Maintenance (Contract expires 12/09)	8/23/05 11/28/06	$287,025 $2,590 $10,000 $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 Separation* *Sand Filter*	2/28/06	$367,425	None
Community Wastewater Program Fund Transfer	Ashland, Bloomville, Boiceville, Bovina, Hamden, and Delancey	5/23/06	$1,500,000	None
Cannie D's	Maintenance (3 year contract)	8/22/06	$10,000	50% by NYC
Stewart's Shops	Maintenance (3 year contract)	8/22/06	$20,000	None
Community Wastewater Management Program Fund Transfer	Delancey	9/26/06	$557,452	None
Trailside at Hunter Mountain	Condo Development *Sedimentation* *Infiltration* *Constructed Wetlands*	9/26/06	$203,345	50% by NYC
Margaretville Lodging, LLC	Motel Development *Interceptor Piping* *Underground Detention* *Water Quality Ponds*	9/26/06	$45,142 (Revised)	50% by NYC

3.6.2 Stormwater Retrofit Program

The Stormwater Retrofit Program is administered jointly by CWC and DEP. The total program budget is $20,541,800—$15,048,050 for capital expenditures, $2,993,750 for maintenance activities, and $2,500,000 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. CWC 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 Grant Program

From 2002–2007, 58 construction grants totaling $10,644,579 were reviewed and approved for funding. Thirty-four projects have been completed utilizing $5,719,934 of program funds, focusing on street drainage, stormwater separation, stormwater treatment, and highway maintenance activities.

Table 3.2. Completed Capital Projects.

Applicant	Project Description	Grant Amount	Closing Date
Cannonsville Watershed			
Village of Hobart Various locations	Sewer Separation, I/I Reduction	$21,375	12/11/2000
Village of Walton Bruce Street	Collection, Conveyance, Filtration	$475,989	9/29/2003
Delaware County DPW Bovina Center	Collection, Conveyance, Sedimentation	$1,686,488	4/19/2006
Delaware County DPW	Truck-Mounted Vacuum Equipment (Vac-All & Accessories)	$171,423	5/07/2003 8/24/2004
Delaware County DPW	Programmable Ice Control	$8,483	5/08/2006
Village of Stamford Railroad Avenue	Sewer Separation, Collection, Conveyance, Sedimentation	$231,448	1/16/2004
Clark Co.	Collection, Conveyance, Sedimentation, Infiltration	$148,304	1/19/2005

Table 3.2. Completed Capital Projects. (Continued)

Applicant	Project Description	Grant Amount	Closing Date
Village of Delhi Orchard and Prospect Streets	Collection, Conveyance, Sedimentation	$37,005	Substantially Complete
Town of Walton Murphy Hill Road	Planning, Design	$29,900	Substantially Complete
Pepacton Watershed			
Margaretville Central School	Collection, Conveyance, Filtration	$128,070	11/03/2003
Roxbury Central School	Collection, Conveyance, Sedimentation	$34,149	3/14/2001
Village of Margaretville Academy Street	Sewer Separation, Collection, Conveyance, Sedimentation	$679,943	7/09/2007
Town of Halcott Elk Creek Road	Collection, Conveyance, Sedimentation	$47,034	5/08/2006
Town of Roxbury Ridge Street	Collection, Conveyance, Sedimentation	$26,122	2/21/2006
Village of Margaretville Park	Collection, Conveyance, Sedimentation, Infiltration	$6,878	8/19/2004
Town of Roxbury New Infrastructure Program	Conveyance, Erosion Control	$44,273	11/15/2004
Town of Andes County Route 2	Collection, Conveyance, Sedimentation	$584,000	Substantially Complete
Schoharie Watershed			
Town of Roxbury Johnson Hollow Road	Conveyance	$9,900	6/13/2000
GCSWCD	Critical Area Seeding Program/Hydroseeder	$58,243	10/16/2000
Town of Windham Mitchel Hollow Road	Collection, Conveyance, Sedimentation	$25,125	12/22/2003
Village of Tannersville Various locations	Sewer Separation, I/I Reduction	$107,161	12/06/2003
Town of Jewett Carr Road	Feasibility Study	$9,900	3/23/2005
Town of Windham Hickory Hill Road	Collection, Conveyance, Sedimentation	$87,671	4/06/2005

Table 3.2. Completed Capital Projects. (Continued)

Applicant	Project Description	Grant Amount	Closing Date
Windham Ventures Parking Lot	Collection, Conveyance, Sedimentation	$20,500	10/20/2004
Town of Roxbury Cronk Lane–Grand Gorge	Collection, Conveyance, Sedimentation	$36,575	9/26/2006
Hunter Mt. Parking Lot	Collection, Conveyance, Sedimentation	$63,367	10/14/2005
Town of Windham Municipal Parking Lot	Collection, Conveyance, Sedimentation	$25,834	8/09/2006
Town of Prattsville Stormwater Improvement Project	Collection, Conveyance, Sedimentation, Infiltration	$277,005	Substantially Complete
Town of Hunter Highway Garage	Collection, Conveyance, Sedimentation	$56,100	Substantially Complete
Greene County Highway Department	Street Sweeper	$180,000	Substantially Complete
Rondout Watershed			
Grahamsville Deli Parking Lot	Collection, Conveyance, Sedimentation	$5,625	9/26/2003
Town of Wawarsing Campbell Road	Collection, Conveyance, Sedimentation	$5,175	4/11/2006
Neversink Watershed			
Town of Denning Transfer Station	Collection, Conveyance, Sedimentation, Infiltration	$9,931	10/10/2002
Ashokan Watershed			
Town of Hurley Landfill and Transfer Station	Collection, Conveyance, Sedimentation, Infiltration	$105,938	Substantially Complete
Ulster County Highway Department	Vac Truck	$275,000	Substantially Complete

Planning and Assessment Grant Program

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. Through 2007, 15 planning and assessment projects were reviewed and approved, with a total funding allocation of $549,549. To date, five planning and assessment projects have been completed, for a total expenditure of $164,760.

Table 3.3. Completed Planning and Assessment Projects.

Applicant	Grant Amount	Closing Date
Ashokan Watershed		
Town of Hurley/Glenford	$4,000	9/19/2006
Ulster County Highways	$50,000	2/03/2006
Schoharie Watershed		
Village of Hunter	$42,260	7/09/2006
Southern Schoharie County*	$38,500	7/31/2006
Village of Tannersville	$30,000	6/28/2006
Town of Prattsville	$12,438	

*Partial

Table 3.4. Current Planning and Assessment Projects.

Applicant	Grant Amount	Funding Round
Town of Roxbury/Grand Gorge	$34,000	2003
Village of Fleischmanns	$39,040	2006
Town of Shandaken/Phoenicia	$44,600	2006
Ulster County Highways Sediment	$50,000	2006
Margaretville I&I Study	$72,655	2006
Village of Margaretville	$49,900	2006
Town/Hamlet of Roxbury	$30,345	2007
Town of Windham	$42,491.50	2007

4. Protection and Remediation Programs

4.1 Waterfowl Management Program

Pursuant to the July 2007 FAD, the Waterfowl Management Program will submit a separate annual report on July 31, 2008.

4.2 Land Acquisition

As of 1996 the City owned 35,509 acres of land surrounding reservoirs in the Catskill/Delaware (Cat/Del) watersheds; as of December 31, 2007 the City (including Watershed Agricultural Council farm easements) had protected an additional 83,096 acres, more than tripling land under City control to a total of 118,605 acres. In 1996 roughly 3.5% of the watershed was owned by the City; today, roughly 11.5% is City-controlled or owned.

The deliverable under the 1997 and 2002 Filtration Avoidance Determinations (FADs) requiring solicitation of 355,050 acres was met in 2004. The 2007 FAD required a solicitation plan, which in turn established benchmarks for 2007 of 30,000 acres of new solicitations (land previously unsolicited) and 56,500 acres of resolicitation. These goals were met and exceeded during 2007.

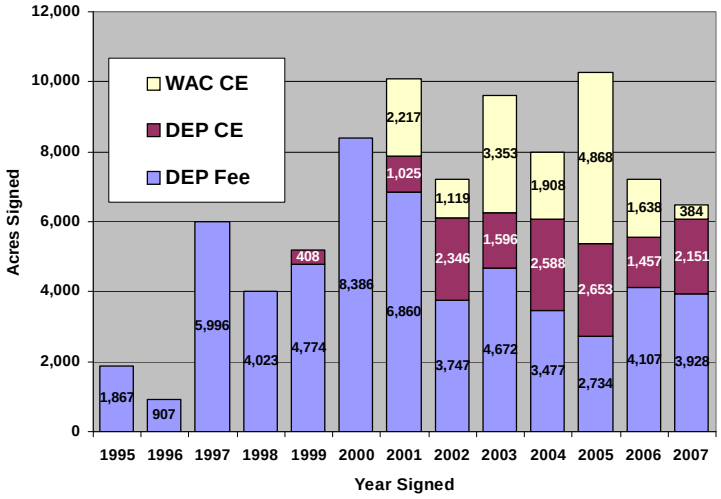

Figure 4.1. Contracts signed program-to-date by year and real estate type

By the end of calendar year 2007, DEP had secured a total of 924 purchase contracts (fee simple and conservation easements) comprising 67,797 acres throughout the Cat/Del watersheds, at a cost of $202.9 million (plus additional "soft" costs of roughly $19 million). Of these, 808 projects totaling 58,998 acres have been acquired ("closed"), with the remaining 116 projects still under purchase contract.

During the last 10 years, the City has increased its land holdings dramatically compared with pre-1997 ownership patterns. In Rondout, a high priority basin, the City increased the number of acres it controls by a factor of six. In West Branch/Boyd Corners, as well as in Schoharie, acreage under City control has increased by a fac-

tor of 12; in Ashokan, City-owned buffer lands have tripled. Overall, City-controlled land has been expanded threefold to 118,605 acres. During 2007, 80 projects comprising 5,365 acres were closed, and 84 projects accounting for 6,079 acres were signed to purchase contract by DEP

Table 4.1. Catskill/Delaware System contracts signed in 2007 by real estate type.

Real Estate Type	# of Parcels	Acres	Average Acres	Purchase Price
DEP Fee	67	3,928	59	$18,366,711
DEP CE	17	2,151	127	$6,671,472
WAC CE	1	384	384	$576,000
Total	85	6,464	76	$25,614,183

4.2.1 2007 Individual Program Summaries

Solicitation

When formal MOA/FAD solicitations ended in 2004, DEP submitted a resolicitation plan (in October 2003) which has provided an efficient mechanism to solicit interest within the pool of solicited landowners. This plan has been followed and goals have been met. An updated version for 2007 was submitted to EPA, DOH, and DEC outlining a solicitation goal of 86,500 acres (combined solicitation and resolicitation). This figure was exceeded by 19,012 (22%) as shown in Table 4.2. Experience indicates that re-soliciting properties determined to be highly ranked against others in the same basin and Priority Area continues to yield success.

Table 4.2. Acres solicited in 2007 by category.

Solicitation Category	2007 Goal	Acres Solicited
New Solicitation	30,000	36,614
Resolicitation—Previously No Response	20,000	21,361
Resolicitation—Previously Not Interested	12,000	19,160
Resolicitation—Previously Offer Refused	17,000	17,419
Resolicitation—New Owner	7,500	10,958
Total	86,500	105,512

Acquisition

In 2007, DEP signed 84 purchase contracts totaling 6,079 acres and closed 80 projects comprising 5,365 acres throughout the Cat/Del systems (Figure 4.2). Contracts totaling an additional 384 acres were signed by the Watershed Agricultural Council (WAC), yielding a total of 6,463 acres secured this year.

Table 4.3. Catskill/Delaware System contracts signed in 2007 by real estate type.

Real Estate Type	# of Parcels	Acres	Average Acres	Purchase Price
DEP Fee	67	3,928	59	$18,366,711
DEP CE	17	2,151	127	$6,671,472
WAC CE	1	384	384	$576,000
Total	85	6,463	76	$25,614,183

Riparian Buffers

Prior to 1997 the City controlled 1,490 acres of riparian buffers (100 feet from streams). Since 1997, the City has protected an additional 4,142 acres of buffers under fee simple acquisition and 1,196 acres under conservation easements, while WAC has protected 1,242 acres through farm easements. (A revision to WAC's Farm Conservation Easement (CE) program has expanded the protected riparian buffer strip from 15 feet to 25 feet from the streambank, which will add on-the-ground protection to intensively farmed properties. However, the additional acreage this represents is not reflected in the buffer numbers reported here.) Including lands owned by the City before 1997, the City protects 11.2% of 100-foot stream buffers, roughly equal to the percent of the watershed protected by the City. When other entities (DEC, land trusts, etc.) are included, a total of 22,420 acres of stream buffers are protected, or 29.4% of the 76,302 acres of buffers calculated to exist in the Cat/ Del System.

Wetlands

DEP calculates that 44,121 acres (4.2%) of the Cat/Del System are either deepwater habitat (2.76%) or wetlands (1.45%), as defined by DEC or the U.S. Army Corps of Engineers. Of these, the City has protected 2,132 acres since 1997 within newly-acquired lands or conservation easements, which represents 2.4% of wetlands and 0.2% of deepwater habitats.

DEP Conservation Easement (CE) Program

During 2007, 17 CEs totaling 2,151 acres were signed to purchase contract by DEP and 12 CEs totaling 1,944 acres were closed. This brings DEP's easement program in the Cat/Del watersheds to 95 easements totaling 13,837 acres closed or under contract, which represents 20% of the acres protected by DEP alone.

WAC Whole Farm Easements

As of the end of 2007, WAC held farm easements on 76 farms totaling 14,915 acres, with an executed contract on one 384-acre farm signed in 2007 (yet to close). The acquisition success rates and success of the overall program as of 2006 convinced DEP, in consultation with EPA, to favorably consider additional funding beyond the $27 million already dedicated. The $27 million consists of the first round of $20 million for farm CEs, derived from the original $250 million Land Acquisition Program fund (which included $10 million for CEs on agricultural land and $10 million for CEs on non-agricultural land) and $7 million approved and released during 2006 (derived from the $50 million Supplementary Fund which is referenced in MOA Section 74a). This $7 million has already been largely committed by WAC to new farm easement projects.) An additional $20 million was subsequently agreed to by EPA and DEP, and these funds formed the basis of a revised program contract that was approved for spending as of December 21, 2007 (also from the $50 million Supplementary Fund). Among other improvements, the revised program includes an expansion of the protected riparian buffer from 15 feet to 25 feet from the streambank.

WAC Forest Easement Program

The 2007 FAD mandates that DEP fund a $6 million program through which WAC will acquire easements on "forested portions of non-agricultural" property. The program contract is to be executed by April 30, 2008. Negotiations began in earnest in late 2007 and continue, with reporting on details of the program to begin later in 2008.

Table 4.4. Catskill/Delaware Program summary* through 12/31/07 by reservoir basin.

Basin	# of Parcels	Acres	Average Acres	Price
Ashokan	172	10,223	59	$27,964,042
Cannonsville	177	22,381	126	$29,762,814
Kensico	11	219	20	$17,156,781
Neversink	22	3,851	175	$4,339,914
Pepacton	172	16,874	98	$26,918,540
Rondout	109	6,384	59	$10,212,820
Schoharie	153	14,626	96	$29,464,673
West Branch	185	8,537	46	$74,356,608
Cross River**	1	91	91	$1,009,284
Total	1002	83,187	86	$221,185,477

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

** Cross River basin is part of the Croton Watershed but is can be operated as part of the Cat-Del as necessary.

Table 4.5. Catskill/Delaware Watershed Program summary* through 12/31/07 by priority area.

Priority Area	# of Parcels	Acres	Avg. Acres	Price
		System: Cat-Del		
1A	107	4,823	45	$31,758,650
1B	261	12,774	49	$76,761,306
2	142	9,385	66	$22,580,864
3	215	24,414	114	$34,078,743
4	276	31,700	115	$54,996,630
Total	1,001	83,096	83	$220,176,193

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

Water Supply Permit (WSP)

The current WSP remains active through January 20, 2012; the 2007 FAD requires DEP to apply to DEC for a new 10-year permit by January 21, 2010.

Transfer of Conservation Easements on Fee Acquisitions to NYS

The most recent package of eight CEs covering 110 newly-acquired DEP properties was sent to DEC in November 2006. One hundred fifty-six CEs were prepared during 2007, with submittals to DEC expected in 2008. Total submissions to DEC remain at 20 CEs covering 246 parcels comprising 16,464 acres.

4.2.2 Technical Program Improvements

During 2007 the City continued to improve and revise program documents and policies (subject to requirements of the MOA, FAD, WSP, and the City Code) to maximize program competitiveness:

- Three 2-hour brainstorming sessions were held in early 2007 to consider a range of possible program improvements. These meetings benefited by representation from several disciplines and divisions within DEP. A number of ideas were developed and are being pursued, as follows:
    - o Purchase Contract: DEP is seeking to provide greater incentives for landowners with respect to sharing of subdivision costs and required condition of the property at closing.
    - o Conservation Easement: a number of terms have been revised to make the program more appealing to a broader range of landowners, including refinement of the section which linked DEP's CE to the NYS Forest Tax Law (RPTL § 480(a)).

  - Land Trusts: the Land Trust Strategy was developed in accordance with the 2007 FAD and includes several ideas developed during the brainstorming sessions. The strategy, issued on November 15, 2007, continues to provide a blueprint for partnership efforts that will be further developed in 2008. These efforts will be described in detail in the February 26, 2008 deliverable as well as in successive FAD reports.
- Continued progress was were made with regard to technical support (Land Acquisition Tracking System and Watershed Land Information System). These systems offer tremendous productivity enhancement and efficiencies.

4.3 Land Management

Background

The 2007 FAD marks the first time DEP is required to submit an annual report on "all aspects of land management activities." While there were a small number of land management activities contained in previous FAD reports, the new requirement establishes a significant milestone in the long-term stewardship of City-owned land and conservation easements.

The 2007 FAD builds on the management approach for City lands and conservation easements outlined in the 2006 Long-Term Watershed Protection Report (DEP 2006a). This management approach, designed to provide effective and professional management, including filtration avoidance, had six major areas of concentration:

- Property management
- Natural resources
- Recreational use
- Land use permits
- Land acquisition assistance
- Conservation easements

The 2006 Report identified four goals for managing City land which became deliverables in the 2007 FAD and are addressed separately in this section. The goals were:

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

DEP staff and Directorate responsibilities

Currently, the majority of "on the ground" activities related to property management are carried out by the DEP Operations Directorate. Other activities and programs, such as forest improvement projects, recreation and access permits, fisheries, wetlands, policy development, conservation easement activity approvals, and project reviews are primarily carried out by the Natural Resources Management Section (NRM). In addition, other tasks and responsibilities, such as right of way formalizations and encroachment resolutions, are carried out cooperatively between Operations and NRM, utilizing the experience, knowledge, and field capabilities of both groups.

NRM staff are primarily located in the Kingston DEP facility, with some employees working in the Sutton Park (Valhalla) location. DEP Operations is comprised of 2 districts, the East of Hudson (EOH) District and the West of Hudson (WOH) District. The WOH District contains four field offices that are located throughout the West of Hudson Watershed near the City-owned water supply lands they steward. This enables regional Operations staff to gain a thorough knowledge of the City-owned lands, reduce travel times, and build relationships with the local community. Due to its smaller geographic size, the EOH Operations District contains only one field office.

While the DEP Operations Directorate is responsible for maintaining and upgrading the City's water supply infrastructure, there exists dedicated Operations staff that inspects City-owned land and conservation easements and addresses other property management issues in close coordination with NRM.

4.3.1 WaLIS

As outlined in the 2006 Long-Term Watershed Protection Program Report (DEP 2006a), DEP shall "bring the power of the City's GIS as decision-support to field level operations in a way that maximizes effectiveness of the City's lands for filtration avoidance."

The Watershed Land Information System (WaLIS) is a key component in tracking property management and easement stewardship-related activities such as the scheduling of tasks and staff assignments of property and easement inspections, tracking the chronology of activities, identifying the responsible staff members, and recording all relevant project information. The system has provided a clear increase in efficiency for DEP programs by freeing up supervisors and project managers from expending excess time reviewing files and preparing maps. Instead, they are able to spend more time in the field performing the work that advances DEP's goals for managing water supply lands. WaLIS also facilitates the sharing of information by a wide array of users in central and remote locations.

WaLIS is the first organized approach to understanding and tracking information about the City's water supply lands and water by managing information at various levels, including by parcel, forest stand, basin, land-use permit area, and project area, among others. WaLIS map prepara-

tion tools provide a way for DEP users of various skill levels to explore data and print quality maps, including maps showing aerial views of watershed lands and resources. WaLIS also enables users to review the data and the history of each particular area.

4.3.2 Conservation Easement Stewardship

As outlined in the 2006 Long-Term Watershed Protection Program Report, DEP shall "continue to monitor and enforce the growing portfolio of City watershed conservation easements to ensure long-term water quality benefits." In addition, DEP purchases conservation easements from landowners (see section 4.2 Land Acquisition for more information). With the purchase of easements comes a long-term stewardship obligation. DEP added 12 easement properties totaling 1,944 acres to its growing portfolio in 2007. The DEP Conservation Easement Stewardship Program strives to meet the FAD obligation. Details on how this is being accomplished are described below.

Baseline Documentation

Baseline documentation is collected for all DEP easements by DEP. This involves the collection of information (the baseline) on the property when the easement is acquired. This baseline identifies the condition of the property at the time the easement is placed on it and can be used to compare the condition of the property during subsequent annual inspections. Baseline documentation typically includes aerial photography, a map, and a survey of the property, photographs tied to GPS points of specific natural resources (e.g., streams, wetlands, steep slopes) and infrastructure (e.g., bridges, stream crossings, buildings), and areas where future activities or violations are likely to occur. The baseline documentation is then certified by the landowners to verify that the condition of the property is accurate. The certification is then filed with the County Clerk's Office as part of the easement agreement. Baseline reports are kept with a DEP stewardship file and placed in an archive file for that easement property.

Inspections

Two annual inspections of all DEP easements are required by the 1997 Memorandum of Agreement (MOA). In addition, all DEP easements are inspected twice annually as per the Monitoring and Enforcement of Watershed Conservation Easements policy (DEP 2002). This Policy provides guidance on the various types of inspections and what they entail, how to respond to violations, and property boundary management and maintenance. The number and acreage of easements by DEP is shown in Table 4.6.

Table 4.6. Number and associated acres of DEP easement properties by Operations field office.

Location	Number and acres of easements
East of Hudson	14/1,126
Shokan	24/4,701
Downsville	16/1,831

Table 4.6. Number and associated acres of DEP easement properties by Operations field office.

Location	Number and acres of easements
Grahamsville	10/1,721
Gilboa	13/1,943
Total	7/11,322

There are three types of inspections that occur on DEP easements: (1) a full on-the-ground inspection in which the entire property is inspected, (2) a focused inspection in which areas are inspected that may have a high likelihood of a violation or have an active project being conducted and, (3) an aerial inspection in which an aerial fly-over is conducted of the property. Each easement must receive a full inspection at least once per year, while the other inspection may be a focused or aerial inspection.

Activity Approvals

Many activities, such as forestry, bluestone mining, and agriculture, that are permitted by the DEP easement, require notice to and approval by DEP. The landowner must submit a proposal for the activity; DEP must review the proposal and render a decision on the request, either denying it or approving it with listed conditions. The easement outlines specific timeframes for DEP's review and decision. Over the last two years, DEP has begun writing easements to allow more activities "as of right" than in older easements. For example, newer easements allow agricultural activities on up to 10 acres without notice to and approval by DEP. In addition, DEP has expanded the acceptable activities on newer easements to allow livestock, tilling and planting of row crops, and the use of chemicals with notice to and approval by DEP.

Many landowners are beginning to seek activity approval before their easement closes, that is, while in the contract of sale phase (pre-closing). While the Land Acquisition Program real estate specialists try to defer this approval request until closing, some landowners want assurances that these activities will be allowed. A DEP activity approval is typically valid for three years. A breakdown of the types of activities approved on DEP easements in 2007 is shown in Table 4.7.

Table 4.7. Number and types of activities approved on DEP easements in 2007. Pre-closing approvals are those completed while in the contract of sale phase.

Activity (exceeding thresholds)	Number pre-closing reviews/ approvals	Number post-closing reviews/ approvals
Forestry	2	8
Pond building/maintenance	1	1
Agricultural	5	2
Livestock	1	1

Violations

Violations of the terms of the easements by landowners are a serious matter. All violations that occur on DEP easements are addressed as per the Monitoring and Enforcement of Watershed Conservation Easements policy (DEP 2002). Fortunately, the number of violations experienced thus far has been minimal. In 2007, only two violations were observed. One case involved a landowner adjacent to the DEP easement property who placed fill in a wetland. The easement property is owned by a municipality, which is utilizing its resources, including its building inspector, to resolve the issue. While the violation is still outstanding at the end of 2007, it should be resolved in 2008.

The second violation occurred when landowners did not follow the conditions outlined in a DEP-approved forest management plan and clear-cut approximately three-quarters of an acre. The landowners admitted to the violation and are working to resolve it. A DEP forester met with the landowners and their forester to develop a reforestation planting program. Trees are expected to be replanted in spring 2008.

Work continued in 2007 on an outstanding violation from 2006 that involves a landowner who constructed a riding arena on DEP easement property. The City brought suit against the landowner, who subsequently reached a court-approved settlement with the City. The settlement required the landowner to remove the arena and restore the site to its original condition; as of the end of 2007, the landowner had not removed the riding arena and was in contempt of court. It is expected this violation will be resolved in 2008.

Continued outreach and education is critical to reduce the instances of violations, whether intentional or by mistake. DEP utilizes each site visit and landowner contact as an opportunity to inform, answer questions, and provide easement interpretation assistance. In addition, NRM has developed a series of landowner guidelines to provide information and project planning tools for agriculture, forestry, bluestone mining, and stream and pond building.

Watershed Agricultural Council Farm Easements

As of the close of 2007, the Watershed Agricultural Council (WAC) had 75 farm easements totaling over 15,000 acres. DEP continues to provide an oversight role on WAC's farm easement stewardship activities. As WAC's farm easement portfolio continues to grow, its stewardship responsibilities increase as well. In 2007, DEP negotiated a new contract with WAC which allocated an additional $20 million to the Council for farm easement acquisition and stewardship. The new contract included three key requirements not present in the old one: (1) that WAC hire a dedicated stewardship person, (2) that a greater emphasis on stewardship practices, policies, and reporting be implemented, and (3) that an increase in the resource protection area from 15 feet to 25 feet be applied. This contract will be in effect until 2009.

4.3.3 Monitoring Water Supply Lands

Property Management

A consequence of acquiring tens of thousands of acres of water supply lands is the need for a comprehensive, long-term approach to properly manage these lands for water quality integrity. While it is often assumed that the control of activities harmful to water supply is best achieved via direct ownership of protected lands, this is only the case if these lands are well-managed. In 2007, DEP made significant progress in achieving the goals outlined in the Long-Term Watershed Protection Program.

In 2007, DEP signed 84 purchase contracts adding 6,079 acres to its growing portfolio of fee-ownership land. The total acres of land and water as well as a breakdown of acres of land and water within each Operations field office are shown in Table 4.8.

Table 4.8. Land and water acreage monitored by each Operations field office at the end of 2007. Pre-MOA land is reservoir buffer land owned before the 1997 MOA.

Location	Pre-MOA City-owned land (acres)	MOA City-owned land (acres)	Total land	Reservoirs/ lakes (acres)	Total land/ water
EOH	11,392	9,057	20,449	11,344	31,793
Shokan	5,240	7,575	12,815	8,100	20,915
Gilboa	1,021	10,046	11,067	1,134	12,201
Grahamsville	5,172	6,992	12,164	3,512	15,676
Downsville	21,233	15,856	37,089	9,795	46,884
Total	44,058	49,526	93,584	33,885	127,469

Below are details on how DEP is fulfilling its FAD property management obligations.

Annual Inspections

All City-owned lands are inspected as per the DEP Monitoring of City-owned Water Supply Policy (DEP 2004a). The policy not only outlines procedures for inspections but also addresses boundary maintenance, encroachments, hazards, and improvements. The types of property inspections are broken down into four categories, which include full inspections, focused inspections, site visits, and aerial inspections. Full inspections are the most comprehensive and include traversing all property boundary lines as well as the interior of the property.

Each property is assigned a priority based on the location of the property and various uses. “High priority properties” include those parcels in which recreation is allowed, where there is a history of encroachments, where there are active land use permits or other projects, and where

there are many adjacent landowners. These high priority properties must have a full inspection completed annually. “Medium” priority properties may have a portion of the property open for recreation and are in lower density areas but face some threat of trespass or encroachments. These properties are required to have full inspections completed every two years. “Low” priority properties are those properties in which there have been no trespass or encroachments observed, have little road frontage, or no public use. These properties must have full inspections completed every three years. DEP can change the priorities at any time depending on circumstances, such as the discovery of encroachments, or perform additional inspections as needed. The number of inspections completed in 2007 and associated acres inspected are shown in Table 4.9.

Table 4.9. Number and acreage of full inspections completed in 2007 by Operations field office.

Location	Number of inspections	Acres of full inspections
Shokan	208	24,320
Downsville	130	27,075
Grahamsville	123	13,569
Schoharie	128	7,228
EOH	216	13,927
Total	805	86,119

Another component of property management is the painting of property boundary lines. DEP invests significant funds to have all properties it acquires surveyed by professional surveyors who mark the property boundary lines with a “blaze” mark (i.e., a notch in a tree or “X” mark on a rock wall). DEP staff then paint these blaze marks so the blazes are not lost over time. This also helps to keep users of City-owned land aware of the location of the property lines. In addition, DEP posts all its property boundaries with signage as appropriate. This may include “no trespassing” or “entry by permit” signs depending on the allowed uses. For 2007, the miles of boundary line painted and posted, as well as site visits made to properties, is shown in Table 4.10.

Table 4.10. Miles painted and posted and site visits made in 2007 by Operations field office.

Location	Number of miles painted	Number of miles posted	Number of site visits
Shokan	56	84	2
Downsville	45	57	70
Grahamsville	49	14	99
Schoharie	47	19	276
EOH	5	4	2
Total	202	178	449

In 2007, NRM finalized work on a sign design manual which provides templates and guidance for signs to be used on City-owned land. This project was undertaken to (1) reduce sign clutter, (2) develop signs that clearly convey a message (whether in words or symbols), (3) provide consistency across the watershed for signage, (4) provide sign vendors specifications, and (5) provide DEP with a menu of possible sign design standards and language. Posting of the new signs is expected to begin in 2008.

Encroachments

Discovery and then addressing encroachments onto City-owned land is an important component of managing and protecting City-owned land. During property inspections, DEP looks for encroachments and, if any are found, all relevant information is then recorded in WaLIS. For simple encroachments such as mowing a small portion of City-owned land along the property boundary, DEP contacts the adjacent landowner and requests that the landowner immediately discontinue the activity. More serious violations that may have water quality impacts or involve structures on City-owned land are addressed at quarterly encroachment resolution meetings. These meetings provide a format to discuss strategies for resolving encroachments and identify a schedule and steps for resolution. Several DEP staff with varied expertise (e.g., legal, property management) are present at these meetings. NRM and Operations also work closely with DEP Police when criminal encroachments such as timber or ATV trespass occur.

In 2007, 38 encroachments were discovered and recorded and 29 were resolved. As the City purchases more land the number of encroachments will increase. However, diligent inspections of City-owned land and proactively attempting to resolve these encroachments will ensure that City-owned land is properly maintained for long-term water quality protection. If the property management activities described above are not conducted on a continuous and thorough annual basis, the City could find itself with significant and costly liabilities.

Neighbor contacts

While inspecting City-owned lands, DEP attempts to engage neighbors whenever possible. Many landowners adjacent to City-owned land are pleased to see that DEP is actively managing its properties and is a superior steward of its lands. Neighbors are valuable in alerting DEP if they observe unlawful activities including trespassing or the dumping of garbage. This contact also ensures neighbors have a clear understanding of where property boundaries are and reduces the chances of encroachments or other misunderstandings. DEP made over 400 face-to-face contacts with landowners adjacent to City-owned lands.

Pre-closing Inspections

Another level of managing City-owned land involves NRM assisting with the Land Acquisition Program in selection and project development for fee land and conservation easement acquisitions. Before the City purchases a property or conservation easement, NRM surveys the entire property, performs a phase one environmental site assessment, and reviews any title or deed issues, among other things, to make sure the City does not assume any liabilities.

DEP completes "pre-closing inspections" to ensure that any questions about encroachments or rights of way are resolved. In addition, the site is inspected for the presence of debris or structures and in cases where the seller is responsible for such removal, verification of removal is required. DEP invests time and much effort to resolving existing encroachment issues, questions of right of way, and removing debris and structures. The City purchases "clean" properties, which will help reduce future management obligations and problems. The number and acreage of pre-closing inspections completed in 2007 is shown in Table 4.11.

Table 4.11. Number and acreage of pre-closing inspections completed in 2007 by Operations field office.

Location	Number of pre-closing inspections	Acres of pre-closing inspections
Shokan	1	2
Downsville	19	2946
Grahamsville	7	295
Schoharie	1	6
EOH	8	626
Total	36	3875

4.3.4 Recreation

The undeveloped lands that DEP owns or is purchasing can provide tremendous recreational opportunities for outdoor enthusiasts. In fact, for many of the watershed communities, such activities represent a way of life that they want to see continued. DEP's water supply lands provide outstanding public recreation opportunities at 19 reservoirs and on water supply lands throughout the Catskill, Delaware, and East of Hudson watersheds. Some of the activities enjoyed by residents and tourists are deep water and in-stream fishing, ice fishing, boat fishing, hunting, hiking, cross-country skiing, and other similar low-impact activities. Areas open to the public have increased in recent years due to the purchases of additional source water protection lands. DEP's management priority is to ensure that there is adequate security to prevent unauthorized activities on these lands from adversely impacting the City's water supply. Thus, DEP is compelled to carefully evaluate potential recreational opportunities on each parcel. Ten new recreational areas totaling 1,479 acres were added in 2007, making a total of 79,296 acres open for recreational use on City-owned land and waters.

Access Permits and Hunt Tags

All recreational use on City-owned water supply land is conducted within the constraints set by the Rules and Regulations for the Recreational Use of New York City Water Supply Lands and Waters, which include the requirement that various permits and tags be obtained before using the water supply reservoirs and lands. This level of control helps maintain adequate protection of the resource through the threat of loss of privilege and also creates a mechanism by which DEP is able to communicate concerns and opportunities to the general public. Access permits must be obtained prior to entry onto most water supply lands; they may be obtained in person or on-line through DEP's website. Access permits are valid for five years. Hunting tags are also required during the hunting season. In 2007, DEP granted 13,267 access permits; a total of 125,257 valid access permits are currently in use by permit holders. Valid hunting tags issued for the 2007–2008 hunting season number 12,333 thus far.

Recreational users can serve as DEP's "eyes and ears" and many are willing to report any issues they see to DEP. DEP also believes positive outreach and contact is vital to fostering a spirit of good will. DEP made over 4,000 face-to-face contacts with recreational users on City-owned land in 2007.

Boat Management and Boat Tags

Fishing by boat is currently allowed on all City-owned reservoirs and lakes except those temporarily closed due to work on dams or because of over-stocking and natural resource degradation issues (e.g., erosion, vegetation impacts). DEP has 136 designated open boat areas on its reservoirs where boats are stored. Defined boat areas are established in an attempt to reduce impacts on natural resources along shoreline areas. Seventy-one boat areas, all located EOH, were closed at the end of 2007 to new boats because of the overstocking and resource degradation issues. DEP developed a boat area rapid assessment (BARA) matrix that determined a "carrying capacity" for each boat storage area by assessing each area based on a variety of natural resource and safety issues. For boat areas that exceeded this capacity, the boat area was closed. There were some reservoirs in which all boat storage areas exceeded capacity, as a result of which the reservoir was closed to new boats.

Boat tags are necessary for those wishing to keep a boat at one of the City-owned reservoirs. At the end of 2007, DEP had 11,070 valid boats (with valid boat tags) on its reservoirs. In 2007, DEP removed over 200 invalid boats from reservoir lands; this effort will continue on an annual basis. At the annual Father's Day Boat Auction in June 2007, 359 boats that were removed from the reservoirs were offered to the public through public auction. This increased to 2,777 the number of boats removed and subsequently auctioned off since 2003.

Before a boat is placed on City-owned land, it must be inspected and steam cleaned by DEP. This is done to ensure the removal of zebra mussel adults and larvae and thus reduce the chances of introducing zebra mussels into the reservoirs. The arrival of these mussels in the reser-

voirs could result in substantial costs for the City, as intake and other infrastructure can become clogged with the attached organisms. In 2007, DEP steam cleaned 1,028 boats. The number of boats steam cleaned and placed on City-owned reservoirs in 2007 is shown in Table 4.12.

Table 4.12. Number of boats steam cleaned and placed on City reservoirs in 2007.

Reservoir	Number of new boats placed
All EOH reservoirs	614
Rondout	84
Neversink	24
Cannonsville	50
Pepacton	106
Ashokan	119
Schoharie	31

4.3.5 Forestry

Forest improvement and restoration projects should be performed on certain forests on City-owned water supply lands for the following reasons:

- Ecological functions such as regeneration, protection of soil, filtration of water, and nutrient buffering are supported through ensuring a continuous, healthy, and vigorous forest cover over time;
- The City's forest stands are largely the same age, following abandonment of past agriculture and extractive forest practices. These forests are aging and, if left alone, will decline over wide geographic areas in the next 30 to 50 years;
- The DEP Rapid Forest Inventory conducted in 2003, assessing the overall condition of DEP forests, indicated that the majority of the forests range in age from 65 to 85 years old, with few acres in young growth. Young trees are necessary for the uptake of nutrients and to replace aging and dying trees.

On the whole, forest management projects are conducted on the aging forests on land holdings to protect public health, maintain ecosystem integrity, provide community benefits, and increase understanding of watershed functions. The NRM foresters undertake a variety of forest-related activities ranging from inventory of the condition of the tree stands to selective removal of trees for planned purposes. By the end of 2007, forestry projects had been conducted in 5 of the 19 basins in the watershed. Objectives of these projects included improving ecosystem functions,

assessing forest structure, thinning and regeneration, clearing of City-owned dikes, and salvage from natural events. A total of 153 acres were treated in 2007, resulting in the sale of 348,697 board feet of timber. Table 4.13 provides a breakdown of forestry projects in 2007.

Table 4.13. Forestry projects completed, in progress, and in the planning stage for 2007. Project area is the number assigned to the area in which trees were harvested. Board feet is the number of feet contained in the trees harvested.

Project Name	Basin	Project area (acres)	Board feet
PROJECTS COMPLETED			
Kensico salvage project	Kensico	50	63,325
Lindholm Road	Neversink	50	192,689
Murphy Hill #1	Pepacton	53	92,683
PROJECTS IN PROGRESS			
Pickerel point	Ashokan	165	535,447
Burns Cove	Ashokan	65	101,072
Rondout Borrow Pit	Rondout	40	77,375
Murphy Hill #2	Pepacton	70	229,799
VanSteenburg Cove	Ashokan	90	245,508
PROJECTS IN PLANNING PHASE			
Neversink Borrow Pit	Neversink	75	N/A
South Rondout	Rondout	60	N/A
Davis Bend	Ashokan	45	N/A

Forest Management Plan

DEP is in the process of developing a forest management plan. Work began on developing the plan in the latter half of 2007. NRM developed a draft table of contents for the plan based on input from members of various groups within DEP. In addition, the NRM Forestry Coordinator attended the Society of American Foresters national meeting to network and collect additional information about forest management planning. NRM forestry staff also reached out and collected forest management plans from other water supply entities such as the Quabbin and Wachussett systems in Massachusetts.

DEP began to assemble and develop the inventory requirements that will provide a framework for acquiring a baseline forest inventory. This comprehensive watershed-wide inventory is needed for the management plan and will give DEP a better understanding of forest resources on

its land. Coordination was begun with the United States Forest Service Enterprise Team to develop an inter-governmental contract to begin forest inventory work and other assessments in 2008.

4.3.6 Land Use Permits

DEP is responsible for the issuance of revocable land use permits for special uses of City-owned water supply lands in accordance with the Rules and Regulations for the Recreational Use of New York City Water Supply Lands and Waters. The majority of these permits are for utility lines and services, access and driveways, and recreational partnerships (e.g., snowmobile trails, parks). For low-impact activities of short duration, DEP also issues letters of permission, and these typically include scientific studies, sampling, and outreach events.

In 2007, DEP made progress on a comprehensive land use permit policy which will provide DEP with an organized and consistent method of reviewing and consenting to the use of City-owned land that is compatible with water quality protection. DEP has developed an integrated process for reviewing and issuing permits and letters of permission that involves the review of applications and site characteristics of proposed projects. DEP staff from various disciplines have a chance to review a project and submit special conditions to ensure it is carried out with no impact to water quality and does not interfere with other uses of City-owned land. In addition, DEP consults with the applicant to mitigate any potential impacts to City-owned land by projects that may interfere with DEP's use of the property or cause threats to the water supply. If after consultation it is determined that the threat to the water supply land cannot be mitigated or eliminated, DEP may deny the permit application.

At the end of 2007, active permits included 201 issued to municipalities, 712 to utilities, 175 to individuals, and 31 to commercial enterprises.

4.3.7 Agricultural Use

In an effort to promote the concept of working lands, DEP allows use of its land for limited agricultural activities. The program was initially set up to allow the harvesting of hay and tapping of sugar maple trees for maple sap. No chemicals or fertilizers were permitted for use on these early projects. In 2005, DEP revised its Agricultural Use of City-owned Water Supply Lands (DEP 2005a) to expand allowable agricultural activities on City-owned land. Farmers can now submit a proposal on how they would farm City-owned land while protecting water resources. Candidates are typically properties that were farmed up until the point they were sold to DEP. There are certain minimum requirements set by DEP for farming on City-owned land such as a minimum 25-foot buffer along all streams and wetlands, a prohibition on spreading raw manure during frozen or snow-covered conditions, and, if fertilizers are to be used, an approved nutrient management plan.

Most of the farmers using City-owned land are enrolled in the Watershed Agricultural Council's Whole Farm Plan Program. Plans developed under this program can be expanded to include City-owned land. For multiple proposals submitted by interested farmers on the same piece of land, the proposals are scored against each other, with those protecting water quality and using best management practices or low-impact farming (e.g., organic farming, wider buffers, no fertilizer use, no-till methods) receiving the highest scores. DEP currently has 15 crop and maple tapping projects in 10 different towns totaling over 400 acres. New agricultural projects for 2007 are shown in Table 4.14.

Table 4.14. Projects initiated in 2007 for the agricultural use of City land.

Project #	Type	Town	Acres
1670	Corn	Middletown	17
1671	Hay	Middletown	28
1680	Maple tapping	Yorktown	5

4.3.8 Invasive Species Control

The first year of a multi-year black swallow-wort (*Cynanchum louiseae*) eradication effort was completed on City-owned land in the Pepacton Reservoir basin in 2007. Black swallow-wort is a highly invasive vine that readily displaces native flora in fields, pastures, fence rows, shorelines, and roadsides. In an effort to minimize further spreading of this invasive vine, DEP modified its roadside mowing schedule. In addition, NRM established permanent plots to serve as pre- and post-treatment monitoring sites. Plot centers were staked and flagged, plot density was measured by two independent stem counts, and the surrounding vegetation type was recorded. Photographs were taken at each site to document site conditions. Herbicide treatment of the Pepacton site was then completed by a pesticide applicator contractor under the supervision of DEP. Garlon 4 (Triclopyr) was applied as a foliar spray to black swallow-wort in the forested upland area, and a foliar spray of Roundup Pro (glyphosate) was applied to plants in the riparian zone.

Over the course of 2007, DEP encountered two previously unknown occurrences of black swallow-wort in the West of Hudson watershed. The occurrences were mapped and reported to the Catskill Regional Invasive Species Partnership (CRISP), which is one of several voluntary regional partnerships that are forming across the state in response to the recommendations of the New York State Invasive Species Task Force.

Work began in 2007 to explore the feasibility of establishing a Bureau of Water Supply Invasive Species Working Group. To minimize the risk of invasive species-caused damage to the NYC water supply, DEP is considering adopting a proactive, agency-wide comprehensive plan to

identify, prioritize, and address invasive species threats before they become entrenched and intractable. For those invasive species that are currently present in the watershed, this plan could provide guidance for identification and prioritization, eradication and/or control to reduce or eliminate the threat of spreading as deemed necessary. The plan would be a science-based program designed to (1) prevent the introduction of invasives to water supply lands, reservoirs, and streams, by focusing on activities that carry a risk of introducing invasives;(2) support rapid response to priority emerging invasives; (3) control existing priority invasives; (4) rehabilitate and restore important invasive-impaired sites as resources allow; (5) proactively manage lands in a way that anticipates and provides for future threats; and (6) address a framework for outreach and education goals.

4.4 Watershed Agricultural Program

The Watershed Agricultural Program (WAP) began in 1992 as a comprehensive, voluntary partnership between New York City and watershed farmers to maintain and protect the existing high quality of the City's water supply through the development and implementation of Whole Farm Plans (WFPs) on 85% of commercial farms in the watershed. WFPs integrate pollution prevention goals into each farmer's business operation by recommending specific best management practices (BMPs) that control nonpoint sources of agricultural pollution without compromising the farm's economic viability.

Whenever possible, WAP implements traditional BMPs that are proven to protect source water quality, with a particular emphasis on waterborne pathogens, nutrients, and sediment. WAP also employs and evaluates innovative BMPs that increase the number of alternatives available to farmers to address priority pollution concerns. In this way, WAP provides the highest level of agricultural pollution control within a positive context of regulatory relief for watershed farmers.

WAP is administered locally by the Watershed Agricultural Council (WAC) using funds provided in large part by DEP. Over time, WAC and DEP have leveraged generous financial support from non-City sources to complement and enhance WAP, particularly from the United States Department of Agriculture (USDA), Environmental Protection Agency (EPA), and Army Corps of Engineers. Local, state, and federal agencies provide planning and engineering services, technical assistance, educational programs, and scientific and administrative support through WAC subcontracts, partnerships, and cooperative agreements.

This annual WAP report covers the following topics: progress in achieving FAD goals; status of the large farm, small farm, and East of Hudson programs (including new WFPs and the implementation of existing WFPs); status and summary of annual status reviews for large farms, small farms, and East of Hudson farms; WAC farm recruitment activities; progress in soliciting new acres in the Conservation Reserve Enhancement Program (CREP); implementation plans for the subsequent year (including numbers and types of BMPs to be implemented, estimated costs of

those BMPs, nutrient management plans to be created or revised, and WFP revisions to be completed); progress in the WAC Agricultural Easement Program; a summary of related research activities (City and non-City funds); and an evaluation of WAP based on certain criteria.

4.4.1 WAP Evaluation

The previous 2002 FAD required an evaluation of WAP every two years according to the following evaluation criteria: (1) farmer participation; (2) acceptance, implementation, and maintenance of WFPs by farmers; (3) reduction of phosphorus and parasite loading risk from farm to watercourse; (4) efficacy of whole farm planning and the implementation process; and (5) science of whole farm planning. In December 2005, DEP submitted a FAD report that reviewed and evaluated the WAP evaluation criteria in consultation with WAC's Advisory Committee. The report highlighted WAP's ongoing transition from an intensive planning and implementation program to a future effort focused on WFP maintenance, comprehensive farm management, and participant land stewardship activities. The report concluded that future WAP evaluation criteria should include new quantitative indicators that capture and assess the full extent of farm management activities and land stewardship accomplishments as documented by the annual WFP status review process and tracked by an improved WAC database system.

In January 2008, DEP submitted a WAP Five-Year Plan which reaffirmed that one of the most important tasks moving forward will be a thorough reassessment of the core metrics of program effectiveness, with a continued focus on developing and evaluating prioritization methodologies, appropriate levels of treatment, and standards of reasonableness for measuring a complex, ambitious, and constantly evolving program. Pursuant to the 2007 FAD, DEP plans to review the WAP evaluation criteria over the next two years in preparation for submitting a proposed new methodology for measuring and evaluating WAP in a report due December 31, 2010.

In the interim, WAP continues to be an effective pollution prevention partnership as measured by the current FAD goals and metrics reported below and especially by the continued high level of participation and support within the watershed farming community. It is also important to note that WAC initiated a multi-year database project in 2007 that will greatly support future WAP evaluations when fully implemented. The WAC database project is summarized in this report along with related research activities. Overall, DEP remains committed to meeting future FAD goals and milestones for WAP through the execution of a four-year WAC successor contract later in 2008 covering the Watershed Agricultural and Forestry Program.

4.4.2 FAD Goal Progress

The table below summarizes the accomplishments of WAP through 2007 (see also the corresponding maps which document specific activities (Figures 4.2–4.6)). As of this report, 293 large farms out of 306 known farms are signed up for WAP (these figures include 41 sub-farms),

representing a 95.7% participation rate for West of Hudson commercial farms. Since the original 85% sign-up goal has been met, WAP staff continue monitoring the status of these farms while pursuing the development of WFPs on the 13 known large farms currently not participating.

Table 4.15. Summary of WAP accomplishments as of December 31, 2007.

Task	Farms	Sub-Farms	Total Farms
Current number of known watershed large farms	265	41	306
Current number of eligible large farm sign-ups	252	41	293
Total WFP implementation agreements	247	41	288
Total WFPs substantially implemented	215	28	243
Active	112	14	126
Under Revision	44	12	56
Inactive	59	2	61
WFP annual status reviews conducted during 2007	216	30	246
Total WFP agreements on small farms	55	0	55
WFPs approved during 2007	8	0	8
Total WFP agreements on East of Hudson farms	38	0	38
WFPs approved during 2007	5	0	5

4.4.3 Large Farm Program (West of Hudson)

There are 288 farms (including 41 sub-farms) with WFP implementation agreements, representing 94% of all known commercial farms in the watershed and 98% of the participating large farms (see Figure 4.2). These figures include four large farms that signed up for the WAP during 2007 and are expected to have WFPs developed in 2008. In addition, one farmer in the Town of Andes has been unable to reach agreement on his WFP; WAC plans to visit this farm in early 2008 to seek a resolution.

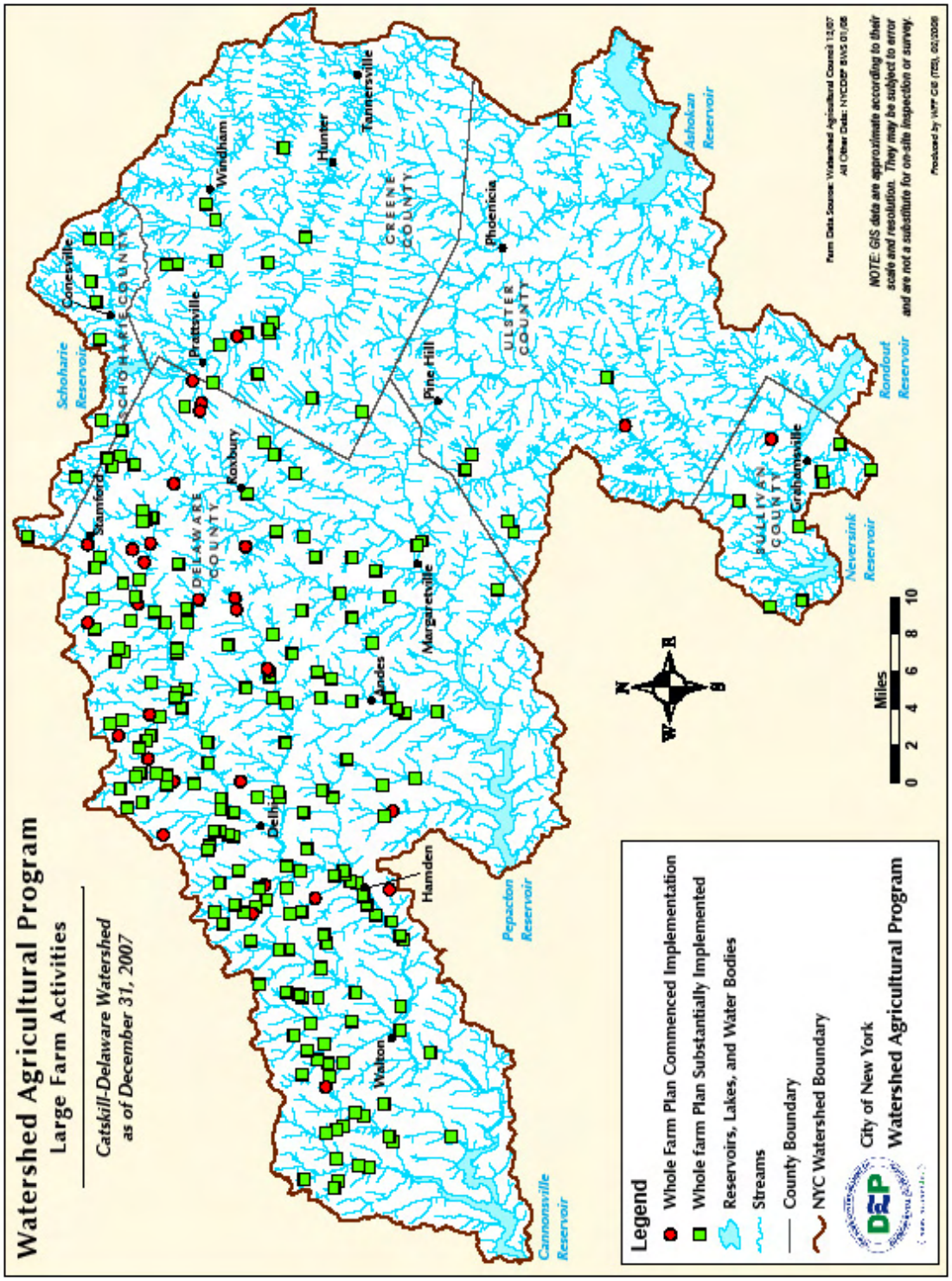

Figure 4.2. Watershed Agricultural Program, large farm activities, Catskill/Delaware Watershed as of December 31, 2007.

Farms Substantially Implemented. Through 2007, 243 WFPs have been substantially implemented, which represents 79.4% of the 306 known large farms in the watershed and 82.9% of the participating farms. The 2007 FAD requires that 90% of all active large farms in the West of Hudson Watershed meet the definition of substantially implemented by September 30, 2010. There are 27 high priority WFP revisions scheduled for 2008, of which DEP anticipates at least half will become substantially implemented through the WFP revision process.

During 2007, 28 WFP revisions were approved and 352 BMPs were installed on West of Hudson large farms at a cost of $1,791,404 (see Table 4.16).

Table 4.16. Implementation of BMPs on West of Hudson large farms during 2007.

BMP Code	Best Management Practice	No. of BMPs
312	Waste Management System	7
313	Waste Storage Facility—Roofed	1
314	Brush Management	1
328	Conservation Crop Rotation	4
329	Conservation Tillage	2
362	Diversion	2
382	Fencing	26
391	Riparian Forest Buffer	8
393	Filter Strip	8
412	Grassed Waterway	1
512	Pasture & Hayland Planting	1
516	Pipeline	4
528	Prescribed Grazing	6
558	Roof Runoff Management System	1
560	Access Road	9
561	Heavy Use Area Protection	10
574/614	Spring Development	17
575	Animal Trails & Walkway	17
580	Streambank Protection	3
590	Nutrient Management Plan	60
595	Pesticide Management	2
606	Subsurface Drain	1
612	Tree & Shrub Planting & Natural Regeneration	14
620	Underground Outlet	1
633	Waste Utilization	50
701	Barnyard Water Management	21

Table 4.16. Implementation of BMPs on West of Hudson large farms during 2007. (Continued)

BMP Code	Best Management Practice	No. of BMPs
748	Record Keeping	51
749	Manure Pile Area	13
3010	Roofed Barnyard—Feeding Pad	2
3130	Ventilation System	1
3175	Enhanced Nutrient Management Credit	3
3420	Manure Management Equipment	2
3600	Pesticide Storage Cabinet	2
5002	Bridge Replacement	1
Total Large Farm BMPs Implemented		352
Total Large Farm BMP Cost		$1,791,404

Annual Status Reviews (ASRs). The 2007 FAD requires that ASRs be completed on all farms with substantially implemented WFPs. Two hundred twenty-six large farms were substantially implemented in 2006 and therefore required an ASR in 2007. WAP completed 246 ASRs on large farms, which included all 226 of the required large farms (see Figure 4.3).

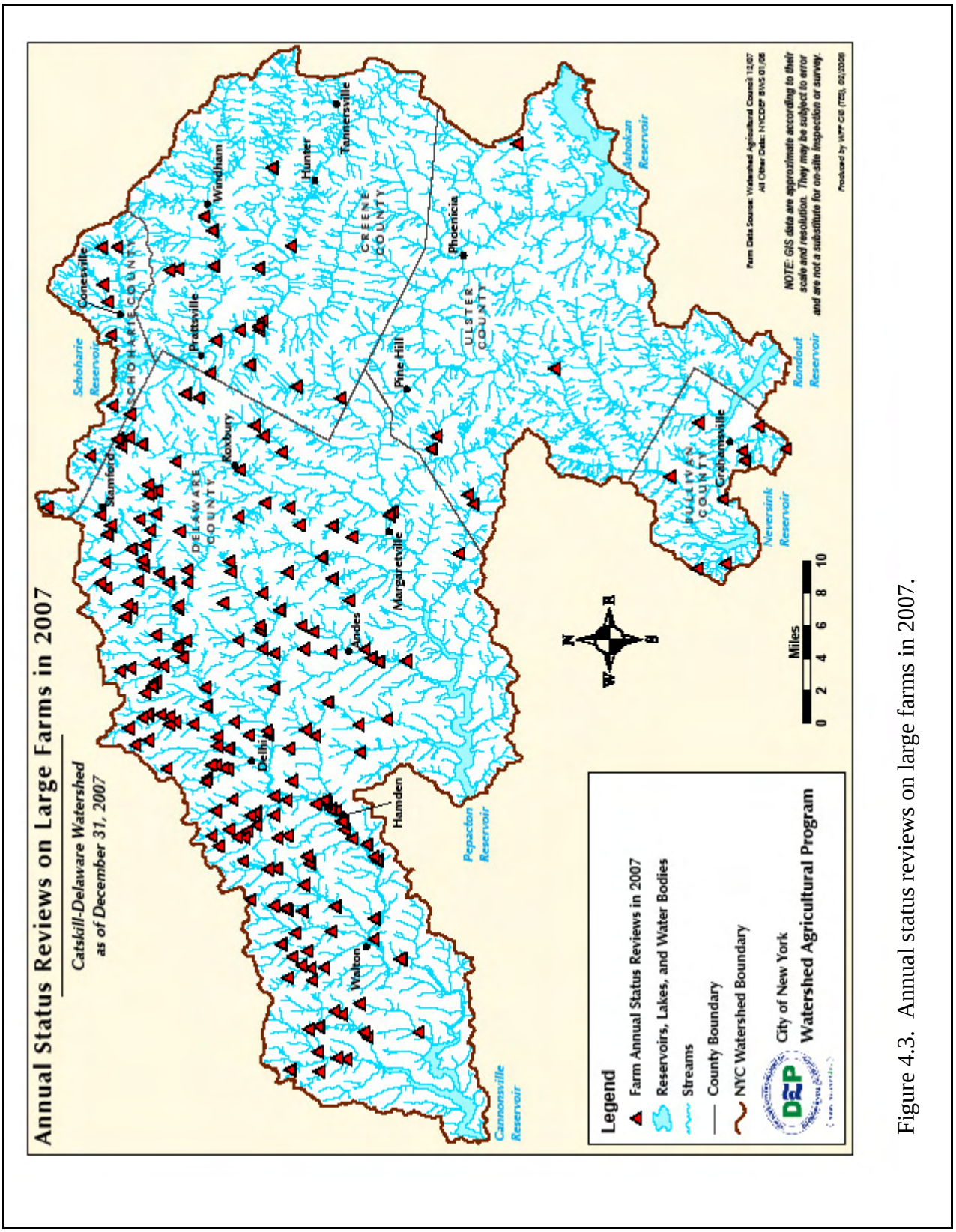

Figure 4.3. Annual status reviews on large farms in 2007.

4.4.4 WAC Farm Recruitment

During 2007, four new large farms signed up to participate in WAP, which is a significant accomplishment compared to previous years. In terms of additional recruitment, WAC mailed letters to the 13 known large farms that are not currently signed up and encouraged them to become WAP participants. WAC also sponsored two program participant recognition events, one each in the West of Hudson and East of Hudson Watersheds. These well-publicized local events serve an important secondary purpose of recruiting new farmers into the program.

4.4.5 Farmer Education Program

During 2007, WAC collaborated with Cornell Cooperative Extension (CCE) to continue implementing a series of on-farm workshops and tours that are designed to educate watershed farmers about specific agricultural topics such as nutrient management, organic dairy farming, no-till crop production, rotational grazing, pasture management, and WFP maintenance. Approximately 130 watershed farmers participated in these educational programs.

4.4.6 Small Farm Program (West of Hudson)

During 2007, WAC approved eight WFPs for West of Hudson small farms. The 2007 FAD, which was issued in July, includes a new small farm goal of 10 WFPs per year. Both DEP and WAC are committed to meeting this new goal beginning in 2008.

A total of 55 small farm WFPs have been approved through 2007 (see Figure 4.4), of which 41 WFPs have commenced implementation and 19 WFPs have all identified pollutant issues addressed. During 2007, 133 BMPs were implemented on small farms at a cost of $453,008 (see Table 4.17 below), and 47 ASRs were completed on small farms. A total of 595 BMPs have been implemented on small farms to date at a cost of more than $2 million.

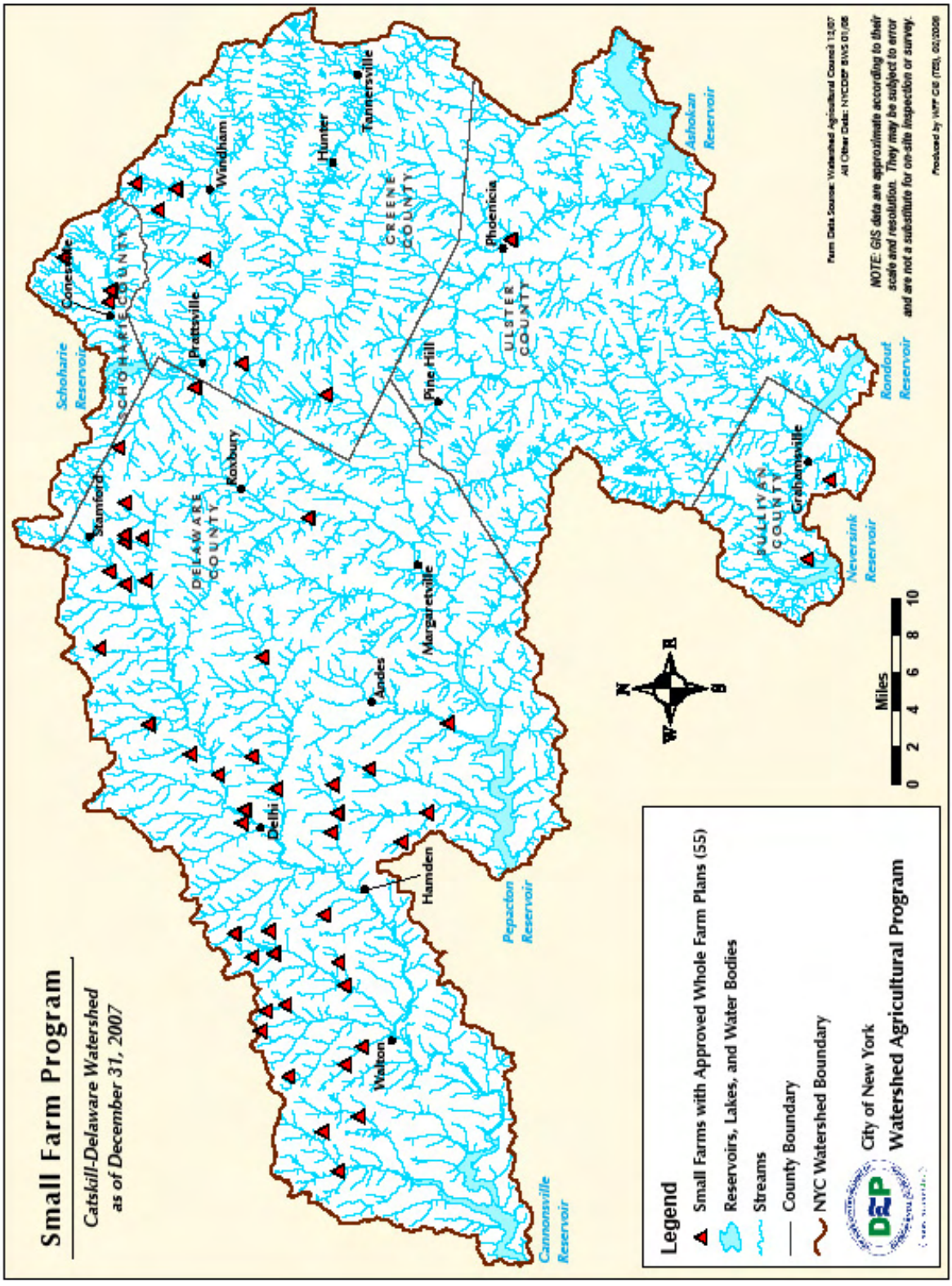

Figure 4.4. Small Farm Program, Catskill/Delaware Watershed as of December 31, 2007.

Table 4.17. Implementation of BMPs on West of Hudson small farms during 2007.

BMP Code	Best Management Practice	No. of BMPs
312	Waste Management System	2
362	Diversion	1
382	Fencing	15
516	Pipeline	7
560	Access Road Improvement	5
561	Heavy Use Area Protection	8
574	Spring Development	5
575	Animal Trails & Walkway	13
580	Streambank Protection	1
587	Structure for Water Control	1
590	Nutrient Management Plan	19
612	Tree & Shrub Planting	5
612.3	Tree & Shrub Planting—Natural Regeneration	1
633	Waste Utilization	16
707	Barnyard Water Management System	3
748	Record Keeping	18
749	Manure Pile	9
3010	Roofed Barnyard	3
3100	Calf Housing Structure	1
Total Small Farm BMPs Implemented		133
Total Small Farm BMP Cost		$453,008

4.4.7 East of Hudson (EOH) Program

During 2007, WAC approved five new WFPs for EOH farms. The 2007 FAD includes a new EOH goal of no less than six WFPs per year. WAC anticipated approving a sixth WFP in 2007, but this particular farmer withdrew from the program before the plan was approved. Both DEP and WAC are committed to meeting this new FAD goal in 2008.

A total of 38 WFPs have been approved on EOH farms through 2007 (see Figure 4.5), of which 33 have commenced implementation. A total of 52 BMPs were implemented on EOH farms during 2007 at a cost of $262,147 (see Table 4.18 below), and 33 ASRs were completed. To date, a total of 277 BMPs have been implemented on EOH farms at a cost of $1.55 million.

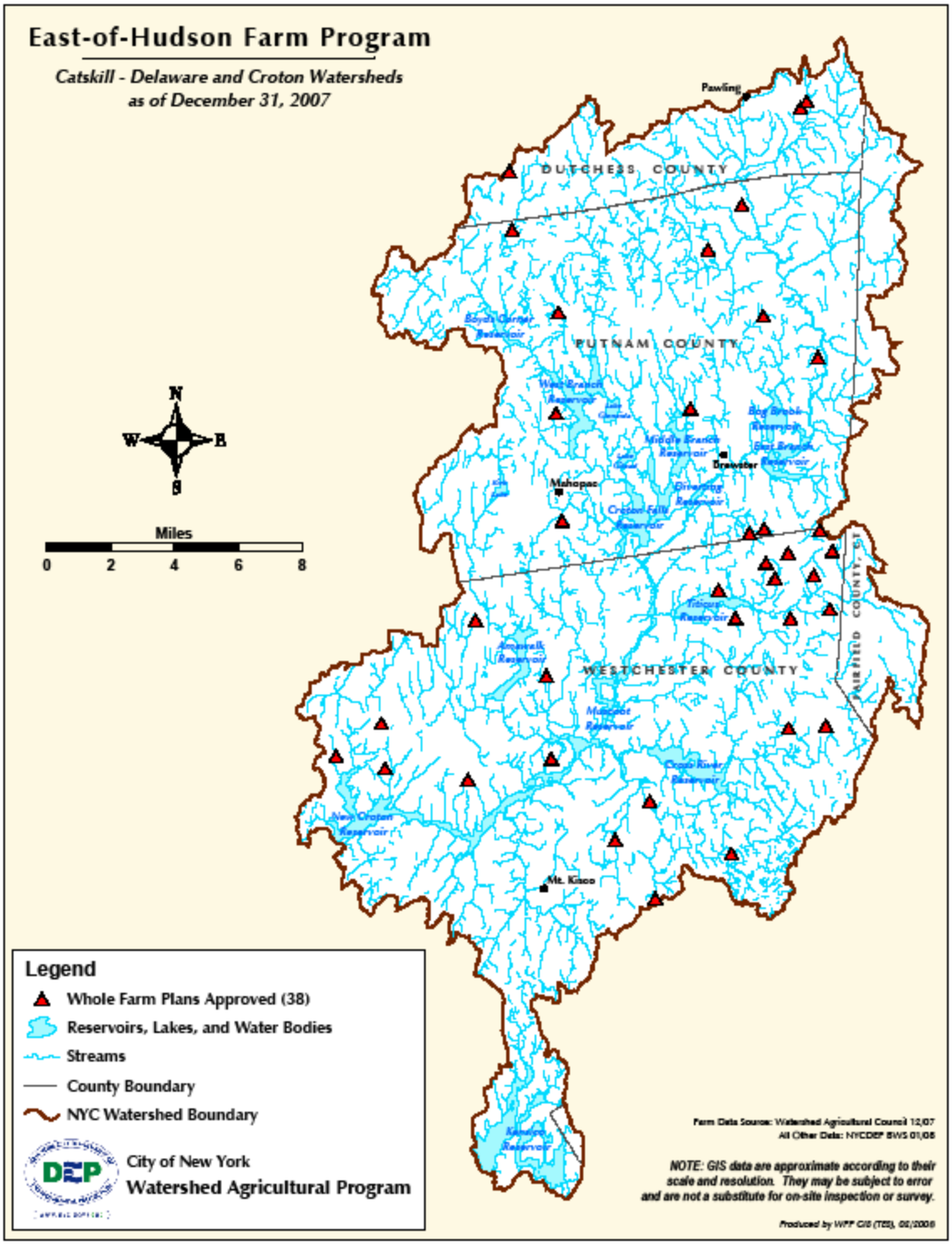

Figure 4.5. East of Hudson Farm Program, Catskill/Delaware and Croton Watersheds as of December 31, 2007.

Table 4.18. Implementation of BMPs on East of Hudson farms during 2007.

BMP Code	Best Management Practice	No. of BMPs
317	Manure Composting Facility	1
342	Critical Area Planting	1
362	Diversion	1
382	Fencing	4
391	Riparian Forest Buffer	2
393	Filter Strip	1
512	Pasture & Hayland Planting	2
528	Prescribed Grazing	1
558	Roof Runoff Management System	5
560	Access Road	2
561	Heavy Use Area Protection	9
587	Structure for Water Control	2
590	Nutrient Management Plan	9
606	Subsurface Drain	3
612	Tree & Shrub Planting	1
620	Underground Outlet	2
633	Waste Utilization	1
638	Water & Sediment Control Basin	1
647	Use Exclusion	1
719	Waste Infiltration Area	1
748	Record Keeping	1
783	Pathogen Management	1
Total East of Hudson BMPs Implemented		52
Total East of Hudson BMP Cost		$262,147

4.4.8 Nutrient Management Planning

During 2007, the WAP Nutrient Management Team completed 60 nutrient management plans (NMPs) on large farms and nine NMPs on small farms. In total, 152 farms have current NMPs, representing 34,017 acres and 14,797 animal units. In 2007, WAC also increased eligibility in the Nutrient Management Credit (NMC) Program to 80 farms in the Cannonsville Reservoir basin. This expansion added 16 Cannonsville farms to the NMC Program, bringing the total Cannonsville participants up to 80 farms, which satisfies the 2007 FAD. Three farms located outside

the Cannonsville Reservoir basin are also participating in the NMC Program. The NMPs on these 83 farms include 25,050 acres of cropland, hayland, and pasture. The WAP Nutrient Management Team has a goal of completing 64 new and updated NMPs in 2008.

4.4.9 Conservation Reserve Enhancement Program (CREP)

A total of 1,885.2 acres of riparian forest buffers are currently under a CREP contract, including 164.8 new acres that were enrolled in 2007 (see Figure 4.6). In addition, more than 225 acres of riparian buffers have been approved by WAC and are currently in the CREP contract pipeline as administered by the USDA. Out of 171 CREP contracts, 157 are complete and have all associated BMPs implemented. The Delaware County Soil and Water Conservation District (SWCD) estimates that CREP has excluded more than 10,000 head of livestock (mainly dairy and beef cows) from watershed streams and protected approximately 181.4 stream miles. Pending passage of a new federal farm bill by Congress and the President, the New York City Watershed CREP Memorandum of Agreement between the City and USDA was extended to March 2008. DEP anticipates that a new extension will be executed in 2008 to continue CREP for the term of the next farm bill.

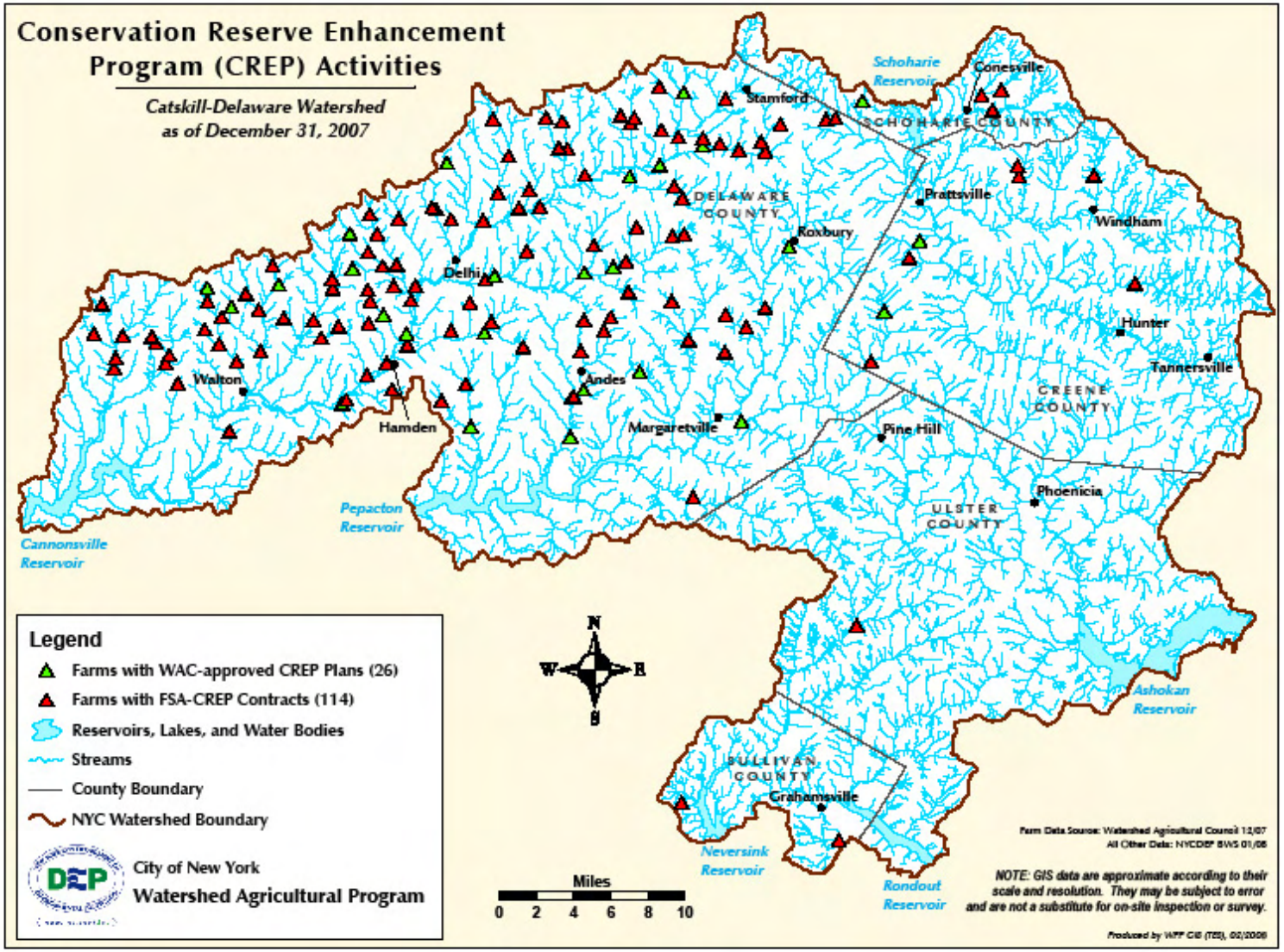

Figure 4.6. Conservation Reserve Enhancement Program (CREP) activities, Catskill/Delaware Watershed as of December 31, 2007.

4.4.10 WAC Agricultural Easement Program

For a discussion of the WAC Agricultural Easement Program, see WAC Whole Farm Easement Program in Section 4.2 Land Acquisition Program.

4.4.11 WAP-Related Research Activities (City and non-City funds)

Since WAP strives to make effective on-farm planning and BMP implementation decisions based on sound science, WAC supports specific agricultural research projects where existing science is lacking or additional refinement is needed. In addition, the USDA Natural Resources Conservation Service (NRCS), Agricultural Research Service (ARS), Cornell University, and other agencies and institutions have initiated various research studies that will help quantify, assess, and improve the environmental benefits of many farm conservation practices.

Conservation Environmental Assessment Program (CEAP)

Researchers from Cornell University's Department of Biological and Environmental Engineering received a $650,000 competitive grant from the USDA Cooperative State Research, Education and Extension Service (CSREES) through its Conservation Environmental Assessment Program (CEAP), a joint program with the NRCS. The research is being conducted in the Town Brook subwatershed between September 2005 and September 2008. The following information is excerpted from a progress report covering the period September 2006 to September 2007:

> Research focused on transferring existing hydrologic models that can realistically predict spatial location of variable source areas in which runoff is produced by saturation excess. The spatial distribution of these variable source areas is an important consideration in numerous applications, such as water resource planning or the siting of management practices. A number of manuscripts relating to this topic are either in press or are being considered for publication. One of the main problems in validating models is the delineation of variable source areas. Past research has developed a methodology that determines the spatial variability of saturated areas using a sequence of remotely sensed images as the source of spatial information. In the Town Brook subwatershed, the Normalized Difference Water Index (NDWI) was derived from medium resolution Landsat imagery collected over seven months that was used to characterize the areas susceptible to saturation. Researchers found that within a single land cover, saturated areas were characterized by the soil surface water content when the vegetation was dormant as well as leaf water content of the vegetation during the growing season. The resulting map agreed well with both observed and spatially distributed computer simulated saturation areas, with accuracies in the range of 49-79%. This methodology shows that remote sensing, through spatial/temporal variations in vegetation and surface water content, appears promising for delineating saturated areas in the landscape.

Cross-Farm Time Series Assessment Database for Phosphorus Management Evaluation

In 2007, Delaware County SWCD and CCE responded to a DEP data request relating to the Cross-Farm Database. This included soil sampling data by field from participating farms in the Cannonsville Reservoir basin from the start of WAP. The data are now being reviewed by DEP, Cornell, and Penn State researchers. A final report on this project is due in March 2008.

Covered Bedded Pack System BMP for Small Dairy Farms

Since 2006, using DEP funds and a USDA Conservation Innovations Grant, WAC and CCE have implemented an experimental covered bedded pack system (CBPS) on a farm in the Town of Hardenburgh, Ulster County. The CBPS serves as a barnyard water management system, feeding area and manure storage structure, while also housing the dairy herd. Based on a Vermont model, the CBPS contains 8-foot side walls, a fabric roof, an adjustable height watering system, and a rotating feeding area. This demonstration BMP is being monitored for two years to determine its applicability for other small dairy farms with less than 100 cows. A final report is expected to be completed in 2008.

The advantages of a CBPS are expected to be numerous. It is estimated to be more cost-effective than constructing a separate manure storage structure, concrete barnyard, and livestock feeding area by significantly reducing bedding and labor requirements. The system can also offer more efficient and comfortable housing than a tie-stall barn and is best-suited for small dairy farms that have cows on pasture for half the year, especially when implemented in tandem with the renovation of an existing tie-stall barn into a milking parlor or other milking system.

In addition, spreading the bedded pack generally requires a smaller tractor than a liquid tank spreader, which is important given that small farms generally have smaller equipment. A box spreader and hay fork for the front-end loader will eliminate the need for additional manure handling equipment. Wood shavings or processed straw will be easier to clean out of the CBPS than unprocessed material, and they also provide a good composting material. If long hay is used for bedding, it may need to be composted before spreading and is typically more difficult to remove from the barn. The CBPS has a lower chance for catastrophic manure storage failure compared to aboveground liquid manure tanks, and the manure odor should be less pungent.

WAC Database Needs Assessment Project

During 2007, WAC initiated a comprehensive farm data organization project consisting of (1) a needs assessment and (2) the implementation of a centralized and accessible database, including proper controls for farmer confidentiality and data integrity. This centralized database will enable WAC and DEP to better serve internal needs for program evaluation and assessment, while also assisting researchers who support WAP. Since 1992, WAC's data assets have grown by several orders of magnitude and are typically not interconnected by program.

WAC issued a Request for Proposals and selected PAR Government Systems Corporation (PAR) to perform the database needs assessment. PAR recommended the development of a Centralized Database Management System (CDBMS), which provides both a centralized approach to storing and managing data as well as a centralized set of software applications for searching and accessing the data. PAR also recommended that WAC transition from a desktop-based Geographic Information System (GIS) environment to a server-based GIS environment. This would allow GIS data to become part of the centralized database and also be accessible across the organization using standard software interfaces. PAR also recommended that GIS data and other datasets with spatial context be combined in a single "geodatabase" that would maximize flexibility in querying and mining WAC's data. The next phase of the CDBMS project is scheduled to begin in 2008.

Delaware County Precision Feed Management Program

Using funds provided by DEP over the past three years, WAC has contributed the local match to Delaware County's federal grant for its Precision Feed Management Program. Based on a recent correspondence with Delaware County, DEP anticipates receiving the Final Technical Report of the Precision Feed Management Program around April 30, 2008. The 2007 FAD requires DEP to review and prepare a written evaluation of this report and to submit a written evaluation within nine months after receiving the final report from Delaware County. Therefore, DEP expects to submit its written evaluation report around January 30, 2009.

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4.5 Watershed Forestry Program

The Watershed Forestry Program is a public-private partnership that supports well-managed working forests as a beneficial land use for watershed protection. Since 1997, DEP has contracted with the locally-based Watershed Agricultural Council (WAC) to administer and implement core program tasks that emphasize pollution prevention and forest stewardship practices. WAC also receives matching grants from the USDA Forest Service (USFS) to help strengthen the economic viability of the wood products industry, develop forest management and riparian plans, promote urban-rural conservation education, and support targeted outreach.

The 2007 FAD requires DEP to continue implementing the Watershed Forestry Program, as detailed in the City's 2006 Long-Term Watershed Protection Program, and reporting annually on the following core areas: (1) forest management planning and stewardship; (2) best management practice (BMP) implementation; (3) logger and forester training; (4) model forest program; and (5) watershed forestry education program. This report also highlights key program activities and accomplishments relating to forestry economic development (i.e., marketing and utilization).

Forest Management Planning and Stewardship

The Watershed Forestry Program provides technical and financial assistance to eligible landowners to encourage their adoption and implementation of long-term forest management plans. During 2007, 78 forest management plans were completed covering approximately 14,200 total acres, of which an estimated 11,130 acres are forested. Eight of these plans cover East of Hudson properties. Six landowners updated their five-year-old plans during 2007. To date, 684 plans have been completed covering 121,458 total acres, of which an estimated 94,800 acres are forested. These figures include 50 plans covering East of Hudson properties.

Riparian Planning. During 2007, 59 riparian plans were completed covering 1,239 riparian acres. To date, 173 riparian plans have been completed covering 5,333 riparian acres.

Management Assistance Program. WAC continues to implement the Management Assistance Program (MAP) on a three-year pilot basis for landowners having a WAC forestry plan. Eligible practices include: timber stand improvement (TSI), tree planting, riparian improvements, wildlife improvements (including apple tree release), and invasive species control. Sixty-eight projects were approved for MAP pilot funding during 2007, of which 5 projects were subsequently canceled by the landowner and 43 were completed (21 TSI, 13 wildlife enhancements, six tree planting, two invasive species control, and one riparian improvement). Five of the completed projects were located East of Hudson. To date, 115 projects have been approved for MAP funding. Seven of these projects were cancelled by the landowner and 70 projects were completed. At the end of 2008, DEP will submit a comprehensive evaluation report for the entire three-year MAP pilot.

Five-Year Plan Evaluation. During 2007, DEP and WAC evaluated the five-year implementation status of 77 WAC plans developed during 2002. The evaluation found that 16 landowners (21%) participated in road BMP programs, 2 landowners (3%) enrolled in WAC's Agricultural Easement Program, 2 landowners (3%) signed conservation easement contracts with DEP's Land Acquisition Program, 7 landowners (9%) were approved for MAP pilot funding, 4 landowners (5%) completed new WAC forestry plans or upgrades on separate parcels of land, and 2 landowners (3%) updated their five-year-old WAC plans. No landowners received funding through the federal Forest Land Enhancement Program, although 19 of 51 landowners (66%) who were eligible for the New York State Forest Tax Law (§480-a) certified their WAC plans with the State Department of Environmental Conservation (DEC). For additional information, please refer to DEP's evaluation report submitted January 31, 2008.

Best Management Practice (BMP) Implementation

The Watershed Forestry Program offers cost sharing, technical assistance, and other incentives to loggers, foresters, and landowners to promote their voluntary implementation of forestry BMPs during and after watershed timber harvesting operations. During 2007, the BMP program

was expanded and reorganized into three primary components: Erosion Control (timber harvest roads and forest roads), Bridge Loans (including bridge cost-sharing and rentals), and BMP Free Samples. The program also initiated an enhanced evaluation component in 2007.

Erosion Control. This program supports the design, layout, and construction of new timber harvest roads and the remediation of existing forest roads having erosion problems. During 2007, 38 timber harvest road projects and three road remediation projects were completed. These 41 projects included 45 miles of proper road layout, 1,254 water bars, 18 broad-based dips, 1,152 linear feet of geotextile road fabric, 1,656 cubic yards of stone, 125 hay bales, 140 linear feet of corduroy, 320 linear feet of culverts, and the post-harvest stabilization of 33 acres. To date, 105 timber harvest road projects and 52 road remediation projects have been completed. These 157 projects include 214 miles of proper road layout, 7,233 water bars, 376 broad-based dips, 5,218 linear feet of geotextile road fabric, 7,509 cubic yards of stone, 1,194 hay bales, 2,981 linear feet of culverts, and the post-harvest stabilization of 108 acres.

Bridge Loans. This program strives to minimize the impacts of logging equipment on watershed streams by encouraging the use of portable bridges and supporting the proper design and layout of stream crossing approaches on both sides of a watercourse. During 2007, WAC procured a long-span (50') portable bridge that is available for temporary loan along with 7 short-span (20') bridges, 1 long-span (30') bridge, 6 plastic arch culverts, and 12 sets of rubber tire land mats (used to reduce erosion on stream approaches). During 2007, WAC loaned out 10 20' bridges, 1 30' bridge, 7 arch culverts, and 3 sets of rubber tire land mats.

BMP Free Samples. To encourage the use of both traditional and innovative erosion control technology, WAC purchases and distributes free samples of the following BMPs: geotextile road fabric, silt fencing, traditional pipe culverts, open-topped culverts, hay bales, grass seed, straw wattles, rubber belt water deflectors, organic (non-petroleum) chainsaw oil, and erosion control blankets. A total of 136 BMP samples (including 120 hay bales) were distributed to loggers, foresters, and landowners during 2007. WAC also utilizes a newly-acquired flatbed trailer to facilitate the use and transport of forestry BMPs throughout the watershed.

BMP Evaluation. To better assess the BMP adoption, utilization, and implementation behaviors of program participants, WAC and DEP developed a BMP evaluation survey that WAC subsequently mailed to 33 participants of the erosion control and bridge loan programs. A total of 14 surveys were returned (42% response rate) by eight foresters (57%), four loggers (29%), and two landowners (14%). Key highlights from the 2007 BMP surveys include:

- When asked about which BMP programs they participated in during the past year, 11 indicated the timber harvest road program, 9 indicated a bridge loan program, 2 indicated the forest roads program, and 2 indicated the bridge cost-sharing program. For the 2 bridge cost-sharing participants, 1 person used his bridge less than 3 times, while the other person used his bridge 10 or more times.

- One hundred percent of all respondents indicated that the BMPs performed to their expectations; 92% reported that the BMPs were easy to find, the BMP material costs were reasonable, and they would utilize the BMPs again in the future; and 86% reported that the labor/time required for BMP installation was reasonable.
- Eighty-six percent of all respondents indicated that they used the BMPs mainly to prevent sedimentation from occurring, while 14% indicated that they used the BMPs mainly to fix an existing sedimentation problem.
- Seventy-eight percent of all respondents indicated that erosion and sediment control training would be beneficial to them.
- Fifty-seven percent of all respondents indicated they would implement/purchase the BMPs on their own, whereas 50% indicated that their use of BMPs was only cost-effective due to their participation in the program and the availability of funding.
- When asked to rate their satisfaction with the technical assistance provided by WAC forestry staff, 79% indicated they were very satisfied (highest rating) and 14% indicated they were mostly satisfied (second highest rating).
- Only 29% of all respondents indicated they would like to see the program cost-share additional BMPs, with the following examples listed: skid trail construction, sediment barriers, and a mechanical hay bale mulcher.

When considering the above results, it is important to recognize that the small number of survey respondents makes it difficult to draw any definitive conclusions. WAC and DEP both acknowledge that future BMP survey efforts will need to focus on improving logger response rates specifically and overall response rates generally. Nevertheless, this fledgling evaluation effort represents a positive step towards assessing and better understanding target audience needs and BMP implementation activities and behaviors throughout the watershed.

Logger and Forester Training

WAC sponsored three forester training workshops in 2007 that attracted 33 participants. Forty-eight foresters are currently trained to write WAC forestry plans, a 9% increase over the previous year. At least half of these foresters provide services to East of Hudson landowners.

During 2007, WAC partnered with Cornell Cooperative Extension and New York Logger Training to promote and support voluntary participation in the statewide Trained Logger Certification (TLC) Program. Twelve workshops were sponsored for about 90 participants. Core topics included Game of Logging (three workshops), Forest Ecology & Silviculture (two workshops), and First Aid & CPR (two workshops). In addition, one each of the following continuing education workshops was offered: Forest Pests, Vernal Pools, Lumber Grading, Garage Safety, and Skidder Bridge Building. Fifty-eight individuals working in the Catskill/Lower Hudson region are fully certified through December 2007, a 3% increase over the previous year.

In addition to sponsoring the above workshops, the Watershed Forestry Program continues to promote voluntary logger certification through a variety of methods. A promotional calendar of logger training events was produced and mailed to about 600 loggers. Eight TLC promotional signs and eight TLC promotional first aid kits were also distributed to loggers to reward their participation and increase program visibility. Finally, WAC collaborated with 11 regional sawmills during 2007 that agreed to offer a price premium for wood harvested by fully certified loggers as an additional training/financial incentive. As a result, more than $21,000 in price premiums was paid to certified loggers during 2007, a seven-fold increase over 2006.

Model Forest Program

During 2007, WAC partnered with SUNY College of Environmental Science and Forestry (ESF), Cornell Cooperative Extension, Frost Valley YMCA, DEC, and others to coordinate and support the following three watershed model forests: Lennox Model Forest (Delaware County), Frost Valley Model Forest (Ulster County), and Siuslaw Model Forest (Greene County).

Lennox Model Forest. In April, a landowner workshop was conducted by SUNY ESF that attracted about 27 participants. In addition, a new timber harvesting schedule was completed in conjunction with the property's forest management plan, and the forest was treated with an aerial application of insecticide to help minimize the defoliating impacts of tent caterpillars.

Frost Valley Model Forest. In cooperation with the Frost Valley YMCA, SUNY ESF continued to plan, mark, and implement a variety of silvicultural prescriptions in several forest treatment blocks. Deer fencing options are currently being explored to improve natural regeneration and provide additional demonstration opportunities for model forest visitors.

Siuslaw Model Forest. In May, a ribbon-cutting ceremony was held at the Siuslaw Model Forest, which is located adjacent to the Agroforestry Resource Center just outside the watershed boundary along County Route 23 in Acra. This location represents a major northeastern gateway into the watershed and is particularly important given the large number of private forest landowners and other watershed target audiences who visit the Center for agroforestry programs. During 2007, SUNY ESF completed installation of continuous forest inventory plots in addition to drafting a forest management plan for the property.

Watershed Forestry Education Program

During 2007, the Watershed Forestry Program collaborated with the Catskill Center for Conservation and Development, Common Ground Educational Consulting, Cornell Cooperative Extension, Clearpool Environmental Education Center, Catskill Watershed Corporation, Trout Unlimited, New York ReLeaf, and other regional partners to implement a variety of urban/rural and upstate/downstate stewardship education programs for several target audiences.

Watershed Forestry Institute for Teachers. In July, the Catskill Center conducted the ninth annual Institute for 19 participants from New York City and watershed schools. The teachers spent a week at the Menla Mountain Retreat in Phoenicia where they received classroom instruction and hands-on field training in various forestry and watershed curricula. Participants visited the Ashokan Reservoir, Shandaken portal, a DEP logging site and stream restoration site, and two wood-using businesses. More than 160 Institute alumni have been trained since 1999.

Green Connections. In June, the Catskill Center completed the 2006–2007 Green Connections educational partnership involving about 300 students from five New York City schools and five watershed schools. In September, the Catskill Center launched the 2007–2008 program for about 250 students from six New York City schools (Baruch College Campus High School, PS 33M, PS 57, PS 78Q, New York Harbor School, High School for Law and Public Service) and six watershed schools (Andes, Margaretville, Stamford, Windham-Ashland-Jewett, Hunter, Sidney). All participating schools received a classroom visit during fall 2007, and 10 of the 12 partner schools completed a downstate field trip. The remaining downstate field trip and all the upstate field trips are scheduled for spring 2008.

Watershed Forestry Bus Tours. In 2007, WAC hired a new local business, Common Ground Educational Consulting, to coordinate and administer the bus tour program. Two funding rounds were held in January and July, with 22 out of 32 applications approved, including two special applications: one for the New York State Outdoor Education Association (NYSOEA), which held its annual conference in Hunter in November, and one for New York City non-formal educators to be organized and promoted by DEP and Trout in the Classroom. During 2007, 29 bus tours were conducted for approximately 1,230 participants from the following diverse groups: PS 206 (two tours), PS 133, Williamsburg Outdoor Club (two tours), PS 166, High School for Environmental Studies (two tours), High School for Law and Public Service (two tours), Mott Hall School, PS 57, PS 24 (two tours), Brooklyn New School, Institute for Collaborative Education, PS 19Q, PS 116, Phipps Community Development, Bronx Academy High School (two tours), Neighborhood School, School of the Future, Prospect Park Alliance, Math and Science Exploratory School (three tours), NYSOEA, and Rocking the Boat.

New York ReLeaf. In January, DEP and WAC co-sponsored a regional ReLeaf workshop in Westchester County that was attended by more than 150 participants. In July, DEP co-sponsored and attended the New York ReLeaf Annual Conference in Saratoga Springs that attracted several hundred participants. On a statewide basis, ReLeaf is overseen by the New York State Urban and Community Forestry Council, of which DEP serves on the board of directors.

Municipal Training. During 2007, WAC initiated a municipal forestry training program for local officials in the East of Hudson watershed. Presentations were conducted for about 70 people representing the Yorktown Environmental Advisory Board, North Salem Planning Board, Kent Town Board, Carmel Town Board, Patterson Town Board, and the Hudson Valley Chapter of the Society of American Foresters. Additional presentations are planned for 2008.

Watershed Environmental Education Alliance (WEEA). WEEA consists of nearly 40 environmental facilities, organizations, and agencies based in and around the watershed that develop, support, and implement school-based education programs. In 2007, DEP assisted WEEA with the development and production of a valuable new field trip guide for school teachers and educators, the *2007-2008 New York City Watershed Environmental Education Resource Directory.* This directory was printed in limited quantities, circulated widely in digital format, and posted online at various partner websites including DEP's education homepage.

Invasive Species Survey. During 2007, DEP and WAC continued to participate in the Catskills Regional Invasive Species Partnership (CRISP) and the Lower Hudson Partnership for Regional Invasive Species Management (PRISM) along with dozens of other local, state, and regional partners. In support of these efforts, WAC hired Cornell University to conduct an invasive species public awareness survey for three target audiences: forest landowners, forestry professionals, and local officials. This survey was designed to compile baseline data regarding current knowledge and behaviors, and to help identify the most effective means for educating these target audiences. Cornell mailed surveys to 4,000 landowners, 950 forestry professionals, and 370 local officials in Delaware, Dutchess, Greene, Putnam, Orange, Rockland, Schoharie, Sullivan, Ulster and Westchester counties. After a series of follow-up mailings and phone calls, the final adjusted response rate for all three audience groups was 29%. Key highlights and recommendations from the Cornell invasive species survey include:

- Landowner awareness of invasive species was low, so outreach efforts should focus first on increasing basic awareness and knowledge. Landowners indicated they would most likely turn to brochures or fact sheets, websites, or Cornell Cooperative Extension for information about invasive species, with over 50% expressing interest in periodic newsletters and special mailings to their homes.
- With respect to the forestry professional audience, 32% identified themselves as foresters, 29% were loggers, 28% were arborists, 16% were landscapers, and 8% were nursery or greenhouse operators. Almost all respondents felt strongly that healthy forests were important to them and that healthy forests require active management to remain healthy. The most likely used sources of invasive species information were brochures or fact sheets, DEC foresters, Cornell Cooperative Extension, and websites. The most popular topics included learning about existing laws, regulations, and quarantines for invasive species, and how best to remove, control, or eradicate invasive plants and insects.
- With respect to the local official audience, 52% of the respondents were town highway supervisors, 24% were town supervisors, 6% were town planners, 5% were chairpersons of town conservation advisory committees, 2% were city or village public works supervisors, and 11%

held "other" job categories. Less than half of the respondents had ever heard of many of the invasive plants and insects listed in the survey, so outreach efforts should focus first on increasing basic awareness and knowledge. Most of the respondents felt strongly that healthy forests were important to them, and almost all of them agreed that healthy forests require active management to remain healthy.

Firewood Outreach Pilot Project. Between May and October, DEP collaborated with DEC to implement a firewood outreach pilot project for the Catskill/Delaware watershed in conjunction with a parallel DEC-led effort in the Adirondacks. A firewood outreach coordinator visited all eight of the state-owned campgrounds in the Catskills to educate campers about the movement of invasive insects via infested firewood, survey adult campers about their current firewood transport habits and attitudes, and provide campground operators with educational information about the spread of invasive insects through infested firewood. A total of 304 camper surveys were completed, and 22 firewood vendors were located near the surveyed campgrounds. The Catskill surveys revealed that 92% of the campers lived in New York State, 27% brought their own firewood from home (of which 57% traveled more than 50 miles), 40% bought their firewood at the campground, 36% bought firewood outside the camp (of which 61% was local and 39% came from an unknown source), 72% were aware of the "don't move firewood" message (of which 81% understood it), and 93% felt positively about the message. When Catskill campers were asked whether they had heard about specific invasive insects, 35% listed the Asian Longhorned Beetle (already present and quarantined in New York City) while only 3% listed the Emerald Ash Borer (not yet found in New York State but widely expected to arrive soon through the potential movement of infested firewood).

Marketing and Utilization

Primarily using grant funding provided by the USFS, WAC continues to support and implement specific forestry economic development projects with a focus on strengthening the economic viability of the forest products industry and promoting the marketing and utilization of locally produced wood products. During 2007, WAC awarded five USFS Economic Action Program Grants totaling $100,000. To date, 80 grants have been awarded totaling $2.33 million. No additional funding rounds are scheduled since the program has essentially been completed using all available grant funds. In lieu of grants, WAC has initiated or pursued the following forestry economic development initiatives: launching the Catskill WoodNet website in March (www.catskillwoodnet.org); sponsoring technical assistance training workshops for local wood-using businesses; promoting local wood products at numerous regional and national trade shows; and exploring potential new opportunities pertaining to woody biomass, "green" marketing, forest banks, urban forestry, and other emerging issues.

Summary

Overall, the Watershed Forestry Program accomplished all of its major core tasks and deliverables during 2007. In 2008, the Watershed Forestry Program will continue to emphasize program evaluation, invasive species education and outreach, and the ongoing integration of related forest stewardship initiatives using matching funds provided by the USFS. A major activity planned for 2008 is the completion and evaluation of the MAP pilot project with a focus on its potential watershed-wide expansion in 2009. Another key program activity will be the ongoing coordination and collaboration with the new Streamside Assistance Program and the pilot WAC forestry conservation easement program.

4.6 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 2007. Significant milestones included completion of the East Branch Delaware Stream Management Plan and associated demonstration stream restoration project at Margaretville, and the Conine stream restoration project in the Batavia Kill watershed.

The devastating June 17, 2007 flash floods in the Pepacton watershed provided DEP SMP an opportunity to substantially strengthen its working relationship within the agency, specifically with DEP Regulatory Review and Engineering, and DEP Western Operations. These floods left not only roads, bridges, and homes damaged or completely washed away, but also posed a continuing threat to water quality. Under an Emergency Declaration by the DEP Commissioner, these units mobilized their resources and their joint effort resulted in the reconstruction of local roads and the successful restoration of lower Holliday Brook using geomorphic principles within 45 days of the flood event.

4.6.1 Stream Management Plans and their Implementation

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, 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 4.7 illustrates the status of stream management plans and restoration projects throughout the West of Hudson (WOH) Watershed.

Below is a list of restoration sites that are shown in Figure 4.7:

Table 4.19. List of restoration sites.

Site Number	Site Location
1	Batavia Kill, Conine Project
2	Batavia Kill, Maier Farm
3	Batavia Kill, Ashland Connector
4	Batavia Kill, Brandywine
5	Batavia Kill, Big Hollow Reach 1
6	Batavia Kill, Big Hollow Reach 2
7	Schoharie Creek, Lexington Culvert
8	Schoharie Creek, Lexington Project 2
9	Schoharie Creek, Buffer Project
10	East Kill, Farber Farm
11	Schoharie Creek, Hunter
12	West Kill, Shoemaker Property
13	West Kill, RAH Stables
14	Broadstreet Hollow, Upper
15	Stony Clove, Lanesville
16	Esopus Creek, Woodland Valley
17	Chestnut Creek, Grahamsville Town Hall
18	Delaware EB, Margaretville Pavilion
19	Delaware WB, Wright Brook, Rama Farm
20	Delaware WB, Town Brook, Post Farm
21	Delaware WB, Town Brook, Palmatier Farm
22	Delaware WB, Terrace Ave*
23	Delaware WB, South Street*
24	Prattsville Floodplain Restoration Project*
25	Gooseberry Creek, Tannersville*
26	Delaware EB, Tremper Kill, Tuttle Farm
27	Chestnut Creek, RT55 Stabilization
28	Neversink Demonstration Project
29	Rondout Demonstration Project

* Locally initiated projects

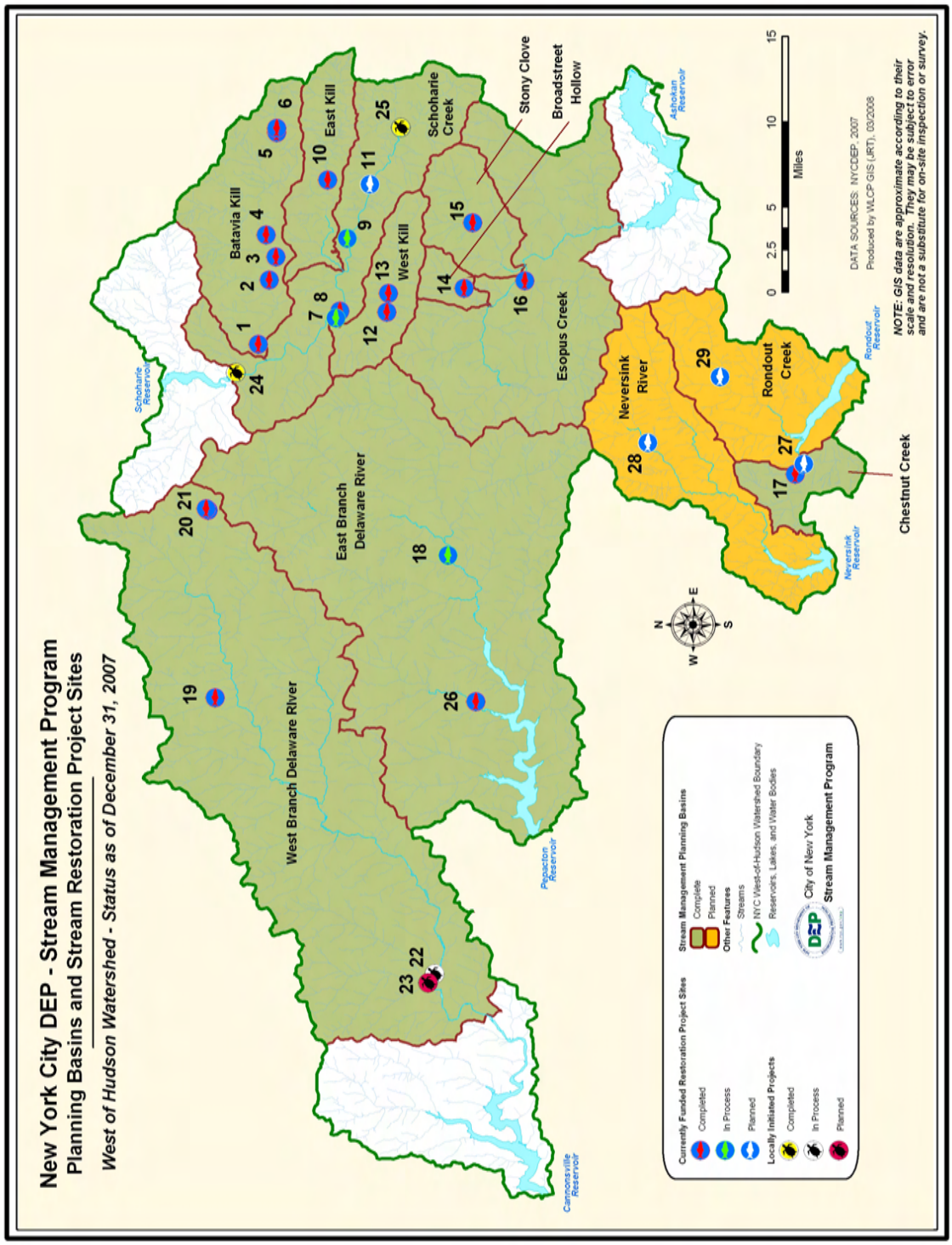

Figure 4.7. Planning basins and stream restoration project sites, West of Hudson, as of December 31, 2007.

Ashokan Basin

In January 2007, DEP and its partners Cornell Cooperative Extension of Ulster County (CCEUC) and the U.S. Army Engineer Research Development Center (ERDC) completed the draft Upper Esopus Creek Management Plan. The three-volume Management Plan (with extensive supplemental appendices) was comprehensively described in the last Stream Management Program Semi Annual Report (DEP 2007a). All of the Management Plan documents are available for download through the project's website (www.esopuscreek.org).

Since production of the Upper Esopus Creek Management Plan, CCEUC has worked closely with the Project Advisory Committee (PAC) and special interest working groups to review and revise as appropriate the findings and recommendations presented in Volume I of the Management Plan. A revised and "Final" Volume I will be completed in spring 2008. DEP and CCEUC have also developed an initial Ashokan Basin SMP Action Plan.

The primary intent of the initial Action Plan is to serve as a means to develop several work plans for the various contracts that will be required for implementation. Major milestones in the Ashokan Basin in 2007 included negotiation of two contracts for this purpose:

- A five-year contract with CCEUC for (1) extending the coordination and development of stream management planning from the Esopus Creek mainstem to the Ashokan Reservoir watershed, (2) developing and implementing a progressive education/outreach program, and (3) administering a $2 million fund for local implementation of SMP recommendations.
- A five-year contract with Ulster County Soil and Water Conservation District (UCSWCD) for (1) one full-time staff to provide technical expertise in stream assessment and management practices, and a coordinator for the proposed Streamside Assistance Program (SAP), (2) an engineer (potentially to be hired through the USDA Natural Resources Conservation Service) with stream channel design experience to design and oversee implementation of stream channel BMPs, and (3) funding a set of stream BMPs recommended in the Management Plan and/or annual Action Plans.

Ongoing work in support of the Management Plan included collaborative development of a supplemental document titled "Aquatic Ecosystem Research and Assessment Strategy" (CCEUC 2007) with particular emphasis on evaluating the impact of suspended sediment on aquatic life. The document (available on the project website) was finalized in December 2007 after many meetings of the aquatic ecosystem work group comprising fisheries professionals from DEC, DEP, the United States Geological Survey (USGS), academia, and Trout Unlimited.

DEP continued to implement the proposed long-term monitoring and BMP assessment program described in Volume III of the Management Plan. Work included (1) surveying monumented cross sections and longitudinal profile surveys and (2) initiating assessment of Woodland Valley Creek by stream reconnaissance mapping of bank erosion, fine sediment sources, Japanese knotweed occurrences, and revetment. The assessment will be continued in summer 2008.

CCEUC continued a very successful education/outreach program. One of its education/outreach activities served the dual purpose of enhancing the riparian buffer along an eroding section of Esopus Creek below Mount Tremper. CCEUC teamed up with DEP and DEC's Trees for Tributaries Program to plant trees along a 300' long stretch of stream that had been maintained as a mowed lawn. Twenty-three volunteers planted 275 trees, willow stakes, and shrubs and were educated on the importance of riparian buffers in the process. As a result of the success of this event at least three similar projects have been planned along the Esopus Creek for 2008.

Schoharie Basin

By the close of 2007, DEP and the Greene County Soil and Water Conservation District (GCSWCD) had completed stream management plans for all major Schoharie Reservoir tributaries: the Batavia Kill (2003), West Kill (2005), East Kill (2007), and Schoharie (2007). Importantly in 2007, in addition to completing the final two plans, the GCSWCD and DEP accomplished the following:

- Completed a two-year Action Plan for the Schoharie watershed that provides the road map for implementing stream management plan recommendations.
- Developed a new framework for Schoharie basin-wide coordination around implementation of the stream management plan recommendations and Schoharie Basin Action Plan.
- Negotiated a new five-year contract between DEP and the GCSWCD to (1) implement stream management plan recommendations, hire a Greene County Streamside Assistance Program Coordinator, and maintain one full-time staff member to oversee stream restoration projects and one full-time staff member to oversee stormwater projects, and (2) implement the Shandaken Tunnel SPDES permit requirements, which include funding $2 million in stream management plan recommendations and repairing 5,000 linear feet of stream.
- Secured nearly $2 million in Water Resources Development Act funding for innovative riparian restoration and stormwater projects.
- Provided support and sponsorship for the first annual Schoharie Watershed Summit, led by the GCSWCD Watershed Assistance Program.
- Expanded partnerships and the planning area to include the Schoharie County Planning Department and Soil and Water Conservation District to assess and plan for the Manor Kill.
- Completed four major stream projects, including the Conine stream restoration demonstration project and the Carr Road riparian planting pilot project (see Section 4.6.5).
- Assisted community review of new digital floodplain maps, and continued to assist communities with their adoption (see Section 4.6.4).
- Secured adoption of the Batavia Kill Stream Management Plan by the Town of Windham.

The following is a summary of 2007 activities in the Schoharie basin by stream.

Batavia Kill

In March, the Windham Town Board unanimously passed a resolution to adopt the Batavia Kill Stream Management Plan. In addition, Supervisor Meehan signed a Memorandum of Understanding between GCSWCD and the Town, which more specifically lays out the roles and responsibilities of the two entities in fulfilling the Plan. In June, the Town was recognized with an award at a public Watershed Awareness Day for taking this proactive step.

Although most of the District's staff for the Batavia Kill work dedicated their time during this reporting period to the design, permitting, and bidding of the Conine Restoration Project (see Section 4.6.5), GCSWCD proceeded with experimental management of Japanese knotweed, provided design support for a New York State Department of Transportation (DOT) project at a priority reach and coordinated with watershed towns and the New York State Department of Environmental Conservation (DEC) on digital floodplain mapping.

Schoharie Creek and East Kill

Stream management plans were completed for Schoharie Creek and East Kill in spring 2007. The two-volume plan was comprehensively described in the last Stream Management Program Semi Annual report (DEP 2007a). All of the Management Plan documents are available for download through the project's website (www.gcswcd.com).

In 2007, DEP and GCSWCD staff met individually with the Project Advisory Committees from the Schoharie-East Kill, West Kill, and Batavia Kill, and a general feeling emerged that having three separate PACs was excessive due to overlap of participants from the municipalities that include multiple watersheds (e.g., Schoharie PAC includes almost all municipalities since all tributaries drain to Schoharie). DEP and GCSWCD were charged with developing guidelines for the newly formed Schoharie Watershed Advisory Committee (SWAC).

The SWAC will oversee stream management plan implementation through a Schoharie Basin Annual Action Plan. DEP and the GCSWCD will ensure that all funding will be spent on projects that are consistent with stream management plan recommendations; DEP funding will be focused on water quality protection/improvement, with particular attention paid to turbidity. Proposed categories of funding include highway/infrastructure, community and landowner stream assistance projects (this is in addition to the Streamside Assistance Program), education and outreach, recreational improvement/access and habitat, planning, stormwater projects, and critical area seeding.

During this reporting period, DEP agreed to partially fund the development of a Greene County Hazard Mitigation Plan and to actively participate in the process. The plan will make the county eligible for State Emergency Management Office funding in the event of an emergency declaration, making projects identified in the Plans eligible for funding.

West Kill

In 2007, West Kill activities focused on transitioning PAC leadership to the developing basin-wide SWAC to ensure adequate West Kill representation, experimentally augmenting the vegetation at the RAH Stables demonstration project, and monitoring of the re-vegetation and channel morphology at the Shoemaker and RAH Stables demonstration projects. To help implement a recommendation made in the 2005 plan, negotiations began with the NYS Natural Heritage Program for a study to define the plant composition of target riparian ecological communities for future floodplain restoration. Future Streamside Assistance Program or stream restoration projects would seek to recreate or establish such ecological communities. Progress on another recommendation in the plan—stream habitat assessment—was made through the DEP-supervised research of a SUNY ESF graduate student studying the effects of stormwater runoff events on stream temperature. In December, the West Kill Stream Management Plan was formally presented to, and favorably received by, the Town of Lexington, which is expected to adopt the plan by resolution in spring 2008.

Pepacton Basin

The East Branch Delaware River Stream Management Plan was finalized in 2007 under the leadership of the Delaware County Soil and Water Conservation District (DCSWCD), the Delaware County Planning Department (DCPD), and DEP. The multi-objective planning process provided numerous opportunities for watershed stakeholders to voice their concern about stream and watershed issues and resulted in the formulation of a comprehensive set of recommendations for future action. Assessments indicated that Dry Brook, the Bush Kill, and Tremper Kill are subbasins where additional management is warranted. Dry Brook was identified as having significant sediment issues, Bush Kill is beginning to experience the effects of streamside development along the Route 28 corridor, and Tremper Kill is experiencing bank erosion associated with the impact of agricultural land use on the riparian buffer. Among the plan's recommendations are proposals for enhanced protection of riparian buffers, improved stream management practices of highway departments, coordinated flood response, and support of floodplain management.

As part of the plan development process, DCSWCD and DCPD made presentations to 11 local planning boards and the Delaware County Planning Board with the goal of implementing stream management at the local level. Discussions included recommendations for the updating of local comprehensive plans to incorporate stream management principles, strengthening local floodplain development ordinances, and exploring inclusion of a stream management review component in local subdivision reviews. Local planning boards included the Towns of Halcott, Middletown, Bovina, Andes, Colchester, Roxbury, Hardenburgh, Delhi, and Hamden; and the Villages of Margaretville and Fleischmanns. The final plan will be presented to town boards for adoption in 2008.

Cannonsville Basin

Following the 2006 flood disaster, activities toward implementation of the West Branch Delaware River Stream Management Plan focused on improved coordination of emergency flood response through workshops and training, and improved coordination with the Natural Resources Conservation Service (NRCS) in the integration of geomorphic principles in design of Emergency Watershed Protection (EWP) projects. This effort is described in detail in Section 4.6.3.

Neversink and Rondout Basins

Outreach to the Towns of Neversink and Denning toward development of stream management plans in these basins was commenced and progressed well in 2007.

SMP's current contracting relationship with Sullivan County SWCD (SCSWCD) provided opportunities for implementation of recommendations in the Chestnut Creek Stream Management Plan. The primary effort this year was design of a combined streambank and sewer line crossing stabilization on DEP property in Grahamsville. All of the assessments needed to prepare a near-final design for the restoration of this reach were completed, and DEP successfully negotiated a new contract with SCSWCD to allow construction of this project in summer 2008.

4.6.2 Education and Outreach

A core component of SMP's mission, Education and Outreach (E&O) activities became more focused this year through improved internal and external coordination. An early 2007 coordination meeting with partners built upon the 2006 National Oceanic and Atmospheric Administration (NOAA) Project Design and Evaluation workshop that focused entirely on watershed education and outreach. A draft E&O strategy is being generated through iterative meetings with DEP's basin-level partners. The objectives of the overall strategy will be to ensure that the E&O components of these partners' annual Action Plans are coordinated such that messages are consistent and efficiencies of scale are achieved in the development or execution of programming. Another goal of the strategy is to ensure that gaps are identified so that the training, education, and outreach needs of all key audiences who influence the management and stewardship of streams are ultimately addressed.

Again this year, SMP employed a variety of formats to reach these audiences, including numerous public meetings, demonstrations and information sessions, workshops, extensive classroom education, college intern programs, technical training programs, restoration project tours, internal coordination with other DEP programs, and external coordination with other agencies on review of many individual projects. Chapter 9.0 of this report (Education and Outreach) presents SMP E&O efforts in the context of agency-wide efforts, organized by target audience.

Several achievements stand out during the reporting period. The multi-agency website, www.catskillstreams.org, was formally launched by the interagency Riparian Buffers Working Group. DEP played a major role contributing to both structure and content. The site provides a

single portal to the management plans that have been developed to date, local contacts for stream management activities and technical assistance, stream restoration research updates and data, guidance on requirements for compliance with stream regulations, and general information for the public including a fact sheet, "Principles of Stream Stewardship," developed by DEP and GCSWCD during the reporting period, which provides broad guidance for restoring or preserving the integrity of streams and floodplains.

Using stream restoration projects to teach stream stewardship principles is a key part of DEP's E&O strategy. In 2007, UCSWCD completed the installation of an informational kiosk at the Esopus Creek Restoration Demonstration Project. The three-sided kiosk includes two large panel posters detailing the history and goals of the project. A third panel has been installed for use by recreational users of the stream.

DEP sponsored the first annual Batavia Kill Stream Celebration, co-hosted by GCSWCD and a private bed & breakfast owner. This well-attended event featured guided stream walks with plant and macroinvertebrate identification, fly casting and tying demonstrations, and other interactive activities for families. The Catskill Watershed Corporation sponsored the "City that Drinks the Mountain Sky" performance by Arm of the Sea Theatre, and Greene County Tourism has agreed to sponsor the 2008 event.

Heightened focus during the reporting period on riparian vegetation (in support of the developing Streamside Assistance Program) led to numerous E&O activities. The Program coordinated a workshop on native plant seed collection, hosting the New York City Parks Department's Greenbelt Native Plant Nursery (GNPN) staff, which addressed the importance of maintaining diverse, local genetic material in ecological restoration projects, the risks associated with introducing non-local genotypes, and the protocols used by the GNPN in seed collection, processing, storage, and propagation.

DEP provided substantial support (including partial funding) to the Hudson River Watershed Alliance's annual conference, *Watershed Connections: Ecological and Economic Values of Streams and Floodplains*, which highlighted the value and function of riparian buffers. Staff from DEP served on the organizing committee and provided the keynote address for this event, which was attended by 180 people from throughout the Hudson River Valley.

Severe flooding again this year in the Delaware basins provided numerous opportunities for outreach and training across agencies and audiences. Significant milestones were achieved and are reported comprehensively in Section 4.6.3.

4.6.3 Flood Recovery Efforts

The flash flood event of June 17, 2007 in the Pepacton watershed required DEP to redirect its stream management staff and those of the DCSWCD to guide emergency stream work. The intense 8", 3-hour rainfall reportedly brought “walls” of water down the Pepacton tributaries of Holliday Brook, Lower Beech Hill and Cat Hollow. Woody debris and sediment choked long sections of stream channel, bridges, and culverts. Flood flows washed way a house and several vehicles on Holliday Brook and resulted in numerous stream avulsions and bank failures (Figure 4.8).

Figure 4.8. Woody debris, house remnants, and sediment jam a private bridge on DEP property along lower Holliday Brook.

Figure 4.9. Holliday Brook Road washout following June 17, 2007 flooding.

A 1,500' section of this brook just above Pepacton Reservoir and a Route 30 box culvert was laden with woody debris, sediment, and flood trash. Several sections of a City roadway parallel to the stream were washed out and required complete reconstruction Figure.4.9.

As part of the emergency response, DOT, the National Guard, DCSWCD, and DEP combined their resources to assist the Towns of Colchester and Andes to complete the initial debris removal along Holliday Brook and reconstruct the roadway to allow access by emergency vehicles. DCSWCD worked closely with DOT to support emergency clearance of debris and initial stream remediation.

Figure 4.10. Double cross-vane during construction at Holliday Brook.

As part of the recovery effort, SMP joined with DEP Western Operations and DEP Regulatory Review and Engineering to direct DEP's consulting engineers in the design and construction of a combined stream restoration and road reconstruction project for the reach and a section of roadway. The project was designed and bid, and a contract awarded within 45 days of the storm. SMP assisted with the preparation of the project worksheet for the Federal Emergency Management Agency (FEMA) reimbursement of nearly half of the City's $5 million flood recovery costs. SMP also provided on-site guidance to the contractor, consulting construction inspection staff, the design consultants, and DEP Bureau of Environmental Design and Construction site engineers for the restoration project, including the dewatering, grading, and construction of the project's 13 grade control structures (Figure 4.10).

Grading, construction of structures, seeding, and initial planting of trees was completed by October 15, and the roadway, including a concrete retaining wall and stormwater drains, was completed by December 15 (Figure 4.11).

The unprecedented cooperative efforts across the agency between bureaus and divisions and the growing recognition of SMP's role as technical advisors to other parts of the agency represent a significant accomplishment for 2007.

In addition to targeted efforts to restore Holliday Brook, DEP also worked to protect other areas of its own lands following

Figure 4.11. Completed cross-vane structure and adjacent grading on Holliday Brook. Roadway is visible at left.

the June 2007 flood, with SMP advising DEP Western Operations on stream remediation and debris removal at Cat Hollow, Lower Beech Hill Road, Close Hollow, Weaver Hollow, and Dryden Brook.

Throughout 2007, SMP also continued to participate in ongoing flood recovery efforts related to the June 2006 event, working with the NRCS Emergency Watershed Program (EWP) in Delaware County. Following an emergency declaration regarding the catastrophic flooding of June 2006, the federal government provided the county with up to $11 million for emergency flood repairs at over 70 sites where streamside infrastructure and environmental or economic considerations merited the expenditures. SMP and DCSWCD trained a team of NRCS engineers to include geomorphic considerations in the design of their projects, and assisted them in doing so. In addition to training NRCS engineers, SMP and DCSWCD staff worked as part of the damage survey teams and helped prepare conceptual designs for the most challenging sites. Later DCSWCD, GCSWCD and SMP staff provided training on the construction of cross vanes for NRCS construction supervisors. Inclusion of geomorphic processes and specific BMPs in the NRCS effort represents a significant accomplishment for stream management in the New York City Watersheds. Prior to this time, NRCS EWP projects primarily consisted of the installation of riprap and rock walls to protect infrastructure, but did little to address the fluvial processes contributing to the instability.

DEP continued to support flood response preparedness workshops across the WOH Watershed. On March 9 and 10, DCSWCD, Trout Unlimited, and DEP co-sponsored and co-hosted a Flood Response Workshop in Walton and Freemont, NY, and on June 14, DCSWCD and DEP sponsored a third workshop in Delhi, NY. The workshops for county and town highway engineers, town supervisors, and agency staff sought to build on the audience's scientific understanding of stream dynamics under flood conditions and enable them to adopt improved post-flood stream management practices. Speakers at the workshops highlighted both successful and unsuccessful efforts and advocated the use of regional curves as an emergency measure for estimating channel dimension in disturbed settings. Attendance at each workshop exceeded 50 participants.

As a result of these ongoing efforts and growing interest in cooperative flood response throughout 2007, DCSWCD applied for and received $161,700 from the Round IX NYS Water Quality Improvement Project grant program. Matching funds from DEP of $161,700 will be provided to implement a flood recovery and training program for local contractors and highway superintendents in the summer of 2009.

4.6.4 Floodplain Mapping

DEP continued to work with its partner GCSWCD to review and comment on the accuracy of revised Flood Insurance Rate Maps and flood studies in Greene County prior to their formal adoption by the local municipalities. DEC provided a review of the ground control/

topographic survey information used in the production of the maps that satisfied the previous concerns of DEP and GCSWCD related to their accuracy. DEC continues to seek the adoption of the maps with the local communities in Greene County. These maps will help communities and resource managers 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.

In 2007 DEP and DEC continued to explore contracting options to for the City to provide financial support to advance the state's program of floodplain mapping. DEC has opted out of participating in this project. DEP is currently establishing a relationship with FEMA to complete this very important work. In 2008, DEP will seek to finalize contracting plans to advance this work.

4.6.5 Stream Restoration Projects

Figure 4.7 depicts the status of 29 restoration projects at the close of 2007. 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 in the 2002 FAD, (3) projects implementing recommendations in completed stream management plans, and (4) locally initiated projects that SMP is involved with, either in their scoping, design review, or as a secondary sponsor or partial funder.

Schoharie Basin Projects

Conine Stream Restoration Project

Inventories in 1997 identified sections of the Conine reach experiencing large-scale erosion and bank failures suspected to be negatively impacting water quality. The position of the channel and evidence of recent channel migration and excessive sedimentation through the reach indicated natural recovery was improbable in the near future. The design included the complete realignment of 1,650 linear feet of the stream channel, including modification of channel geometry, profile, floodplain, and adjoining banks and terraces. The design included vanes and cross vanes to promote channel stability during vegetation reestablishment. Final project costs were $1,085,970 (not including salaries for design and aspects of revegetation), or $658/ foot. Establishment of wetlands in area equal to those impacted was necessary to remain in compliance with the U.S. Army Corps of Engineers (ACOE) Nationwide Permit 27. The project established 4.6 acres of riparian buffer, achieved through the planting of appropriate vegetation, the implementation of a Japanese knotweed (*Fallopia japonica*) management plan, and the establishment of 0.5 acres of mitigation wetlands along and adjacent to the stream.

Figure 4.12. Large failing bank at Conine prior to restoration.

Figure 4.13. Large failing bank at Conine after restoration. The floodplain bench was added to relieve pressure on the slope.

County Route 13 Culvert Replacement

With GCSWCD and the Greene County Highway Department, DEP demonstrated a first multi-objective culvert replacement in the Town of Lexington. This project was designed to address a local priority to protect public and private property, but it also had several other objectives: (1) address a stream problem related to infrastructure, (2) demonstrate the benefits to stream process and habitats of upgrading a stormwater conveyance, (3) engage new stakeholders, (4) increase public understanding of effective stream management practices, and (5) demonstrate practices that improve biological function (such as natural cover in the culvert invert). The project also demonstrated the use of floodplain drains and integrated vegetative measures to reduce the need for traditional rock riprap around drainage structures. Using this project as a demonstration, DEP and GCSWCD will encourage and support local highway departments with their culvert replacements to ensure adequate sizing and consideration of sediment transport and fish passage.

Figure 4.14. County Rte. 13 culvert prior to replacement. The left wing wall was collapsing and the culvert was undersized.

Figure 4.15. County Rte. 13 culvert after replacement. The culvert was upgraded to a 14' x 5' opening with the invert buried 1' and a low flow dish added for fish passage. Two floodplain drains were also installed in the field to the right.

In 2007, DEP and GCSWCD initiated a pilot for the developing Streamside Assistance Program (SAP) to implement riparian plantings on residential properties. Sites were chosen using the vegetation mapping and stream feature inventories that were completed for Schoharie Creek and East Kill. Four candidate properties were selected along Schoharie Creek and East Kill. One landowner was unresponsive, the second refused, the third is still negotiating, and the fourth went forward in 2007. This landowner's property is known as the Carr Road Project.

The Carr Road Project—Piloting the Streamside Assistance Program

The Carr Road Project extends along more than 2,300' of Schoharie Creek in the Town of Jewett. The project has three strategic components: stem injection treatment of Japanese knotweed (*Fallopia japonica*) with glyphosate (Glypro) to prepare the locations for replanting with native vegetation; planting of a 100' wide buffer strip beginning at the top of the streambank, establishing approximately 2.4 acres of buffer; and enhancing the existing buffer on the immediate streambank by planting willow tublings and willow stakes.

In early November 2007, GCSWCD, using its own equipment and labor, initiated planting downstream of the Carr Road bridge. An early season snow storm effectively shut down work for the season after 940 plants had been installed. Additionally, an adjoining downstream landowner, after finding out about the project, expressed an interest in having the riparian buffer extended along his streambank (which extends approximately 1,200' along Schoharie Creek) and immediately signed a landowner agreement with GCSWCD. This owner will be addressed in 2008 under the new Streamside Assistance Program.

This pilot project made it possible to achieve substantial progress in developing program materials for the Streamside Assistance Program, including a landowner agreement template, DEC permits, and landowner vegetation guidance. All the products created during this process will be available to be used or modified by the Streamside Assistance Program.

The Holden Restoration Project, Route 23 in Windham, Batavia Kill

In 2007, a DOT Article 15 stream disturbance permit was flagged by DEC Region 4 for potential inclusion of a natural channel design approach. DOT welcomed the technical assistance of GCSWCD for this sensitive reach. One component of the project was to establish a floodplain bench which restored floodplain function in an area that would have simply been armored with rock.

Ashokan Basin Projects

Monitoring continued on the Lanesville Demonstration Project on Stony Clove Creek, constructed over three years from 2003–2005. The project was reevaluated in May, in order to make recommendations for adjustments; these are scheduled for 2008, and include revegetation of one hillslope being compromised by poor drainage on a high adjacent terrace, and additional bioengineering opposite that hillslope. Monitoring also continued for the Esopus Creek Demonstration Project completed in 2003.

Pepacton Basin Projects

On the East Branch of the Delaware, DEP supported DCSWCD's efforts to design and construct the demonstration stream restoration project at the Margaretville Pavilion site. This project addressed an eroding streambank and failing revetment adjacent to the community fairgrounds by installing three vanes and rock toe protection along the 900' reach. The project took exceptional care to minimize construction impacts to the riparian buffer. The riparian vegetation planting to be installed in 2008 will strengthen the native plant community and provide a self-guided education walk through the enhanced buffer.

Figure 4.16 Margaretville demonstration restoration project site pre-construction.

Figure 4.17. Margaretville demonstration restoration project site post-construction.

Working with the Watershed Agricultural Program and SMP, DCSWCD designed and constructed a 150' long live log crib wall at the Tuttle Farm on the Tremper Kill to protect a streambank where flood flows repeatedly scour through the bank and adjoining horse pasture. This structure, the first of its kind constructed with DEP funding, demonstrates another management practice which DCSWCD will monitor for its effectiveness and durability. Additional plantings along the bank, including expansion of the existing buffer and the removal of gravel berms, will improve bank stability and floodplain function, and reduce flood scour on the floodplain.

Figure 4.18. Live crib wall post-construction.

DEP involvement in the design review phase of locally-initiated projects continued to increase in 2007, with DEP staff providing design review on more than a dozen additional stream-related projects throughout the WOH watersheds, either in the scoping phase, or in the review of NYS Article 15 Stream Disturbance Permits. These projects included the design, permitting, and construction review of the Terrace Avenue project in the Village of Walton, as well as assistance to the NRCS EWP program. DCSWCD initiated construction of the Terrace Avenue streambank project and

completed the construction of the rock toe and VRSS (vegetation reinforced slope stabilization system) bioengineering treatment of the failing bank. Although this project is largely funded by ACOE, DEP has funded salaries in support of the design and construction supervision, and provided over $100,000 in construction costs.

Figure 4.19. Installation of bioengineering on rock toe protection, Terrace Avenue, Village of Walton.

4.6.6 Stream Data Management

Through the creation of stream management plans, design and construction of stream restoration projects, and research into stream processes and project performance, 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 DEP's stream managers and partners for the long term, DEP has developed a geodatabase of stream information for the West of Hudson watersheds. 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 2007, DEP made significant progress in populating the stream geodatabase with data. Recently created information from the assessments of the East Kill, Schoharie Creek, and East Branch of the Delaware River were entered, as well as data sets for existing plans on Broadstreet Hollow, Stony Clove, and Esopus Creek. Stream research data from several reference reaches and BMP reaches have also been added.

4.6.7 Stream Process Research

In 1996, 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 ("regional curves"), a reference reach design geometry and fluvial processes database, and a study monitoring the 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 in FAD Assessment reports and peer-reviewed published reports and papers (Miller and Davis 2003, DEP 2005b, DEP 2006b, DEP 2007a, CCEUC 2007).

The geographic extent of these projects covers the entire Catskill and Delaware watersheds, with monitoring sites in all six reservoir basins, as well as three sites outside the NYC watershed (see summary map of Stream Management Program Planning Basins and Stream Restoration Project Sites in DEP 2006b; see also Miller and Davis 2003 for regional curve study sites). These projects have refined and strengthened DEP's knowledge of how streams in the Catskills function and how DEP as a stream manager can best interact with streams and collaborate with its partners and stakeholders to create sustainable stream stewardship while incorporating its goals of continued high water quality.

Regional Hydraulic Geometry Relationships

Development of regional curves for the Catskills is the foundation for multi-objective stream management, and this task was largely completed in 2003. Relationships developed through this study are used daily by DEP and its partners to help identify and confirm field indicators of a stream's bankfull stage (depth), a necessary first step in any geomorphic stream assessment. This assessment is not only the basis of DEP's stream management plans and their recommendations, but is also important as the basis of project review, project design, landowner site visits (to evaluate problems and potential solutions), and design of restoration projects. During reconstruction of stream channels following flood events, the geomorphic assessment also guides determination of the channel's appropriate dimensions. Regional curves were an essential tool in helping DCSWCD, Delaware County DPW, and DEP respond to the June 2006 and 2007 floods in Delaware County.

During the reporting period, USGS completed a major report in its effort to develop regional curves for all of New York State. This effort, proposed by DEP in 2000 and based on the protocol and quality assurance project plan developed by SMP, was modeled on the regional curve study for NYS Hydrologic Region 5 stream gages. After receiving training from SMP, both agencies worked cooperatively to develop the first sets of curves. This effort represents a huge achievement in education and outreach by DEP project partners, dramatically increasing the availability of these geomorphic stream management tools statewide. Also during the reporting period, USGS personnel leading this effort invited DEP back into the process to assist authoring a definitive set of guidelines for use and interpretation of these NYS regional curves; this work will continue into 2008.

4.6.8 Stream Process Research

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USGS personnel leading this effort invited DEP back into the process to assist authoring a definitive set of guidelines for use and interpretation of these NYS regional curves; this work will continue into 2008.

Reference Reach and Fluvial Process Database

Substantial progress was made toward completion of the second project: to create design geometry and fluvial processes data and characterize associated biological and aquatic habitat for up to 15 reference Catskill stream reaches. 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 provide a better understanding of the range of variability one can expect in stable stream settings. Near the close of 2007 the first complete summary of reference reach design geometry parameters and associated data was compiled and circulated to DEP's primary project partners—the Soil and Water Districts of Delaware, Greene, Ulster, and Sullivan Counties, the NRCS stationed in Ulster County, and the CCEUC. These long-awaited study results will now begin to be used in the design of projects in the West of Hudson Watershed in 2008 and beyond. The fluvial process study (scour and particle tracers) was completed through data collection and analysis, and is ready for interpretation and reporting in 2008.

Monitoring Stream Restoration Projects

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 the sites' fish populations, 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 four years (total of 15 sites). This project was scoped to provide an Interim Report in 2007; the USGS has published preliminary results of fish and habitat data related to the restoration and control sites (DEP 2005b). Although the USGS papers are in draft form, initial analysis and conclusions are presented and the papers are near to being published. Findings indicate that biological integrity of resident fish communities in Catskill Mountain streams can be improved by natural channel design restorations.

Construction and monitoring are dependent on weather and scheduling, both of which have previously experienced delays. For example, 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 (DEP 2005b), with additional reporting provided as peer-reviewed papers by USGS.

Additional data collected during the 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.

Streambed and bank erosion and scour pilot measurements in support of reference reach and BMP reach studies also proceeded as planned for the 2007 field season.All planned field work was completed, including all particle and scour data collection for reference reaches. Data entry and data analysis for all data collected to date also are complete. Scour and bed mobility requires five or more bed mobilizing events. All 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. Figures depicting the distribution of monitoring sites across the WOH Watershed can be found in the April 2006 Biennial SMP Evaluation (DEP 2006b).

4.7 Riparian Buffer Program

DEP values the importance of protecting and managing riparian buffers as one component of an effective overall Watershed Protection Program. To this end, many of DEP's watershed programs, partnerships, and research initiatives actively address the protection, management, and restoration of riparian buffers in the New York City Watershed. Formalizing DEP's recognition of the importance of riparian buffers, a new set of milestones under the "Riparian Buffer Protection Program" were negotiated and agreed upon as part of the 2007 Filtration Avoidance Determination (FAD).

This report will provide an update on each of the milestones set forth in FAD section 4.7, including status of existing programs, Conservation Reserve Enhancement Program (CREP) evaluation and implementation, Streamside Assistance Program (SAP) development, and education and outreach activities.

Highlights of Riparian Buffer Accomplishments for 2007:

- DEP, under fee simple or easement, purchased an additional 846 riparian buffer acres. It now protects 11.2% of 100-foot stream buffers in the Catskill/Delaware System, a 3.7% increase in buffer ownership since 2004.
- The Watershed Agricultural Council (WAC) farm easement program expanded the protected riparian buffer from 15 feet to 25 feet.
- DEP Natural Resource Management (NRM) completed a series of four guidebooks for various activities on conservation easements that all speak to the importance of protecting riparian buffers.
- DEP Stream Management Program (SMP) sponsored restoration of degraded riparian areas in six projects, which covered 7,250 feet of streambank and included installation of over 5,000 native trees and shrubs, 6,400 willow posts, and 2,000 feet of willow fascine.
- Over 120 volunteers participated in SMP riparian planting activities.

- Fifty-nine WAC Forestry plans completed in 2007 contain riparian plans, covering 1,239 riparian acres.
- Two acres of riparian buffers were planted using funds made available through the pilot Management Assistance Program (MAP)
- CREP protected an additional 164.8 acres containing 16 stream miles. All told, CREP riparian buffers exclude over 10,000 head of livestock from streams and creeks and protect a total of 1,885.2 acres, containing 181.4 stream miles.
- The outreach committee of the Riparian Buffers Working Group (RBWG) unveiled www.catskillstreams.org, a website with a wealth of information about stream and riparian buffer management and protection.
- DEP and program partners hosted a native plant seed collection workshop, toured the Greenbelt Native Plant Nursery (GNPN), and developed a landowner guide to native plants.
- DEP co-sponsored and presented at the Hudson River Watershed Alliance's annual conference, "Watershed Connections: Ecological and Economic Values of Streams and Floodplains," which highlighted the value and function of riparian buffers, and was attended by 180 people from throughout the Hudson River Valley.

4.7.1 Existing Programs

This section describes ongoing activities of DEP programs to protect and enhance riparian buffers on DEP owned or controlled land and on private lands. Coordination and cooperation of these programs is covered as well.

Land Acquisition Program

The Land Acquisition Program seeks to prevent future degradation of water quality by acquiring sensitive lands. The overarching goal of the program is to ensure that undeveloped, environmentally-sensitive watershed lands remain protected and that the watershed continues to be a source of high-quality drinking water to the City and other upstate consumers.

GIS analysis of riparian buffers defined these areas as 100 feet from the centerline of streams and rivers; the analysis excludes the length of "shoreline" around reservoirs, ponds, lakes, or wetlands.

The most definite method for protecting buffers is controlling ownership under a status of forever wild or permanently conserved. Of the more than one million acres in the Catskill/Delaware System, 34% were protected as of January 2008, through ownership or easements held by DEP, WAC, New York State Department of Environmental Conservation (DEC) or by other public or private open space entities. Including lands owned by DEP before 1997, DEP protects 11.2% of 100-foot stream buffers. When other entities (DEC, land trusts, etc) are included, a total of 22,420 acres of stream buffers are protected, or 29.4% of the 76,302 acres of buffers that exist in the Catskill/Delaware System**.** Table 4.20 reports the total land in the Catskill/Delaware System and its ownership type. For more information about DEP and WAC acquisitions and ease-

ments, see section 4.2 Land Acquisition Program. As a result of reviewing program elements for enhanced riparian protection, the WAC easement program expanded the width of protected riparian buffers from 15 feet to 25 feet wide from the streambank.

Table 4.20. Catskill/Delaware riparian buffer ownership summary as of January 2008.

Land Protection Category	Total in Cat/Del Watershed* (acres)	% Total Cat/Del Watershed Area	Cat/Del 100 ft. Riparian Buffer** (acres)	% Total Cat/Del Riparian Buffers
Publicly-owned or Controlled lands				
NYC-owned Property (Pre-1997)***	61,570.3	5.9%	1,943.5	2.5%
Newly-acquired NYC Land (Post-1997, Fee)****	53,056.2	5.1%	4,142.2	5.4%
Land Protected by DEP Conservation Easement****	14,118.0	1.3%	1,196.4	1.6%
Land Protected by WAC Conservation Easement****	15,251.2	1.5%	1,242.2	1.6%
Subtotal NYC Lands and Easements	**143,995.6**	**13.7%**	**8,524.4**	**11.2%**
NY State-owned Land	206,091.1	19.6%	13,358.0	17.5%
Other Open Space (Land Trust, Municipal, etc.)	5,452.8	0.5%	537.2	0.7%
Total Cat/Del Public Land:	**355,539.5**	**33.9%**	**22,419.6**	**29.4%**
Private Watershed Lands				
Private Land	693,929.4	66.1%	53,882.8	70.6%
Total All Cat/Del Privately-owned Land:	693,929.4	66.1%	53,882.8	70.6%
Total All Land in Cat/Del:	**1,049,468.9**	**100.0%**	**76,302.4**	**100.0%**

*Cat/Del includes all WOH basins plus West Branch, Boyd Corners, and Kensico.

**Buffered hydrological features include streams and rivers only, and exclude reservoirs and lakes.

***Includes land under reservoirs and major tributaries.

****Under contract or closed as of January 2008.

Statistics produced by T. Spies from BWS GIS, 2/2008.

Natural Resource Management Program

Land Management Planning

In addition to the protective benefits of controlling future land use through the acquisition process, DEP is seeking to actively manage its lands under the guidance of the Natural Resource Management Program. One guiding document, General Land Management Plan (DEP 2004b),

identifies four over-arching goals for management of DEP water supply lands: protecting public health, maintaining ecosystem integrity, providing community benefits, and promoting increasing knowledge.

In addition, the plan calls for DEP land managers to meet land ownership responsibilities and use a land planning process. This is the framework in which additional land management efforts can be directed at riparian buffers on DEP lands.

In terms of riparian buffers, the plan calls for focused attention on variable source areas, wetlands, and shorelines on DEP lands with management efforts directed at protecting and enhancing the pollutant buffering and bank/shoreline protection qualities of riparian areas. Additionally, the plan identifies as a primary objective the maintenance, over time, of a diverse, vigorous, different-aged forested cover as the predominant vegetation type on DEP lands. This applies to riparian areas in particular where managing for high soil infiltration capacities and the predominance of subsurface flow is of critical importance. DEP seeks to achieve this cover type through the use of state-of-the-art silvicultural techniques as well as the control of white-tailed deer and other threats to the maintenance of continuous vegetative cover and vertical structure (including ground cover).

Inspection of DEP Land and Easements

DEP inspects all of its fee lands on a schedule ranging from every year to every three years, depending on the priority that is assigned to them. Priorities are based on property-use type (e.g., recreation, permits, agriculture). Inspections typically involve walking all boundary lines and interior sections of the property. In terms of riparian buffers, inspectors walk along streams, report stream or buffer issues, and record them in DEP's Watershed Lands and Information (WaLIS) Database.

As called for in the MOA, DEP monitors watershed conservation easements on a regular basis. This activity has afforded DEP an opportunity not only to inspect the continued integrity of riparian buffer areas but also to communicate the importance of ongoing protection to easement landowners through one-on-one conversations.

Use of DEP Lands

When reviewing requests from outside parties for proposed uses or projects on DEP land, DEP may require riparian buffers. For example, DEP allows agricultural use of DEP land but requires a minimum 25-foot buffer. Proposals that plan on a buffer greater than 25 feet are given extra points in their rating.

DEP developed a series of guide books for landowners conducting activities on DEP conservation easements. These include guidance for agriculture, forestry, bluestone mining, and stream and pond disturbance activities, and all speak to the issue of protecting riparian buffers. The easement agreement DEP now uses calls for a 50-foot riparian area that restricts most activi-

ties. Some activities, such as forest management, are allowed but require DEP approval and may be subject to special management precautions. Other activities, such as the construction of an accessory structure, cannot occur within 100 feet of streams. For any projects proposed by the landowner for in-stream work, DEP approval is required and careful consideration is given to any proposed stream channel or bank modification.

When DEP conducts forest improvement projects and a portion of the project takes place in a riparian buffer, special precautions are taken. In particular, DEP foresters try to avoid stream crossings when planning such projects. If a stream must be crossed, the location is carefully determined to minimize streambank or stream bed disturbance. In addition, foresters select the best management practice (BMP) for the stream crossing (e.g., fords, permanent versus temporary bridges) that have the least amount of impact. DEP secures stream crossing permits as required by DEC.

DEP has begun to prepare a Forest Management Plan as required by the 2007 FAD. A very important component within this plan will be guidance on how forestry projects are selected, planned, and carried out with respect to riparian areas (including wetlands, springs, and seeps).

Activities on Privately-owned lands

Streams that flow across privately owned lands make up approximately 71% of the total riparian buffer acreage (53,883 acres) of the Catskill/Delaware System. Among all Catskill/ Delaware reservoir basins, privately held riparian lands are most predominant in the Cannonsville basin (87.3%), and are least common in the Neversink basin (43.7%). Table 4.21 reports riparian buffer acres within each basin and their respective ownership. Many of these riparian buffers are also protected to some degree by the various combinations of MOA programs. For instance, Whole Farm Plans and Watershed Forestry Plans have been developed and implemented largely in the Cannonsville and Pepacton basins where private ownership is the greatest. The remaining sections of this report detail efforts to enhance and protect riparian buffers on private land.

Table 4.21. Total acres of protected riparian buffers* in the Catskill/Delaware System**, by basin, as of January 2008.

Protection Type	Ashokan	Boyd Corners	Cannonsville	Kensico	Neversink	Pepacton	Rondout	Schoharie	West Branch	Total Cat/ Del
NYC pre-MOA	308.7	10.0	508.0	96.5	319.2	444.2	77.7	117.0	62.2	1,943.5
NYC Fee***	472.3	397.9	558.5	10.6	148.6	801.8	372.8	952.9	426.8	4,142.2
NYC Conservation Easement***	163.3	52.3	109.3	20.7	227.1	303.9	49.2	236.2	34.6	1,196.4
NYC WAC Conservation Easement***			923.4		19.0	221.9		77.9		1,242.2
NY State	5,071.7	118.3	217.9		2,205.6	1,403.4	1,658.5	2,566.3	116.3	13,358.0
Other Open Space	151.4	16.8	64.6	23.6	112.8	31.6		100.6	35.8	537.2
Subtotal	6,167.4	595.3	2,381.7	151.3	3,032.3	3,206.8	2,158.3	4,050.7	675.8	22,419.6

Table 4.21. Total acres of protected riparian buffers* in the Catskill/Delaware System**, by basin, as of January 2008. (Continued)

Protection Type	Ashokan	Boyd Corners	Cannonsville	Kensico	Neversink	Pepacton	Rondout	Schoharie	West Branch	Total Cat/Del
Privately-owned	5,210.0	592.1	16,394.8	296.8	2,355.8	12,498.1	2,638.0	13,315.1	582.1	53,882.8
Total	11,377.4	1,187.4	18,776.5	448.1	5,388.1	15,704.8	4,796.3	17,365.9	1,257.8	76,302.4

*Buffered hydrological features include streams and rivers only, and exclude reservoirs and lakes.
**Cat/Del includes all WOH basins plus West Branch, Boyd Corners, and Kensico.
***Under contract or closed as of January 2008.
Statistics produced by T. Spies from BWS GIS, 2/2008.

Stream Management Program

The Stream Management Program (SMP) is a critical part of New York City's long-range watershed protection strategy. The SMP's mission is to restore stream stability and ecosystem integrity by encouraging long-term stewardship of Catskill Mountain streams and floodplains. To do this, DEP establishes partnerships with the region's Soil and Water Conservation Districts (SWCDs), landowners, and other local agencies and municipalities. The SMP addresses riparian buffers through stream management planning, riparian vegetation mapping, design and construction of stream restoration projects, invasive plant removal, and development of the Streamside Assistance Program (SAP).

The report, City Efforts to Protect Riparian Buffer Areas—July 31, 2004 (DEP 2004c), details the importance of stream management planning for the protection and enhancement of riparian buffers. By the end of 2007, stream management plans with corresponding riparian buffer mapping had been completed for the Batavia Kill, Broadstreet Hollow, Chestnut Creek, East Kill, Esopus, Schoharie, Stony Clove, East and West Branch Delaware, and West Kill watersheds. As a result of work required by the 2007 FAD, stream management planning will be completed for 85% of the West of Hudson Watershed. See section 4.6, Stream Management Program, for more information regarding stream management planning status.

With planning completed for much of the West of Hudson Watershed, DEP has turned its attention to adoption and implementation of the plans. A new requirement in the 2007 FAD, developing Action Plans with program partners (delivered May 2007), targets implementation. Training in riparian buffer design, SAP participation, bank stabilization for CREP enrollment, and native plant materials development are some riparian activities called for in the Action Plans. A few items completed from these plans include: pilot knotweed management workshop, completion of a native riparian plants brochure, hosting a bioengineering workshop, and completion of riparian demonstration projects**.**

The Action Plans all include recommendations for stream restoration, which resulted in DEP funding five projects in 2007 covering 6,950' of streambank. DEP and its program partners played an advisory or partial sponsorship role in over a dozen other restoration projects. For individual project details, refer to Section 4.6 Stream Management Program. Riparian activities involved in completing these projects include manual or chemical removal of invasive Japanese

knotweed (*Fallopia japonica*), planting of native trees and shrubs, installation of live willow stakes and fascines, native seeding, construction of a live log cribwall and vegetation reinforced slope stabilization, and wetland mitigation. For example, Greene County Soil and Water Conservation District (GCSWCD) and Evergreen Mountain, the project subcontractor, planted over 3,200 trees and shrubs, seeded 4.5 acres, and installed over 2,000' of willow fascine and 6,400 live willow posts on the Conine Stream Restoration project in Prattsville along the Batavia Kill. DEP, with assistance from program partners and interns, is monitoring these vegetative components to understand best practices and species for successful planting efforts.

Believing that native trees and shrubs stabilize streambanks most effectively, DEP is also concerned about the management of riparian invasive plant species. To date the most attention has focused on knotweed, which is found throughout the West of Hudson Watershed in varying densities. As part of stream walkovers, knotweed occurrences have been documented**,** knotweed-free zones have been established, and small populations have been addressed. Program partners have established demonstration management areas in Delhi, Halcott, and Phoenicia.

The SMP's Streamside Assistance Program is discussed in Section 4.7.3, and is the main focus of the SMP's riparian buffer protection and enhancement effort.

Watershed Agricultural Council

The Watershed Agricultural Council (WAC), through two main programs, the Watershed Agricultural Program (WAP) and the Watershed Forestry Program (WFP), is a non-profit organization whose mission is to support the economic viability of agriculture and forestry through the protection of water quality and the promotion of land conservation in the New York City Watershed.

Watershed Agricultural Program

WAP is a successful partnership between watershed farmers and NYC that develops and implements pollution prevention plans (i.e., Whole Farm Plans) on farms to protect water quality without negatively impacting the economic viability of the farm. The program is a voluntary partnership between 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 incorporates the economic and business concerns of each farm into the development of its Whole Farm Plan in order to fully assimilate the principles and goals of pollution prevention into the farm operation.

To date, 95.8% of all commercial farms (306) in the West of Hudson Watershed have agreed to participate in the program. There are presently 288 farms with approved Whole Farm Plans, while four new participating farms will have a Whole Farm Plan developed in 2008. The East of Hudson WAP has approved farm plans at four horse farms that are within the Catskill/Delaware System.

WAP has developed an Environmental Review/Problem Diagnosis (ER/PD) Assessment of commercial farms to identify water quality concerns. Planners and farmers complete the ER/PD, which matches appropriate BMPs with a priority-sorted list of environmental concerns. An important environmental issue related to riparian buffers that was identified by the ER/PD is unlimited livestock access to watercourses. Livestock can cause erosion on streambanks, deposit waste directly into streams, and denude riparian vegetation. The ER/PD identifies the barriers or BMPs (described below) necessary to limit nonpoint source pollution from farms.

The Whole Farm Planning program uses a "multiple barrier" approach to address agricultural nonpoint source pollutants. The first barrier, Pollutant Source Controls, uses BMPs that either reduce or eliminate the source of pollutants. The second barrier, Landscape Controls, implements BMPs that prevent the transport of pollutants across the landscape and into watercourses. Both barriers help to protect riparian buffer areas by reducing the amount of pollutants that reach the buffer.

The third barrier, Stream Corridor Controls, implement BMPs in riparian areas to either stabilize streambanks by excluding livestock or establish riparian buffers to help filter out pollutants before they reach a stream. CREP addresses this third barrier (see Section 4.7.2).

In 2000, WAC established the Small Farm Program to identify and prioritize water quality issues and begin developing whole farm plans and implement BMPs on small farms (those with average agricultural sales between $1,000 and $10,000). WAP approved 55 small farm Whole Farm Plans as of December 31, 2007, which includes approximately 7,994 acres of pasture, hay land, and forests. Establishing riparian buffers through the use of CREP is a major component of the Small Farms Program and 24 of the 55 small farms with plans include CREP buffers. WAC has a goal of developing up to 10 new small farm plans each year. Farms that are eligible for CREP are given higher priority when selecting which farms will be planned in the following year.

Watershed Forestry Program

The other arm of WAC, the Watershed Forestry Program (WFP), is a public-private partnership between DEP, WAC, and the United States Forest Service (USFS), an agency of the Department of Agriculture (USDA). WFP supports well-managed working forests as a beneficial land use for watershed protection. In terms of riparian buffer protection, the program supports several targeted pollution prevention and stewardship education initiatives that encourage loggers, foresters, and private forest landowners to properly manage riparian buffers and protect watershed streams during forest management activities. The program also supports a comprehensive urban/rural school-based education program that teaches the next generation of watershed stewards about the importance of riparian buffers.

WFP provides technical and financial assistance to eligible landowners to encourage them to adopt and implement of long-term forest management plans. Over the years, with technical support from DEP, DEC, and USFS, WFP has revised and strengthened its forest management plan specifications to increasingly focus on riparian buffer management and streamside protection measures. Beginning in 2004, all foresters who write forestry plans on properties that contain either a DEC-classified stream or a stream that appears on a United States Geological Survey (USGS) topographic map are required to also develop a corresponding riparian plan that meets the following minimum guidelines:

- Riparian areas should be identified on a USGS contour or stand type map. Management objectives for riparian areas should be developed cooperatively with the landowner and appear in the narrative for each riparian area. These objectives can range from wildlife management, afforestation, aesthetics, invasive species control, and timber management to no cut areas. Management objectives should address issues with a direct impact on water quality and riparian area management, such as tree planting in reverting farm fields adjacent to streams, the control of invasive species, or potential erosion problems within the riparian area.
- Foresters must identify in the plan narrative specific management recommendations to achieve the stated goals. These recommendations range from tree planting, water bar installation, road closeout, and wildlife mast tree release to timber stand improvement. Management recommendations must be based on site-specific information. If the riparian area differs significantly in age, size class, or species composition from surrounding forest stands, it should be treated as a separate stand and include a complete description of the forest type. When riparian management includes non-forested open areas (agricultural and non-agricultural), management objectives should include afforestation (with species options and planting criteria both described) along with potential programs available to support the establishment of forest stands.
- The minimum width for riparian areas is either two times the average height of the trees adjacent to the water body or the minimum distance, based on slope, as identified in the "New York State BMP Field Guide" (DEC 2000), whichever is greater. The riparian area begins at bankfull condition and extends to the distance identified above. (There is no minimum acreage.)
- New York State Timber Harvesting Guidelines and additional forestry BMPs pertaining to forest function, water quality protection, habitat, recreation, or aesthetic objectives should be identified.

During 2007, 78 forest management plans were completed, covering approximately 14,200 total acres, of which an estimated 11,130 acres are forested. Fifty-nine of these plans also contain riparian plans covering 1,239 riparian acres. To date, a total of 684 plans have been completed, covering 121,458 total acres (94,800 forested acres). One hundred and seventy-three of these plans also contain riparian plans covering 5,333 riparian acres.

Since 2005, with DEP support, WFP has been implementing the Management Assistance Program (MAP) on a three-year pilot basis. This program, which is modeled closely on the federal Forest Land Enhancement Program (FLEP), provides landowners having a Watershed For-

estry Plan with up to $2,500 in grant funding assistance to implement specific practices recommended in their plans. Eligible practices include timber stand improvement, tree planting, riparian improvements, wildlife improvements, and invasive species control.

With particular respect to riparian improvements, these projects strive to improve or protect water quality, riparian areas, and forested wetlands through the implementation of approved practices (based on USDA Natural Resource Conservation Service standards). Riparian buffer establishment on non-forest land, for example, requires at least three rows of planted shrubs and/or seedlings at a maximum spacing of 12' x 12' adjacent to water bodies using only non-invasive native or naturalized plant species. Funding is provided for tree shelters, fencing, and site preparation.

During 2007, 68 MAP projects were approved for funding, and 43 projects were completed (including 1 riparian improvement). To date, a total of 115 MAP projects have been approved for funding (including 5 riparian improvements), and 70 projects were completed (including 3 riparian improvement projects which resulted in 2 acres of newly planted riparian buffers).

Another mechanism for supporting voluntary implementation of forestry BMPs during and after watershed timber harvesting operations is offered by WFP through cost-sharing, technical assistance, and other incentives to loggers, foresters, and landowners. During 2007, the BMP program was expanded and reorganized into three primary components: Erosion Control (timber harvest roads and forest roads), Bridge Loans (including bridge cost-sharing and rentals), and BMP Free Samples.

The Bridge Loan component is the most relevant BMP program in terms of protecting riparian buffers. This program strives to minimize the impacts of logging equipment on watershed streams by encouraging the use of portable bridges and supporting the proper design and layout of stream crossing approaches on both sides of a watercourse. This aspect of the program—funding for stream crossing approaches—was adopted in 2007.

Coordination

A recommendation from the report on City Efforts to Protect Riparian Buffer Areas (DEP 2004c) stated the need for increased coordination to deliver riparian buffer programming. DEP has improved coordination efforts in several areas. Internally, representatives from different programs meet to share progress in addressing riparian buffers and often staff from different programs comment and advise on activities within riparian buffers. Various DEP programs also collaborate on student riparian planting activities on DEP property. DEP has sponsored several Riparian Buffers Working Group (RBWG) meetings, involving staff from various organizations and levels of government that help implement the Watershed Protection Program. See section 4.7.3 for more information about this Group.

DEP has taken a leadership role in the newly established Catskill Regional Invasive Species Partnership (CRISP) to cooperate in the management of invasive pests and plants that threaten the health of functional, forested, riparian buffers. Dozens of organizations and agencies have joined CRISP. DEP promoted three cooperative CRISP efforts during 2007: (1) with WAC and Cornell University, an invasive species public awareness survey, (2) with DEC, a firewood outreach protection project, and (3) with The Nature Conservancy, a black swallow-wort eradication effort. Details of these activities can be found in Section 4.5 Watershed Forestry (survey and firewood project), and Section 4.3 Land Management (black swallow-wort).

Another valuable area of coordination on riparian buffers occurs among DEP, WAC, and Delaware County SWCD in stabilizing streambanks to make properties eligible for CREP participation. To date DEP and DCSWCD have completed three stream restoration projects on agricultural land that would not have otherwise qualified for CREP inclusion. Plans exist to complete similar projects in future years.

Finally, DEP co-sponsored, coordinated, and presented at the Hudson River Watershed Alliance's annual conference, *Watershed Connections: Ecological and Economic Values of Streams and Floodplains*, which highlighted the value and function of riparian buffers, and was attended by 180 people from throughout the Hudson River Valley. Other organizations represented on the planning committee included Clearwater, Mohonk Consultations, and DEC.

4.7.2 Conservation Research Enhancement Program (CREP) Evaluation and Implementation

In August 1998, DEP entered into a five-year Memorandum of Agreement (MOA) with DEC and USDA to implement CREP in the Catskill/Delaware Watersheds. Another five-year agreement followed in 2003. DEP is actively participating in CREP until March 15, 2008 under the current New York City Watershed CREP Agreement. DEP/WAC is working to develop another five-year agreement with USDA to extend the CREP program through 2012.

This MOA allows watershed landowners to enter into 10- to 15-year contracts with the USDA to retire environmentally sensitive agricultural lands from production. CREP helps establish forested riparian buffers and filter strips adjacent to streams and other water bodies. USDA pays the farmer on average an enhanced rental rate of $115 per acre per year as well as 50 percent of the cost of all BMPs associated with establishing riparian buffers and/or permanent vegetative cover. In addition, in federal Fiscal Year 2000, USDA added two significant financial incentives, the Signup Incentive Payment (SIP) and the Practice Incentive Payment (PIP). DEP, through its agreement with WAC, pays the remaining 50 percent of BMP costs for participating farms, as well as technical and administrative assistance costs.

Without the financial incentives provided by USDA, farmers would not be able to give up the use of these sensitive riparian areas to establish buffers. The buffer width, determined by the USDA standard for "Riparian Forest Buffer", varies between 35 and 180 feet. The majority of

buffers implemented so far have been on pasture land, which requires additional conservation practices to ensure the success of the buffer. These practices may include tree and shrub planting, fencing to exclude livestock, alternative water supply, and stream crossings.

Exclusion of livestock from the riparian buffer eliminates the direct deposit of manure into streams and protects streambanks from erosion caused by heavy hoof traffic. More than 10,000 head of livestock (mainly dairy and beef cows) have been excluded from streams in the watershed West of Hudson as a direct result of CREP. Trees and shrubs established in the buffer area will help trap sediment, nutrients, and pathogens from adjacent agricultural lands. Farmers agree to maintain all conservation practices implemented by CREP for the full term of their CREP contract, which will help protect these newly established riparian buffers.

A total of 1,885.2 acres of CREP riparian buffers are now under contract. In addition, more than 225 acres of riparian buffers have been approved by WAC that are in the CREP contract development pipeline. All the associated BMPs have been implemented on 157 out of 171 contracts. Based on GIS data, an estimated 181.4 stream miles are now protected by CREP buffers. WAC has a goal of adding 150 new riparian forest buffer acres through CREP annually.

The CREP Committee with input from the RBWG developed a draft CREP outline for a program evaluation, which will be used to guide the CREP evaluation due on December 31, 2009. The outline includes a CREP evaluation survey to be completed by farmers who are participating in CREP as well as those farmers who are not participating. The purpose of the survey is to find out why some farmers may be reluctant to participate in CREP or enroll cropland, and also to find out from those who are participating what they like about the program. WAP staff while conducting their annual status reviews with farmers also completed the CREP survey. Approximately 45 surveys were completed in 2007. More about CREP can be found in Section 4.4 Watershed Agricultural Program.

4.7.3 Streamside Assistance Program (SAP) Development

The 2004 Riparian Buffer Report and its review by partnering agencies identified the need for a program for private properties that do not qualify for participation in other MOA programs (e.g., small, non-agricultural lands). To this end, DEP agreed to develop a SAP that would provide private landowners with enhanced education and training opportunities as well as access to technical assistance in the design and installation of riparian buffer projects. In support of this initiative, DEP budgeted funds and is negotiating contracts to hire staff at four watershed SWCD offices, implement projects, and develop a communications strategy. Following is a summary of developments in the Streamside Assistance Program that have occurred to date.

Riparian Buffers Working Group Coordination

In 2005, DEP initiated the formation of the RBWG to encourage a dialogue about riparian buffers among various entities working in the West of Hudson region. To date, DEP has hosted three of these meetings, which have included presentations by partner organizations, facilitation by Al Todd of the USFS, and keynote presentation by Bern Sweeney, Ph.D., Director of the Stroud Center. These meetings provide an opportunity for valuable dialogue about the various components included in the Riparian Buffer Protection Program.

After developing, printing, and distributing the booklet, "Catskill Streams and You: Living Streamside in the Catskill Region" (DEP 2006c), the outreach committee of the RBWG formally launched the multi-agency website, www.catskillstreams.org. DEP played a major role in the development of the site and contributed both to its structure and content. In addition to general stream process and management concepts, the site also contains detailed information about the importance of riparian buffers, instructions about streamside planting, a list of Catskill native trees and shrubs and where to get them, and other guidance about proper management of the streamside area.

Site Prioritization

One important piece of SAP is how to choose sites that receive treatment. In 2007, DEP and the GCSWCD initiated a pilot SAP planting project, and used vegetation mapping and stream feature inventories completed for Schoharie Creek and East Kill to make site selections. The chosen location, the Carr Road Project, was selected from a field of four properties abutting Schoharie Creek and East Kill. This project extends along more than 2,300' of Schoharie Creek in the Town of Jewett and has three strategic components: (1) site preparation through stem injection treatment of Japanese knotweed (*Fallopia japonica*) with glyphosate (Glypro), (2) planting of a 100' wide buffer strip beginning at the top of the streambank, establishing approximately 2.4 acres of buffer, and (3) installing willow tublings and willow stakes on the immediate streambank. To date, GCSWCD has installed 940 plants, and this work has attracted an adjoining downstream landowner who immediately signed a landowner agreement with the GCSWCD. This property, approximately 1,200' long, will be addressed in 2008 as another pilot planting for SAP.

In contrast to the Greene County process, Cornell Cooperative Extension of Ulster County (CCEUC) chose an opportunistic approach by conducting a planting on a property after a landowner expressed interest at a meeting. CCEUC teamed up with DEP and the DEC Trees for Tribs program to plant trees along a 300-foot long stretch of stream that had been maintained as a mowed lawn. Twenty-three volunteers planted 275 trees, shrubs, and willow stakes and were educated on the importance of riparian buffers in the process. The success of this event led to the planning of at least three similar projects along Esopus Creek for 2008.

Streamside Management Guidance

Working as part of a team, a SAP liaison will be employed in county SWCD offices. The SAP Coordinators will work independently within their assigned reservoir basin(s), but will also meet together and with DEP and other partners throughout the year to share, discuss, and critique experiences. Ulster County SWCD, DCSWCD, and GCSWCD are negotiating contracts with DEP that include a provision to hire a SAP Coordinator to implement the program. DEP is also exploring a partnership to provide young people the opportunity to assist with invasive plant removal and native tree and shrub planting in a team-based setting.

Often, SWCD staff develop basic planting plans that delineate a different list of species for installation along the bank and on the floodplain. In other instances, District staff have sub-contracted with a landscape ecologist to develop more detailed planting plans. Vegetation monitoring efforts will help evaluate these different approaches to tree and shrub placement. Further training in riparian buffer design, included in all basin Action Plans, will also improve project implementation.

Maintaining and Using Native Plant Material

DEP and partnering organizations have stressed the importance of maintaining ecological integrity and facilitating the use of plant materials that are native to the Catskill region. In 2007 DEP began exploring various options for receiving local genetic plant material. One possibility is through the New York City Parks Department Greenbelt Native Plant Nursery (GNPN). After meeting with GNPN staff and touring the facility in the summer, DEP is exploring a pilot agreement with GNPN to collect seed in the Catskills and grow out the plant material in GNPN's nursery. A workshop on Native Plant Seed Collection by GNPN staff, which addressed the importance of maintaining diverse, local genetic material in ecological restoration projects, the risks associated with introducing non-local genotypes, and the protocols used by GNPN in seed collection, processing, storage, and propagation, helped to initiate a relationship with the nursery staff and to garner support from program partners for developing these plant materials.

A root-pruning method patented by RPM Ecosystems LLC (RPM), located in Dryden, NY, provides another possibility for planting hardy, vigorous native plant material. The method purportedly produces trees and shrubs that grow faster and survive better than traditional nursery stock. DEP is exploring the option of contracting RPM to collect seed in the Catskills and grow out the material. This autumn DEP paid for 292 RPM trees to be planted by program partners throughout the Catskills at different project sites. DEP will monitor how these trees perform over the course of the next couple of years and then decide whether to contract with the company.

Another aspect of developing native plant materials for SAP implementation is having ready access to material of appropriate size. For several years, GCSWCD has maintained a Plant Materials Center (PMC) with support from various state grants and DEP. Most recently, by using DEP contract funds as a match, GCSWCD obtained $850,000 in Water Resources Development

Act funding to enhance the PMC and to implement riparian buffer projects. The PMC provides a source for willow stake and fascine material, sedge seedlings, balled-and-burlapped trees, and containerized trees and shrubs as needed.

DEP hired a Student Conservation Association intern to investigate questions about plant material supply and demand in the Catskills, appropriate types of materials to install on project sites, and aspects of similar programs throughout the United States. These findings will be useful in implementing SAP.

Communication Materials

DEP is exploring the best way to receive advice and recommendations on program identity and development of an outreach agenda and marketing strategy to best reach the intended audience for SAP. As DEP develops SAP, it will also work on a strategy for advancing the program among private landowners.

In the meantime, program partners will continue to reach out to landowners through various workshops and materials. This past summer a CCEUC intern developed a Native Plant List for homeowners. Additionally, substantial progress was made through the Carr Road pilot planting project in developing program materials for SAP, including a landowner agreement template, DEC permits, and landowner vegetation guidance. Other related outreach efforts can be found in Chapter 9. Education and Outreach.

4.7.4 Management Agreements

All owners of land on whose property restoration projects are being performed sign a 10-year temporary easement agreement. Each landowner agrees not to disturb any vegetation or construct roads or other permanent structures within the project area.

4.7.5 Education, Outreach, Marketing Strategy

In addition to the many education and outreach initiatives described above, DEP is working to develop an enhanced education, outreach, and marketing strategy for riparian landowners in accordance with the FAD milestone date of December 31, 2009.

4.8 Wetlands Protection Program

DEP's Wetlands Protection Strategy, initiated in 1996 and periodically updated since then (most recently in 2007), consists of regulatory and non-regulatory elements designed to protect and preserve the water quality function of wetlands in the watershed. The regulatory aspect of the program is focused largely on wetlands permit application and legislative review, while the non-regulatory component encompasses a variety of initiatives, including wetlands acquisition, mapping, and research. In 2007, permit review for activities on regulated wetlands and adjacent areas (see Figure 4.20), as well as legislative review, continued on the regulatory side. Planning for the

West of Hudson Wetlands Status and Trends Project, and continuation of field data collection for the West of Hudson Reference Wetlands Monitoring Program, were highlights of the non-regulatory portion of the program.

It should be noted that DEP's Wetlands program is active both in reservoir basins covered by the 2007 FAD as well as reservoir basins in the Croton system. Information provided in this section relative to activities in reservoir watersheds in the Croton system are provided for informational purposes only.

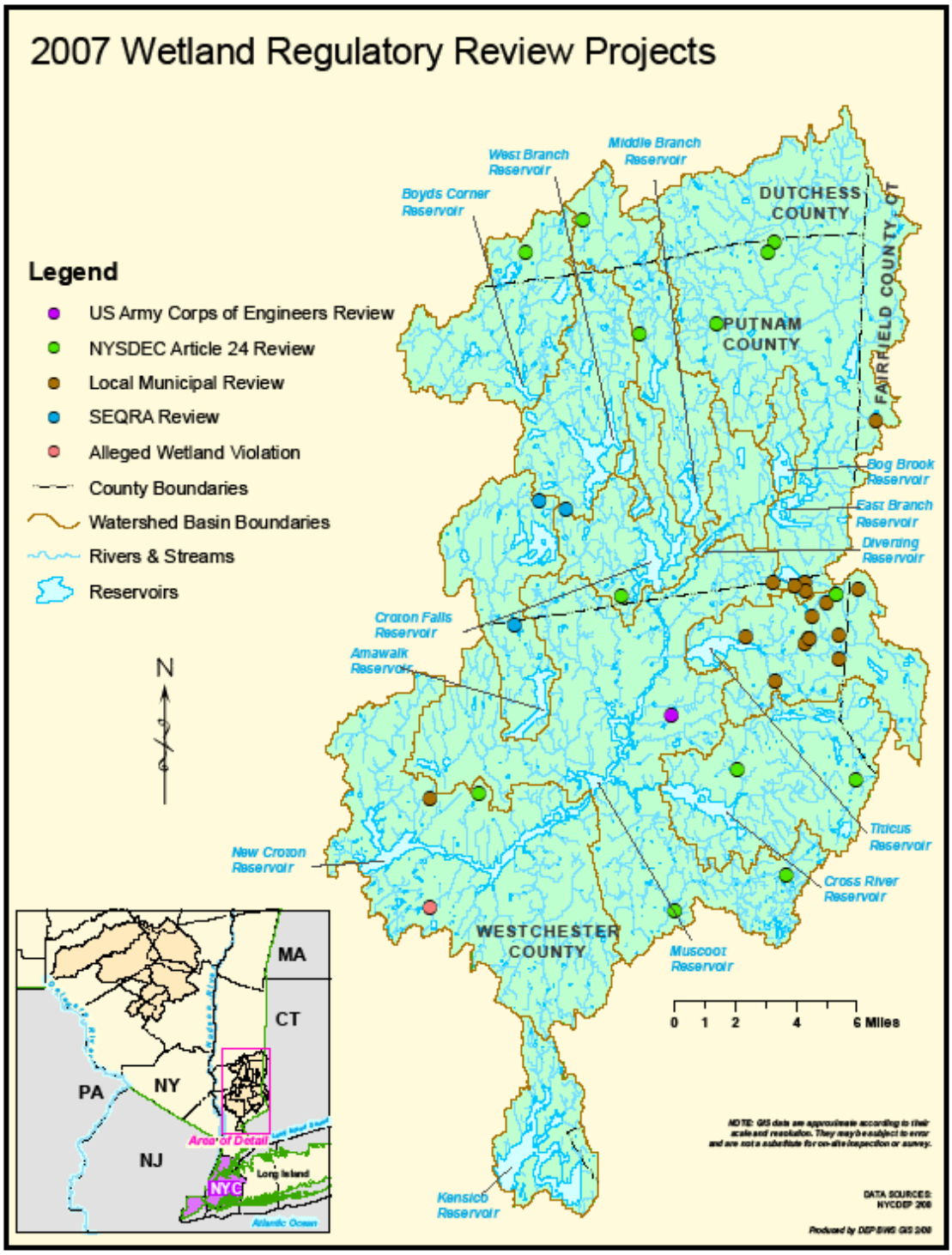

Figure 4.20. 2007 Wetland Regulatory Review Projects.

4.8.1 Regulatory Programs

Wetland Permit Application Reviews

Federal Reviews

Sponsors of projects affecting wetlands under the jurisdiction of the Army Corps of Engineers (ACOE) pursuant to Section 404 of the Clean Water Act submit Pre-Construction Notifications (PCNs) to ACOE if they believe their project is authorized by a nationwide permit and that they do not need an individual permit to proceed. DEP continually checks the ACOE website for PCNs to see what proposals are pending in the watershed. It then requests a copy of the permit applications to review. DEP also receives on-line notifications from ACOE regarding projects in the region. If, in its review, DEP concludes that a project will adversely impact a wetland, DEP will request ACOE to require an Individual Permit Application to allow for a thorough review of the proposal. In 2007, DEP commented on one proposal.

Table 4.22. DEP Reviews of United States Army Corps of Engineers Section 404 Permit Applications.

Project Name	NYC Reservoir Basin	Notification/ Permit	Wetlands Losses (acres)	Wetlands Gains (acres)	Activity
Falcon Ridge Subdivision	Muscoot	Public Notice	0.163 unspecified (buffer)	0.5 Wetland creation/ enhancement. Mitigation plantings	Construction of roads for subdivision

State Reviews

Article 15 Protection of Water Permit Reviews.

DEP issues comments to DEC Regions 3 and 4 concerning proposals with potential wetlands impacts. During 2007, DEP reviewed and commented on the seven DEC Article 15 Protection of Waters Permits presented in the table below.

Table 4.23. Article 15 Protection of water permit reviews.

Project Name	Town	Stream	State Permit	Project Type
Bull Run Road Bridge	Middletown	Bull Run	Article 15	Stream Disturbance
Neversink Ballfield	Neversink	Rondout Creek	Article 15	Stream Disturbance
Allen Brook Sewer Crossing Repairs	Hunter	Allen Brook	Article 15	Stream Disturbance
Hamden Community Wastewater Management	Hamden	Launt Hollow Creek	Article 15	Stream Disturbance
Silvestri Project	Hamden	Terry Clove Creek	Article 15	Stream Disturbance
Pine Brook Road	Walton	Pines Brook	Article 15	Stream Disturbance

Table 4.23. Article 15 Protection of water permit reviews. (Continued)

Project Name	Town	Stream	State Permit	Project Type
Margaretville at Village Park	Middletown	East Branch Delaware River	Article 15	Stream Disturbance

Article 24 Freshwater Wetland Permit Reviews.

DEP's review of freshwater wetland permit applications assesses the proposal's potential impact on wetlands and identifies measures to mitigate those impacts. DEP reviewed 13 Article 24 Freshwater Wetland Permit Applications during 2007.

Table 4.24. DEP reviews of New York State Department of Environmental Conservation Article 24 Wetland Permit Application.

Project Name	NYC Reservoir Basin	Notification/ Permit	Wetlands Losses (acres)	Wetlands Gains (acres)	Activity
Telecom Property	East Branch	Article 24	0.36 Unspecified (buffer)	Unspecified. Water quality swale and native vegetation plantings.	Wetland crossing for gravel drive to parking area.
Michelle Estates	Cross River	Article 24	0.029 (buffer)	None	Construction of emergency access drive for WWTP
Bottlegate Farm	Middle Branch	Article 24	0.37 (buffer)	Mitigation plantings	Construction of stormwater detention basin in wetland buffer
Hudson Valley Trust Pedestrian Bridge	East Branch	Article 24	0.057 (buffer)	None	Construction of gravel pedestrian walking path and wood pedestrian bridge with concrete abutments to cross DEC regulated stream
Frantell Development Corporation	East Branch	Article 24	0.5 (buffer)	Two planted stormwater detention basins and additional buffer plantings	Construction of 22,500 sq. ft. retail building with associated parking, sewage treatment, water supply
Sach's Park	Muscoot	Article 24	Unspecified grading for proposed pond shelf. 1.82 (buffer)	Mitigation plantings. 0.42 (restoration area) 1.08 (restored meadow)	Wetland restoration

Table 4.24. DEP reviews of New York State Department of Environmental Conservation Article 24 Wetland Permit Application.

Project Name	NYC Reservoir Basin	Notification/ Permit	Wetlands Losses (acres)	Wetlands Gains (acres)	Activity
Dynacast	New Croton	Article 24	0.59 (previously disturbed buffer)	None	Construction of an approximately 6,314 sq. ft. addition to an existing commercial building
John and Ronni Foster	Muscoot	Article 24	Unspecified (buffer)	Unspecified mitigation planting area	Construction of swimming pool
KTT Builders	Croton Falls	Article 24	Unspecified (buffer)	None	Proposed residence and septic
Peter Kamenstein	Titicus	Article 24	Unspecified (buffer)	None	Gravel driveway in buffer
Thistle Waithe Learning Center	Cross River	Article 24	0.078 (buffer)	0.335 Plantings	Pool abandonment and stormwater outflows
Beach Property	Boyd Corners	Article 24	0.02 (buffer)	None	In ground pool.
Dortono	Middle Branch	Article 24	Unspecified, Unspecified (buffer)	None	Pipe stream, fill wetland for house, septic

401 Water Quality Certifications.

DEP did not receive any requests for DEC 401 Water Quality Certifications during 2007.

Wetland Violations

There was one alleged wetland violation reported during the reporting period.

Table 4.25. Wetland violations.

Project Name	NYC Reservoir Basin	Notification/ Permit	Wetlands Losses (acres)	Wetlands Gains (acres)	Activity
Fairhills Farm	New Croton	Wetlands Violation	Unknown	Unknown	NOV issued by the Engineering Section. Wetland Permit needed by the Town of Yorktown.

Local Municipal Reviews

Local municipal wetlands applications are forwarded to DEP for review by New York City watershed towns. This includes permit applications from watershed towns in Connecticut, whose law requires applicants to notify DEP of applications for projects that lie within the NYC watershed. As with state and federal applications, DEP assesses the proposal's impact on wetlands and identifies measures to mitigate those impacts. DEP reviewed 16 local municipal wetlands applications during the reporting period.

Table 4.26. Local municipal reviews.

Project Name	NYC Reservoir Basin	Notification/ Permit	Wetlands Losses (acres)	Wetlands Gains (acres)	Activity
Annor, Inc.	Titicus	Local Municipal —Town of North Salem	Unspecified (buffer)	None	Proposed retaining wall and underdrain
Wiederhorn	Titicus	Local Municipal —Town of North Salem	Unspecified (buffer)	None	Construction of an indoor riding arena
113 W. King Street	East Branch	Local Municipal —City of Danbury, CT	0.045 (buffer)	None	Construction of home, driveway, and septic system
White-Flowers	Titicus	Local Municipal —Town of North Salem	0.48 (buffer)	None. Cultec infiltration system for increase in impervious surfaces	Construction of barn
Cheryl Aiello	East Branch	Local Municipal —Town of North Salem	0.003 (buffer)	None	Construction of sump line from house to storm drain
John and Marilyn Gizzi	East Branch	Local Municipal —Town of North Salem	Unspecified (buffer)	None	Construction of pool in wetland buffer.
Mehmetaj	Titicus	Local Municipal —Town of North Salem	0.016, 0.2 (buffer)	0.48 Mitigation plantings	Construction of single family home, septic, drainage
Pavilion	Titicus	Local Municipal —Town of North Salem	0.3 (buffer)	None	Replacement of existing gravel drive, grading and construction of 5 parking spaces within previously disturbed area of buffer.
Peter Kamenstein	Titicus	Local Municipal —Town of North Salem	0.003 (buffer)	None	Addition over existing masonry wall.

Table 4.26. Local municipal reviews. (Continued)

Project Name	NYC Reservoir Basin	Notification/ Permit	Wetlands Losses (acres)	Wetlands Gains (acres)	Activity
Francese Residence	New Croton	Local Municipal —Town of Yorktown	0.04 permanent (buffer) 0.03 temporary (buffer)	0.12	In ground pool, fence, stone patio
Brownridge Residence	Titicus	Local Municipal— Town of North Salem	Unspecified (buffer)	None	Addition to house
Roberty Murphy	Muscoot	Local Municipal —Town of North Salem	Unspecified (buffer)	None	Reconfiguration of driveway, drainage and pond berm.
Abrantes	East Branch	Local Municipal —Town of North Salem	Unspecified (buffer)	None	Deck addition.
Sullivan and Straus Property	Titicus	Local Municipal —Town of North Salem	200 cu. yds. Unspecified (buffer)	None	Dredging pond and depositing spoils on property. Line retention pond with clay and repair concrete wall. Construct sediment trap at inlet and forebay at outlet.
Monomoy Farm, LLC	Titicus	Local Municipal —Town of North Salem	0.18 permanent 0.69 temporary 1.05 permanent (buffer) 4.91 temporary (buffer)	1.11 Mitigation plantings	Horse farm improvements including bridle trails, farm roads, bridge, farm pond.
Ridgefield Golf Course	Titicus	Local Municipal —Town of Ridgefield, CT	0.6, 104 cu. yds. Plus an unspecified amount from pilings—2 @ 10' for 450' Unspecified (buffer)	Unspecified	Remove 230' of mostly gravel run-ups to bridge, reestablish open water, remove floating bridge, install permanent 450' timber bridge.

SEQRA Documents.

In 2007, DEP reviewed dozens of SEQRA documents from towns that forwarded projects to DEP for review. As with other applications, DEP assesses the proposal's impact on wetlands and identifies measures to mitigate those impacts. Below is a table summarizing projects that had major wetland review issues.

Table 4.27. SEQRA document reviews.

Project Name	NYC Reservoir Basin	Notification/ Permit	Wetlands Losses (acres)	Wetlands Gains (acres)	Activity
River Run Senior Housing	Cannonsville	SEQRA—Town of Delhi	Unspecified	Unspecified	Proposed 70-unit adult community on West Branch Delaware River
OmniPoint Communications, Inc.	Muscoot	SEQRA—Town of Somers	Unspecified	Unspecified	Commercial development
Wixon Pond Estates	Amawalk/West Branch	SEQRA—Town of Carmel	Unspecified (buffer)	Unspecified	6-lot subdivision and access road, stormwater basins
Wixon Pond Development	Croton Falls	SEQRA—Town of Carmel	0.03, unspecified (buffer)	None	4-lot subdivision and access road, stormwater basins

Legislative Reviews

In 2007 DEP commented, through the New York City Law Department, on proposed changes to the State Water Quality Certifications, which were changed due to revisions to the ACOE's Nation Wide Permits in 2006.

4.8.2 Non-Regulatory Programs

Acquisition of Wetlands

See Section 4.2 Land Acquisition Program.

Wetland Mapping and Research

The wetland mapping and research programs are designed to support both the regulatory and non-regulatory aspects of DEP's Wetlands Protection Strategy (DEP 2007b). These programs include both the Wetland Functional Assessment Program and the Wetlands Status and Trends Project.

Wetland Functional Assessment

DEP's Wetland Functional Assessment Program combines the United States Fish and Wildlife Service (USFWS) Watershed-based Wetland Characterization and Preliminary Assessment of Wetland Functions (W-PAWF) with a Reference Wetlands Monitoring Program to deter-

mine baseline characteristics and water quality functions of wetlands among various hydrogeomorphic settings. The W-PAWF, which was completed in 2004 and submitted as a FAD deliverable (Tiner 2004a and b), developed hydrogeomorphic classifications and preliminary functional assessments for wetlands in the NWI database. The purpose of the reference wetlands monitoring program is to verify these classifications and preliminary assessments and to provide additional measures of ecological and water quality conditions for reference wetlands.

West of Hudson Reference Wetland Monitoring Program.

In previous years, water quality, water table elevation, vegetation, and soils were sampled at 22 reference wetlands located throughout the Catskill and Delaware watersheds to evaluate functional assessments developed through W-PAWF. (Results are reported in DEP 2006d, DEP 2006e, and DEP 2007b). In 2007, DEP continued to collect water table elevation data from the monitoring wells at the 22 headwater reference wetlands and continued to confirm plant species identification using plant specimens collected during the vegetation surveys. DEP also continued to analyze data collected from these reference wetlands.

West of Hudson Wetlands Status and Trends Project

Planning for this program, as well as the startup of the contracting process with USFWS, took place in 2007. The project will look at gains and losses of wetland acreage and type, by basin, in the Catskill/Delaware watershed from the 1980s to the 1990s, and from the 1990s to 2003. DEP will complete the work in 2008.

4.9 East of Hudson Non-Point Source Pollution Control Program

The East of Hudson Nonpoint Source Pollution Control Program is a comprehensive effort to address nonpoint pollutant sources in the four East of Hudson (EOH) Catskill/Delaware (Cat/Del) watersheds[1]. The Program supplements DEP's existing regulatory efforts and nonpoint source management initiatives. The Program generates data on the watershed and its infrastructure and uses that information to evaluate, eliminate, and remediate existing nonpoint pollutant sources, maintain system infrastructure, and evaluate DEP's programs.

4.9.1 Wastewater-Related Nonpoint Source Pollution Management Programs

Nonpoint sources of wastewater may include exfiltration or other releases from defective sewer lines, failing septic systems, and illicit connections to the stormwater collection system. The four target watersheds contain 12 wastewater treatment plant discharges and a system of sewer infrastructure within several sewer districts. Outside of the existing sewer districts, wastewater is treated by subsurface sewage disposal systems (SSDS).

1. The East of Hudson Catskill and Delaware reservoirs include West Branch, Croton Falls, Cross River, Boyd Corners, and Kensico Reservoirs. Kensico Reservoir is discussed in section 4.10 of this report.

Wastewater Infrastructure Mapping and Inspection Program

As part of DEP's efforts to reduce potential pollutant loading from wastewater sources, DEP developed a program for the inspection and mapping of the sanitary infrastructure in the EOH Cat/Del watersheds. The inspection program includes identifying defects and assessing those that may result in exfiltration of effluent to surface water. Digitized data include 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 other pertinent data concerning cross and illicit connections.

DEP began infrastructure inspections in 2004. No cross connections, illicit connections, or defects that may lead to exfiltration of wastewater were identified in the over 6,000 feet of sanitary sewer inspected. The contractor discovered that the number of structures and length of pipe were substantially greater than initially estimated. DEP's change order request to complete the inspection and mapping under the stormwater contract was denied because of the overall scope change of the request. The work to inspect and digitally map the remaining 250,000 linear feet of sewer pipelines and 1,200 structures will be completed under a new contract. Once the inspection and mapping are complete, DEP will coordinate the remediation of any identified failures with the responsible entity.

Septic Program East of Hudson

DEP provides ongoing support to Westchester County and Putnam County in their efforts to reduce the potential impacts of improperly functioning or maintained SSDSs. Within Westchester County, DEP continues to work with the County Health Department on its efforts to ensure that homeowners properly use and maintain their SSDS. This includes the county's regulatory requirement that only contractors that have been fully trained and licensed by the county are allowed to construct and repair SSDSs. The county also maintains a database that indicates the number of repairs completed within the watershed. Funding to initiate the contractor training, contractor licensing, and septic repair database was provided through the East of Hudson Water Quality Investment Program Funds (WQIP), as provided for in Section 140 of the 1997 Watershed Memorandum of Agreement.

Within Putnam County, DEP works with the Septic Repair Program (SRP) staff to target repairs in priority areas as well as provide septic education information. The SRP includes several phases of implementation that target priority areas within the Cat/Del watersheds located East of Hudson (Figure 4.21). Putnam County used DEP's Croton Watershed Strategy and other water supply factors (e.g., 60-day travel time), as well as data from the Putnam County Department of Health, to develop a three-stage program roll-out.

DEP provided the necessary funds to carry out the county's SRP through the WQIP. Putnam County allocated $3.3 million of the WQIP funds to repair septic systems in the highest priority areas. Based on the level of participation to date, Putnam allocated an additional $550,000 to

allow areas in additional phases to be included in the program earlier than initially planned. The county sent introductory mailings to homeowners within the primary target area of Phase I in December 2005. Since that time, there have been a total of three mailings to each of the homeowners located in the first three priority areas. To date, Putnam has sent approximately 3,000 mailings and repaired more than 70 systems.

Additionally, the New York State Department of Environmental Conservation (DEC) has drafted Phase II Municipal Separate Storm Sewer Systems (MS4) permit requirements that call for specific measures to reduce the impacts of improperly functioning SSDSs. In particular, based on the draft permit, EOH municipalities are required to "develop, implement and enforce a program that requires property owners to inspect, repair and/or replace failing septic systems that are tributary to the small MS4…." As EOH MS4 areas implement the Phase II MS4 requirements, DEP will evaluate its existing activities in order to avoid duplicative or conflicting efforts.

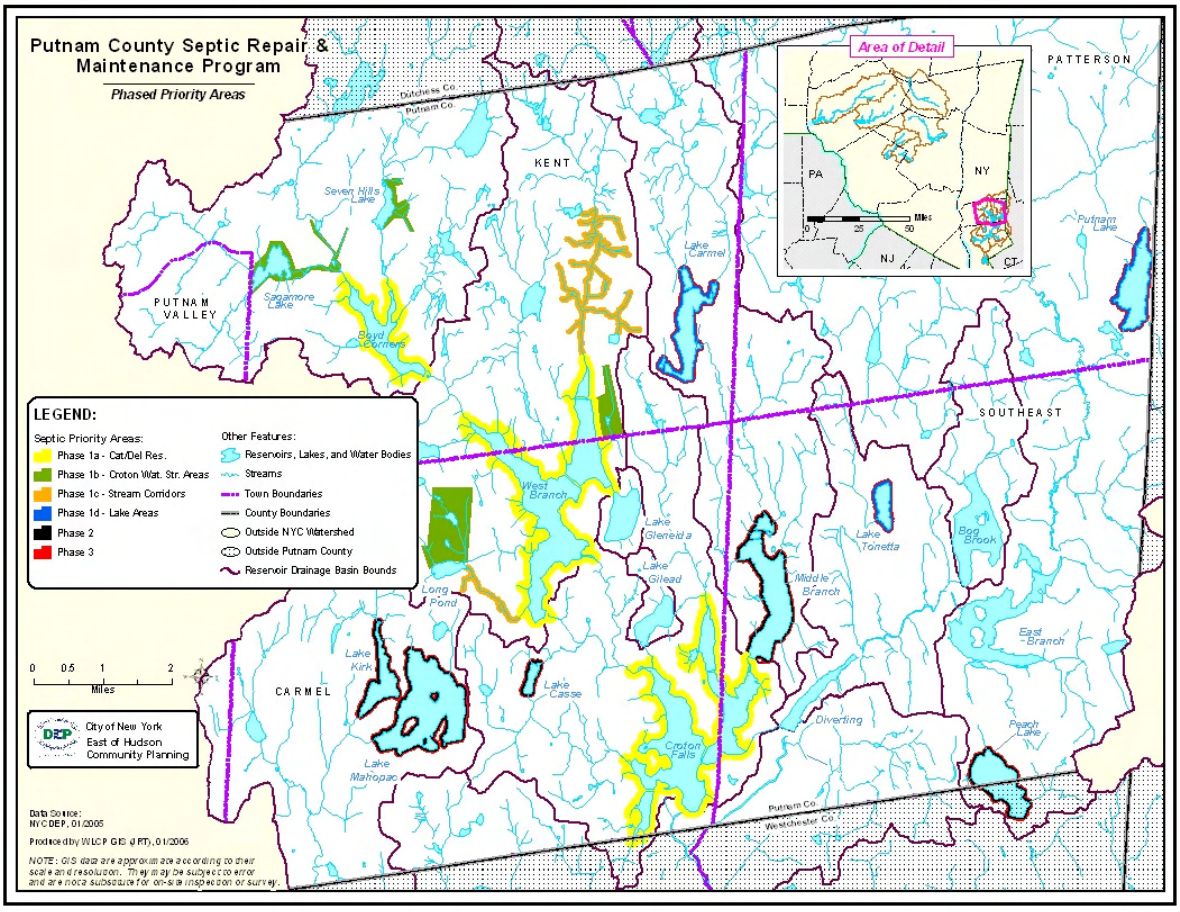

Figure 4.21. Putnam SRP – Phased Priority Areas.

4.9.2 Stormwater-Related Nonpoint Source Pollution Management Programs

In an effort to further reduce pollutant loading from stormwater, DEP is working on multiple nonpoint source reduction projects within the EOH Cat/Del watersheds. These projects include large retrofit and remediation projects as well as remediation of smaller erosion sites. In addition, DEP is gathering new information through mapping that will further enhance pollutant reduction initiatives.

Stormwater Retrofit Projects

Hemlock Dam Road and Magnetic Mine Road are the sites of two large retrofit projects funded by DEP. The sites contain stretches of unpaved road in the town of Carmel that drain toward Croton Falls Reservoir. DEP identified possible roadway and drainage improvements in an effort to reduce erosion potential and turbidity in the Croton Falls watershed. The project will make roadway improvements as well as improve the functionality of the existing stormwater conveyance system along the roadways.

DEP completed conceptual design in May 2007. Conceptual design included establishing design and construction schedules, general design drawings, and compiling a preliminary list of expected permits that would be required. During the reporting period, the soil borings, topographical survey, and wetland delineation were initiated and completed. Preliminary design began in September 2007 and draft permitting documents were prepared. The 40% complete design drawings were distributed for review in November 2007. Initial comments received in December 2007 indicated that due to impacts on existing wetlands and numerous tree removals, additional and more extensive permitting is likely to be required from DEC, the Army Corps of Engineers, as well as the local townships.

Stormwater Remediation Projects

Five large remediation projects are under final design and environmental review as outlined below.

Remediation Projects on City-Owned Property (CR-1 and CF-1)

The following two large remediation projects are located on City-owned property. During the reporting period, inaccuracies in the previous designer's survey and design drawings were corrected. New preliminary designs have been approved and preliminary contract documents are anticipated in the first half of 2008. This will be followed by the environmental review, permitting, and local municipal approvals.

CR-1: Maple Ave, Town of Bedford, Westchester County: DEP will install stormwater drainage improvements, stabilize parking areas with porous pavers, repair and clean out some culverts, and stabilize embankments. This project will reduce sediment loading in the storm drainage inflows to Cross River Reservoir.

CF-1: Michael Brook, Town of Carmel, Putnam County: DEP will repair a severely eroded drainage ditch along Hughson Road that drains directly into Croton Falls Reservoir. Numerous trees and other debris that have accumulated at the juncture of Croton Falls Reservoir and Michael Brook will be relocated outside the watercourse of Michael Brook.

Remediation Projects on Privately-Owned Property (WB-1, WB-2 and BC-1)

The following three large remediation projects are located on privately-owned property. During the reporting period, DEP continued work to complete project designs and to draft the easements necessary to perform work at these sites. Access agreements to conduct additional survey work were also drafted and it is anticipated that these agreements will be finalized by early 2008. Joseph Court (Location WB-1) will require permanent easements from two property owners for future maintenance. Sycamore Park (Location WB-2) is owned by the Town of Carmel and will require an intergovernmental agreement.

WB-1: Joseph Court, Town of Kent, Putnam County: DEP will repair and stabilize a severely eroded drainage channel on a steep slope that drains into West Branch Reservoir. This work will include cleaning out accumulated debris and stabilization of the drainage channel.

WB-2: Sycamore Park, Long Pond Road/Crane Road, Town of Carmel, Putnam County: DEP will remove gravel parking areas within the wetland buffer zone and replace them with grass pave porous pavers. This will serve to stabilize parking areas within the wetland buffer and remove the source of gravel migration into the wetlands. Landscape improvements and barriers will be installed to prevent the current parking encroachment into the wetlands. Drainage improvements and swales will contain runoff from the paved road and parking areas beyond the wetland buffer. Debris build-up within the current culvert located under the access road and draining directly to the wetlands will be removed and the culvert outfall will be reconstructed outside of the wetland. The DEC regulated wetland has been delineated and the location certified by DEC. Preliminary site plans have been reviewed by the Town of Carmel and their comments are being incorporated into final design drawings.

BC-1: Nemarest Club, Town of Kent, Putnam County: DEP will (1) replace a defective and undersized road culvert where the stream crosses under a dirt road, (2) relocate large rocks that are currently in-channel near the road crossing, (3) install forebays adjacent to the culvert, and (4) replace guide rails along the culvert crossing.

Stormwater Remediation Small Projects

The Small Stormwater Remediation Projects Program involves the identification and remediation of smaller erosion sites in the four EOH Cat/Del watersheds. Approximately 30 sites were selected for remediation. Typical erosion abatement includes embankment stabilization, headwall repair, road drainage improvements and installation of stabilized outlet controls, renovating eroding gravel parking areas, and trail stabilization. Once sites are selected, design and per-

mitting processes begin and are followed immediately by construction. Construction for each site is typically about one week, minimizing exposure of disturbed soil in close proximity to water bodies. Figure 4.22 shows a typical site selected for inclusion in the program.

Figure 4.22. Eroded drainage ditch at Hemlock Road.

In 2007, construction was completed at several sites. These sites will be monitored during the next reporting period to ensure that the stabilization efforts were successful. Completed sites will be included in DEP's Facility Inspection and Maintenance Program. Sites that have been completed are shown in Table 4.28. Figure 4.23 is an example of a completed project.

Table 4.28. Completed small stormwater remediation projects.

Site No.	Reservoir	Town	Street Name	Location	Description of Work
CF1-05	Croton Falls	Carmel	Crafts Road	Putnam County Bikeway	Watercourse erosion repair
CF2-05	Croton Falls	Carmel	Hemlock Dam Road	West side of Croton Falls Road	Forebay construction, channel stabilization
CF3-05	Croton Falls	Carmel	Hemlock Dam Road	Southeast of Croton Falls Road	Headwall and endwall repair, embankment and channel stabilization

Table 4.28. Completed small stormwater remediation projects. (Continued)

Site No.	Reservoir	Town	Street Name	Location	Description of Work
CF4-05b	Croton Falls	Carmel	Croton Falls Road	Stebbins Road	Embankment and channel stabilization
CF4-05a	Croton Falls	Carmel	Croton Falls Road	Between Stebbins and Pigott Roads	Embankment and channel stabilization
CF 3-07	Croton Falls	Carmel	Stoneleigh Avenue	Magnetic Mine Road	Channel erosion stabilization, pipe outlet stilling basin
CF3-10	Croton Falls	Carmel	Croton Falls Road	Boat Area #6	Repair eroded swales
CF5-05	Croton Falls	Carmel	Stoneleigh Avenue	Vista on the Lake	Replace asphalt swale with water quality swale, repair eroded swale

Figure 4.23. Swale repair at Vista on the Lake.

Sites that are scheduled for construction in 2008 are shown in Table 4.29.

Table 4.29. Ongoing small stormwater remediation projects.

Site No.	Reservoir	Town	Street Name	Location	Description of Work
CR1-06	Cross River	Lewisboro	Post Office Road	Autumn Ridge Road to Benedict Road	Embankment stabilization, forebay, and drainage swales
CR2-06	Cross River	Lewisboro	Benedict Road	Post Office Road to Oscaleta Road	Embankment stabilization, forebay, and drainage swales
CR2-07	Cross River	Lewisboro	Route 35	Near Bouton Road	Embankment stabilization, sediment removal, headwall repair
CR1-07	Cross River	Lewisboro	Route 121	Near High School	Headwall and endwall repair, embankment stabilization, riprap swale construction
CF3-06	Croton Falls	Carmel	Drewville Road	Intersection with Cherry Hill Road	Headwall and endwall repair, embankment stabilization, and rip rap swale construction
CF2-06	Croton Falls	Carmel	Drewville Road	Boat Area #14	Headwall and endwall repair, embankment stabilization, riprap swale construction
WB1-06	West Branch	Carmel	Route 301	Gleneida Avenue	Headwall and endwall repair, embankment stabilization
WB3-06	West Branch	Carmel	Gypsy Trail	Ninham Court to Route 301	Embankment stabilization, riprap swale construction
BC2-06	Boyd Corners	Kent	Cole Shears Court	East Boyds Road to Dead end	Headwall and endwall repair, embankment stabilization, riprap swale construction

Table 4.29. Ongoing small stormwater remediation projects. (Continued)

Site No.	Reservoir	Town	Street Name	Location	Description of Work
WB2-07	West Branch	Kent	Belden Road	Route 6 to Route 47	Headwall and endwall repair, embankment stabilization, riprap swale construction,
CR1-05	Cross River	Bedford	121 Old Post Road	From Honey Hollow Road To Upper Hook Road	Riprap drainage swale along Route 121; DEP boat storage stabilization, trail grasscrete
CR3-05	Cross River	Pound Ridge	Cross Pond Road	Scofield Road	Repoint headwall, clean and construct drainage swales, construct forebay
WB1-05	West Branch	Carmel	Glenvue Road	Gleneida Avenue	Embankment and channel stabilization, forebay construction
BC3-07	Boyd Corners	Kent	Ninham Road	Northeast of East Boyds Road	Embankment stabilization, riprap swales
CF1-07	Croton Falls	Carmel	Croton Falls Road	Near Stebbins Road	Streambank stabilization
CF2-07	Croton Falls	Carmel	Croton Falls Rd	Near Sandy Road	Streambank stabilization
CF 4-07	Croton Falls	Carmel	Croton Falls Road	Between Stebbins and Sandy Roads	In-stream restoration site A-weirs and/or vanes
CF4-06	Croton Falls	Carmel	Drewville Road	Weber Road to West Shore Road	Headwall and endwall repair, embankment stabilization, riprap swale construction
CF5-07	Croton Falls	Carmel	Croton Falls Road	Between Stebbins and Sandy Roads	In-stream restoration site B-weirs and/or vanes

Table 4.29. Ongoing small stormwater remediation projects. (Continued)

Site No.	Reservoir	Town	Street Name	Location	Description of Work
WB3-07	West Branch	Kent	Nicols Road	East side of causeway	Riprap swale construction, embankment stabilization, improve parking for boat area
WB4-07	West Branch	Kent	Nicols Road	West side of causeway	Riprap swales, embankment stabilization
BC1-07	Boyd Corners	Kent	Farmers Mills Road	Route 52	Embankment stabilization, riprap swale construction
BC2-07	Boyd Corners	Kent	Route 52	White Pond Road	Headwall and endwall repair, embankment stabilization

Spill Containment Facilities

DEP has developed a spill containment plan for the four EOH Cat/Del reservoirs in order to mitigate spills from local roadways. During 2007, 14 deployable sites, which were installed to partition the reservoirs in the event of a spill, and 12 permanent boom sites or containment facilities, have been constructed (Table 4.30). Construction of storage buildings and boat ramps associated with the spill containment plan is anticipated to commence in 2008.

Table 4.30. Spill containment facilities.

Reservoir	Boat Ramps (New)	Boat Ramps (Improvements to Existing)	Buildings	Number of booms (Deployable/ Permanent)
West Branch	Shaft 9	Belden Road: provide turnaround, move gate off road	15' x 30' at Belden Road, 15' x 30' at Shaft 9	2 Deployable 3 Permanent
Boyd Corners	East Boyds Road	None	12' x 12' at East Boyds Road ramp	3 Deployable 4 Permanent

Table 4.30. Spill containment facilities. (Continued)

Reservoir	Boat Ramps (New)	Boat Ramps (Improvements to Existing)	Buildings	Number of booms (Deployable/ Permanent)
Croton Falls	Magnetic Mine Road, Hemlock Dam Road	Drewville Road: improve entrance/ egress, move gate	12' x 12' at Magnetic Mine Road, 15' x 30' at Hemlock Dam Road	5 Deployable 0 Permanent
Cross River	None	Route 35	15' x 30'	4 Deployable 5 Permanent

Facility Inspection and Maintenance

DEP previously developed a facility inspection and maintenance program in order to ensure that previously constructed remediation facilities continue to function as designed. New facilities continue to be brought on line and are added to the routine inspection program. Facility maintenance is promptly completed under the construction contract warranty for the first year and under the three-year maintenance contract thereafter. Inspection and maintenance follows procedures identified in the Operation and Maintenance Guidelines (DEP 2000a); facility types not described in this document were incorporated into the facility maintenance contract with explicit maintenance instructions.

Stormwater Infrastructure Mapping and Inspection Program

DEP is managing a program to digitally map and video inspect stormwater infrastructure in the West Branch and Boyd Corners watersheds, having already completed the contract to map the Croton Falls, Cross River, and portions of the West Branch and Boyd Corners watersheds. Digital data include stormwater pipe size, estimated age, material and location, catch basins, manholes, culverts and outfall location, size and estimated age, and all pertinent data concerning cross and illicit connections.

In 2007, DEP's contractor mapped approximately 79,000 linear feet of stormwater infrastructure (95% of the total). In some areas, steep local topography made it difficult to determine the precise GPS location of pipe inlets/outlets with the resolution required by the contract. This difficulty was due to the limited availability of an adequate number of satellites. As a result, the contractor will be required to re-shoot these points when better satellite coverage is available or use offset methods.

Stormwater infrastructure in the project area generally consists of short lengths of pipe. Nearly all sections are less than 300 feet in length and over two-thirds are less than 100. In this area, stormwater infrastructure is mainly culverts crossing under roads, with occasional catch basins and manholes in newer subdivisions. Approximately 50,000 linear feet of existing stormwater piping (65% of the total), including all of the area within the West Branch Reservoir watershed, have been video inspected. The inspections have revealed some areas with deformation, breakage, and/or clogging. Figure 4.24 shows typical pipe deformation.

Figure 4.24. Pipe deformation on Westleigh Court.

All mapping and inspection information will be shared with the local municipalities responsible for maintaining the infrastructure. DEP will transmit these reports by individual drainage subbasins, beginning with West Branch, as the digital mapping is transmitted from the contractor to DEP's GIS system. DEP has notified the relevant municipalities that the mapping and inspection information will be made available to them so they can effectively plan for their compliance with the Phase II MS4 permit requirements.

During the inspection effort, any potentially illicit connections to the storm sewer system are identified and investigated. The goal of the program is to notify the responsible municipality or county agency so that appropriate steps can be taken to eliminate all illicit inputs and remediate other sources as appropriate. Follow-up by DEP with local municipalities and/or county agencies will continue as issues are identified. To date, several "tap-ins" have been reported (Table 4.31). All potentially illicit connections that have been identified to date have been forwarded to the appropriate town and county agencies.

Table 4.31. Stormwater tap-ins and potential illicit connections.

Section	From Manhole	To Manhole	Pipe Length (ft)	Street	Town	Observation
28	WB011CB14	WB011CB16	223	Robin Drive	Carmel	At 13.96- 4" Tap Break-In
29	WB011CB14	WB011CB12	239	Robin Drive	Carmel	At 96.35- 4" Tap Break-In
79	WBP10CB17	WBP10OU3	300	Horsepound Road	Carmel	At 45.38- 6" Tap Break-In

Table 4.31. Stormwater tap-ins and potential illicit connections. (Continued)

Section	From Manhole	To Manhole	Pipe Length (ft)	Street	Town	Observation
88	WBP10CB4	WBP10CB6	225	Joseph Court	Carmel	At 214.04- 4" Tap Break-In
209	WBH20CB14	WBI20CB8	212	Pennebrook Lane	Carmel	At 50.17- 4" Tap Break-In
						At 81.98- 4" Tap Break-In
257	WBJ18CB2	WBJ18CB4	74	Albin Road	Carmel	At 60.04- 6" Tap Break-In
						At 65.63- 6" Tap Break-In
306	WBF15CB21	WBF15CB13	36	Chestnut Ridge Road	Carmel	At 32.41- 4" Tap Break-In
308	WBF15CB13	WBF15CB11	96	Chestnut Ridge Road	Carmel	At 95.65- 4" Tap Break-In
377	WBG16CB5	WBG16CB3	201	Brittany Lane	Carmel	At 200.37- 6" Tap Factory Made Intruding

Stormwater Infrastructure Capacity Evaluation

Upon completion of the digital mapping and inspection program, DEP will initiate a program to evaluate the adequacy of infrastructure in the four EOH Cat/Del watersheds that were mapped and catalogued. The program will consider the adequacy of existing piping, swales, and drainage structures to safely convey stormwater to receiving waters and potential improvements that may promote water quality. The information will be shared with the agencies responsible for maintenance of the drainage systems. A scope of work for the program is currently being developed.

Stormwater Prioritization Assessment—DEP Properties

Using information gathered from DEP's implementation of retrofit and remediation projects, DEP will be developing prioritization criteria for potential future stormwater projects that could be located on City-owned property. Information to be used in generating the prioritization will include East of Hudson watershed stormwater mapping, existing GIS data layers, and the prioritization determination developed through the Croton Watershed Strategy.

Funding Program—Croton Falls/Cross River

As part of its efforts to reduce pollutant loading within the Croton Falls and Cross River watersheds, DEP will be providing support for stormwater improvement projects that are initiated by municipal, county, or regional stormwater entities. Under the program, DEP can provide up to $4.5 million in matching funds for eligible stormwater projects located in the Croton Falls and Cross River watersheds and upstream, hydrologically connected basins. Completed projects may also be used by the awarded district or municipality toward their efforts to comply with MS4 permitting requirements.

As anticipated by the 2007 FAD, several EOH municipalities and counties have expressed interest in exploring the possibility of forming a regional entity that could coordinate and manage DEC's MS4 permitting requirements. As noted in the FAD, it is understood that the MS4 requirements are requirements of federal and state law and that responsibility for meeting those requirements rests with the EOH watershed communities and not with the City of New York. The FAD does provide that some portion of the $4.5 million may be allocated toward stormwater improvement activities performed by a regional entity.

4.9.3 Other Activities

Croton Watershed Strategy

The primary goal of the Croton Watershed Strategy project was to develop an integrated watershed management plan for the Croton System which would allow DEP to optimize management efforts and focus limited resources on critical areas to achieve maximum water quality benefit. The results were compiled in a series of documents and released in March 2003 as a FAD Deliverable.

The watershed assessment examined both existing and full build-out conditions in the watershed for 74 subbasins. The methodology focused on impairment from point and nonpoint watershed sources of four critical indicator variables: total phosphorus, total suspended solids, pathogens, and toxic chemicals. The assessment does not model actual concentrations of water quality variables, but rather identifies a subbasin's relative potential to impair water quality compared to other subbasins. The subbasin results were used to develop basin-specific management recommendations and watershed-wide prioritizations.

The Croton Watershed Strategy results have been used as guidance in several DEP management programs and SEQRA reviews of new development projects. The Croton Watershed Strategy was also used in response to a request from Putnam County to assist in prioritizing a phased approach to its Septic Repair Program.

Croton Planning

Pursuant to Paragraph 138 of the New York City Memorandum of Agreement, the City, Westchester County, and Putnam County agreed that a cooperative comprehensive approach to watershed planning in the Croton System would serve to identify significant sources of pollution in the Croton watershed, yield recommendations to improve water quality, and protect the character of Croton watershed communities. Both Westchester and Putnam Counties requested that such planning efforts be undertaken in their respective counties. DEP committed to provide $1 million to both Westchester County and Putnam County for the total costs and expenses of conducting such a study. The plans are undertaken consistent with Section 18-82 of the New York City Watershed Rules and Regulations.

Putnam County and Westchester County sought to complete Croton Planning within the same time frame so that public comment periods could be coordinated and simultaneous. Putnam County has prepared a Draft Plan and anticipates that revisions to that document provide updated information. In 2007, a new mayor or supervisor was elected in five of the six municipalities in Putnam County that are involved in the Croton Planning process. Each new municipal leader may review the findings and recommendations within the Draft Plan.

In 2007, Westchester County released a revised draft version of the "Comprehensive Croton Watershed Water Quality Protection Plan for Westchester County", held public information sessions, and completed a public comment period.

4.10 Kensico Water Quality Control Program

Kensico Reservoir, located in Westchester County, is the terminal reservoir for the City's Catskill/Delaware water supply system. Because it provides the last impoundment of Catskill/Delaware water prior to entering the City's distribution system, DEP has prioritized watershed protection in the Kensico basin to ensure the continued success of past efforts while providing for new source water protection initiatives that are specifically targeted toward stormwater and wastewater pollution sources.

4.10.1 Stormwater Management and Erosion Abatement Facilities

BMP Construction, Operation, and Maintenance

DEP constructed 45 stormwater management and erosion abatement facilities throughout the watershed in order to reduce pollutant loads conveyed to the reservoir by stormwater. The facilities, shown in Figure 4.25, were routinely inspected and maintained as needed throughout the year. Maintenance was completed in accordance with the Operation and Maintenance Guidelines (DEP 2000a, revised 2003), which require regular inspections. Table 4.32 shows inspection requirements and typical maintenance needs.

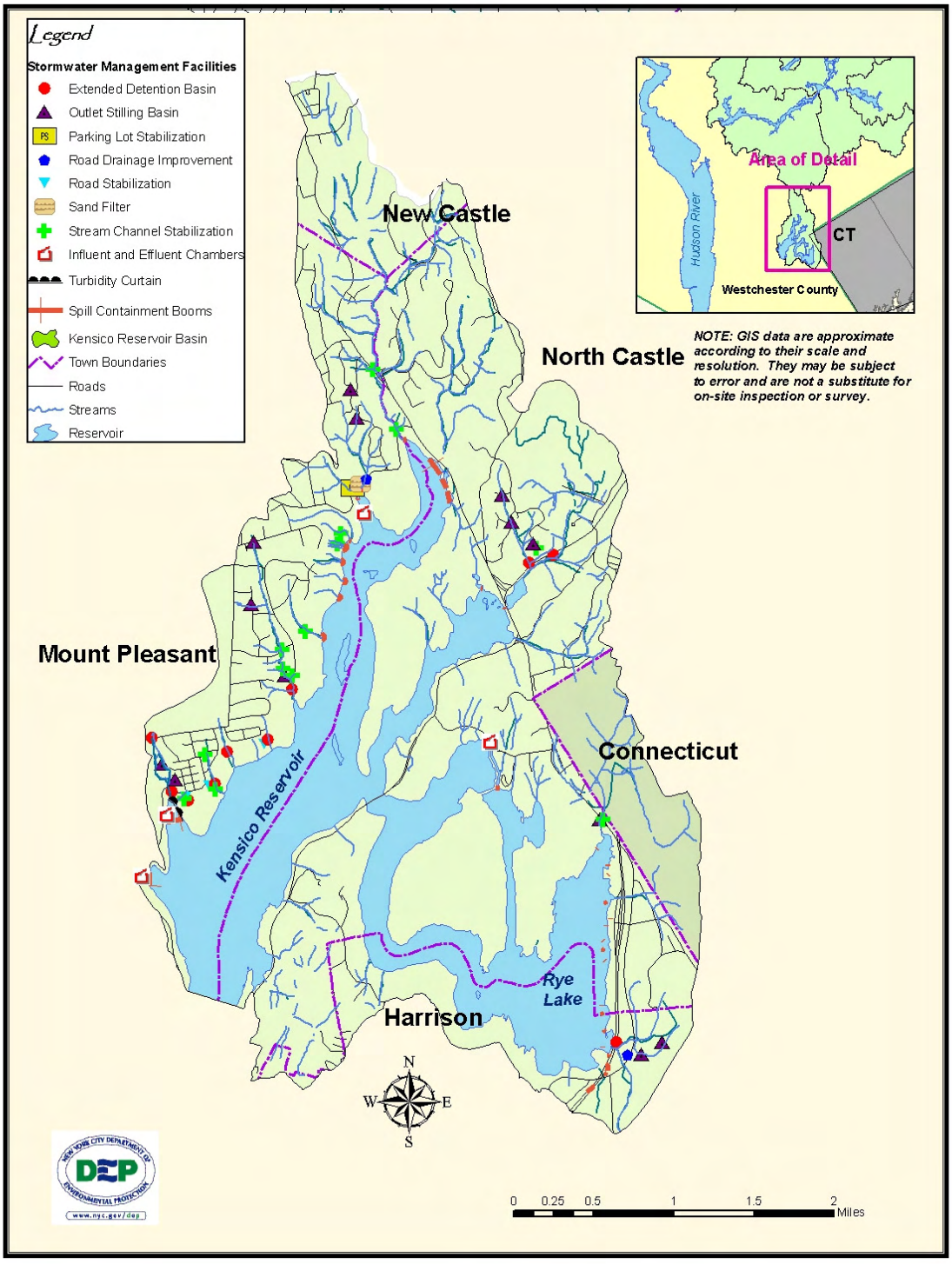

Figure 4.25. Location of stormwater management facilities in the Kensico Reservoir watershed.

Table 4.32. Inspection checklist for extended detention basins.

Inspection Guidelines	Minimum Inspection Frequency	Maintenance Guidelines
Access routes, basin structures, including riprap 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 riprap when clogging becomes apparent. Replace filter fabric when riprap 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 biannually. Do not mow wetland vegetation.
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.

Table 4.32. Inspection checklist for extended detention basins. (Continued)

Inspection Guidelines	Minimum Inspection Frequency	Maintenance Guidelines
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 years 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.

Spill Containment Facilities

DEP installed, and now maintains, spill containment facilities around Kensico Reservoir (Figure 4.26). The facilities improve spill response, clean up, and recovery, thereby minimizing water quality impacts in the event of a spill.

In 2007, DEP continued to maintain the 39 spill containment facilities installed at the outlets of 26 storm drains along Interstate 684 and Route 120 (Figure 4.27). Two storage buildings to house emergency response equipment were previously installed at Shaft 18 and Shaft 17. A third building has been installed at the Catskill Influent Chamber.

Although no spills have been reported on Interstate 684 or the roads surrounding Kensico since the booms were installed, the booms have functioned as designed. Temporary booms were located 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.

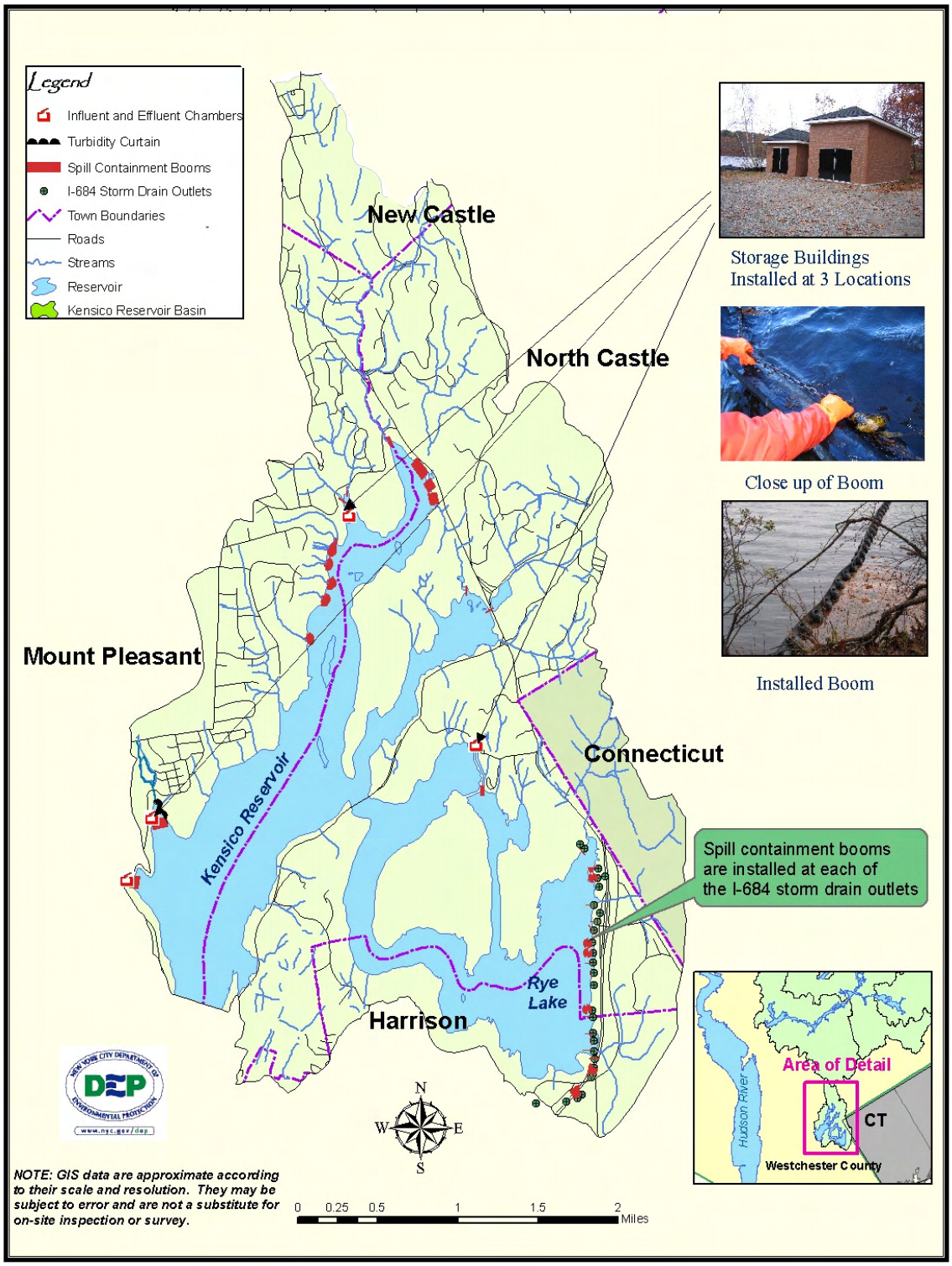

Figure 4.26. Spill containment facilities in Kensico Reservoir.

Figure 4.27. Kensico spill boom, Site 11.

Turbidity Curtain

Since its installation in 1995, the 800-foot-long turbidity curtain installed in the reservoir between the Catskill Upper Effluent Chamber (CATUEC) and Malcolm and Young Brooks has effectively deflected discharges from the two watercourses away from the effluent chamber. Figure 4.28 shows the location of the turbidity curtain and its flow deflection function.

In 2007, DEP monitored the extended turbidity curtain, and performed the following maintenance tasks:

June 29, 2007. A contractor dive team inspected the turbidity curtain and supports which include all hardware and anchoring points. The dive team identified items on the curtain that required maintenance.

July 24, 2007. Divers added two new anchors, connected the bottom of the curtain to existing blocks, and replaced both sides of the curtain wires.

July 25, 2007. All wires were replaced with stainless steel wire and crosby clamps.

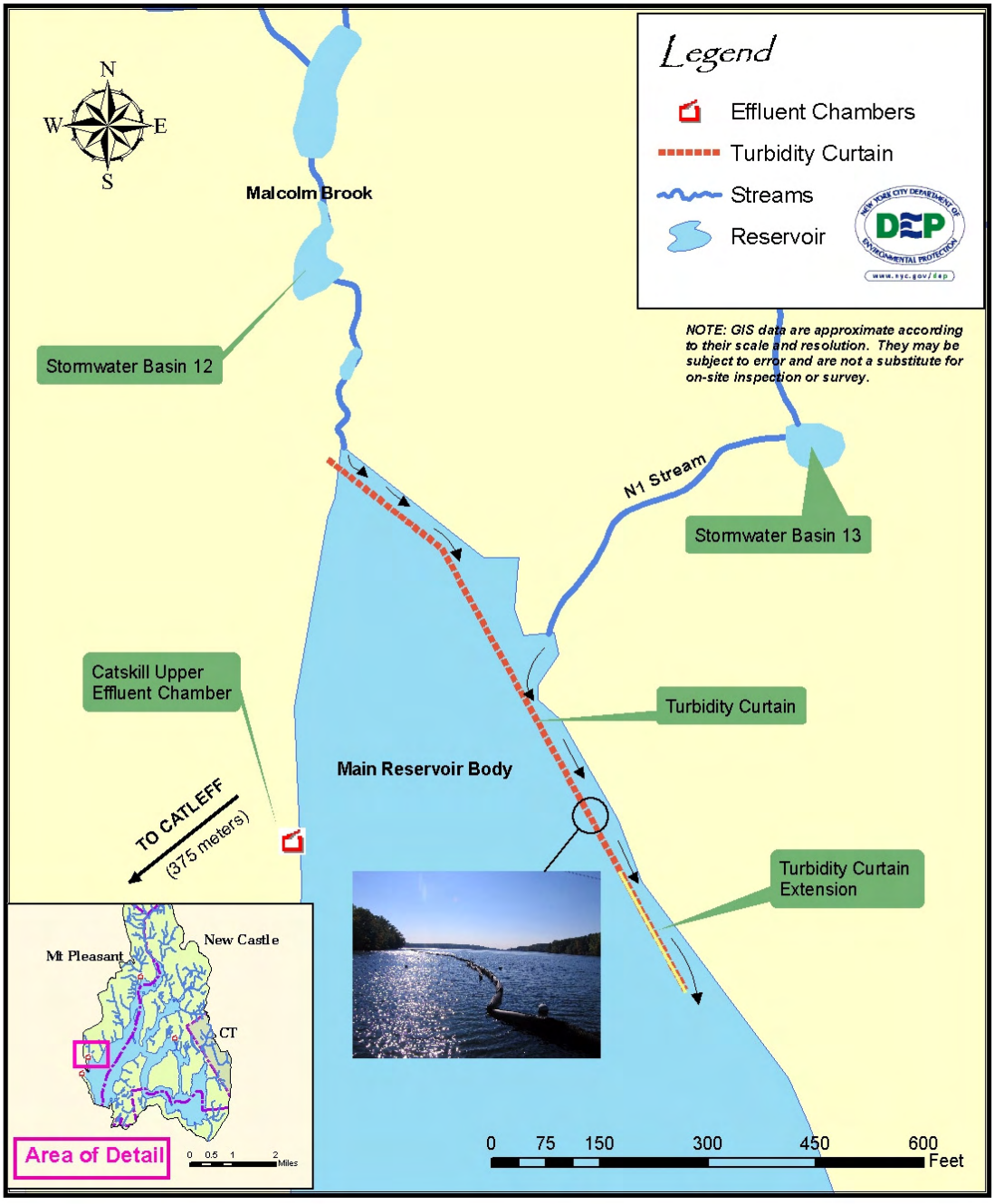

Figure 4.28. Turbidity curtain in Kensico Reservoir.

Computer Assisted Facilities Management

A Computer Assisted Facilities Management (CAFM) application has been developed for DEP staff to use to ensure facilities are inspected and maintained properly. The database and application design have been modified to refine the scheduling and management of inspection,

maintenance, construction, and repair activities and the reporting related to those activities. The CAFM application has been delivered in SQL form and is now utilized to track inspection and maintenance of the facilities.

BMP Monitoring

Monitoring to assess the pollutant removal rates of the detention basins and sand filter continued in 2007 in accordance with the Monitoring Plan for the Kensico basins (DEP 2000b, revised 2004). Six events were sampled at BMP Facility 74. This was in addition to the three events at this facility that were sampled in 2006. The 2007 monitoring effort concludes the FAD sampling requirement of the Kensico BMPs. As per the 2007 FAD, a more detailed report of the findings will be presented in the 2009 Kensico Programs Annual Report.

To date, monitoring has shown that the detention basins function as designed, to reduce the loads of turbidity and fecal coliform bacteria. Monitoring data in combination with the maintenance program's volume of accumulated sediment removed from each basin confirm that the basins reduce loads of suspended solids conveyed 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 become a source of stormwater-borne sediment.

4.10.2 Kensico Action Plan

Kensico Action Plan Summary

In early 2006, DEP initiated the development of the Kensico Action Plan in an effort to build on the successful watershed management and protection strategies within the Kensico basin. In March 2006, DEP retained HDR|LMS Engineering Inc. to complete the Kensico Action Plan. DEP submitted the final Kensico Action Plan in August 2007.

Key components of the Kensico Action Plan included the following:

- completing a user-friendly library of data and background material on the development of the Kensico Reservoir BMPs
- delineating and remapping the Kensico watershed using the most recently available photogrammetric base maps
- modeling the Kensico catchments, using the most recent GIS coverages and subbasin mapping; this modeling exercise estimated the relative volumes, rates, and quality of stormwater discharging from the various Kensico watershed subbasins
- completing a review of the results of the sanitary sewer mapping and video infrastructure inspection program
- preparing four stormwater remediation plans
- completing three water quality risk assessments
- assessing the sediment accumulations in the approach channels to Shaft 18 and CATUEC

The four stormwater remediation plans consisted of the following proposals:

1. Drainage improvements in the N-1 catchment. Observations during high flows indicated that overland flow that was expected to flow into BMP 13 bypassed this structure and instead discharged into BMP 12. As a result, more runoff than was expected reached BMP 12, causing it to be less effective, and minimal runoff was received by BMP 13, reducing its treatment benefit. The construction of catch basins to intercept this flow and redirect it to BMP 13 is proposed to enhance the performance of both basins.
2. Pipeline system for N7 subbasin. A riprap-lined channel in the N7 catchment area receives flow from upgradient impervious surfaces and is not properly stabilized. Stream velocities, compounded by the steepness of the slope, have contributed to the erosion of this channel. The proposed project is to pipe portions of this channel in order to reduce erosive velocities, restabilize the area above the pipe, and install centrifugal sediment traps at the base of the slope.
3. Extended detention basin for the N12 subbasin. The construction of an extended detention basin on this catchment is proposed for the treatment of stormwater runoff. This extended detention basin will be constructed off-line, allowing baseflows from the stream to by-pass the structure. Only stormwater runoff will be treated by this design.
4. Whippoorwill stream stabilization. Several areas of the Whippoorwill stream corridor were identified where streambank erosion contributed to the sediment load to Kensico Reservoir. Several tools are proposed to re-direct streamflow away from these banks, forcing the stream energy to the center of the stream. This design is expected to reduce the sediment load to Kensico Reservoir without the construction of a large-scale basin.

The three water quality risk assessments consisted of the following:

1. Westchester County Airport. This review assessed the water quality risks to the reservoir associated with the operation of the Westchester County Airport. The report found that the airport had previously re-plumbed stormwater from airport surfaces so that it would be discharged outside of Kensico Reservoir watershed. In addition, fuel and de-icing storage facilities are located outside the Kensico watershed. The report found that the airport's compliance programs are adequate to ensure that releases of petroleum and hazardous materials from the airport will be addressed properly.
2. Swiss Re Corporate Park. Swiss Re is one of the largest commercial office parks within the Kensico Reservoir watershed. A review of the Swiss Re property found no chemical transport from the property to Kensico Reservoir. In fact, several environmental initiatives have been implemented by the facility, including the elimination of "non-green" cleaning agents, non-organic fertilizers, and all herbicides.
3. Turf management chemicals in the N5 subbasin. Previous DEP water quality data found that the N5 subbasin had detectable levels of common herbicides in runoff. A risk assessment was conducted to determine the source and risk associated with these chemicals. The assessment included the development and implementation of a survey to homeowners and landscapers in the area. Data from this survey were used to quantify chemical treatment within this watershed. These data were then applied to a model to evaluate potential herbicide loading and its impact on water quality within Kensico Reservoir. The modeling work found that less than 0.1% of the applied herbicides are transported to Kensico Reservoir, and the observed concen-

trations are well below federal water quality criteria.

In order to evaluate the potential need for further effluent chamber dredging, the Kensico Action Plan also included a summary of the work performed since sediment was removed from the intake channels at the CATUEC and Shaft 18 in May 1999. Based on the results of the sub-bottom profiling, DEP determined there is no need to dredge the channel into Shaft 18 or CATUEC.

Kensico Action Plan Implementation

Following submittal of the Kensico Action Plan in August 2007, DEP evaluated the four proposed pollution remediation practices: (1) a pipeline system and engineering stormwater practice at N7, (2) an extended detention basin at N12, (3) stream stabilization at Whippoorwill, and (4) drainage improvements along West Lake Drive in order to enhance the performance of BMPs 12 and 13. Based on the evaluation of the projects, DEP determined, in December 2007, to move forward with the implementation of all four of the projects and provided an implementation schedule.

In 2007, DEP initiated the work to prepare the necessary bid specifications and to secure a design contractor during the construction phase. Completed project specifications are expected to be submitted by the design consultant, HDR|LMS, in the first half of 2008. Once approved by DEP, the contract documents will be submitted for legal review and advertisement.

4.10.3 West Lake Sewer

The West Lake Sewer Trunk Line, owned and maintained by the Westchester County Department of Environmental Facilities (WCDEF), conveys untreated wastewater to treatment facilities located elsewhere in the county. Given the proximity of the collection system to Kensico Reservoir, potential defects or abnormal conditions within the sewer line and its components could lead to exfiltration or overflows of wastewater. The intent of this program is to work with the county to mitigate risks posed by the line while maintaining the collection system's location and gravity flow.

Sanitary Sewer Remote Monitoring System

DEP has proposed a sanitary sewer remote monitoring system for the West Lake sewer in an effort to track the status of the sewer line and improve the response time in the event an overflow were to occur. During the reporting period, DEP initiated a discussion with WCDEF. The nature of the discussion was to outline DEP's approach in establishing a contract for the installation of a remote water level monitoring system at key locations on the West Lake Sewer Trunk Line. The WCDEF Director of Maintenance acknowledged the effectiveness of the video inspection and maintenance work already being done on the trunk line under the DEC Order on Consent. The Director further understood the potential benefit of reviewing the feasibility and implementa-

tion of a remote water level monitoring system to reduce the potential of sewage discharge. However, further discussions with the county and additional aspects of the proposal will need to be addressed in 2008.

Sewer Line Visual Inspection

DEP conducts an annual visual inspection of the trunk line in order to assess the condition of exposed infrastructure, including manholes, for irregularities. The annual full inspection was performed in December 2007. Partial inspections were conducted throughout the year in association with ongoing routine maintenance of Kensico stormwater best management practices in the vicinity of the line. No defects or abnormalities were noted.

4.10.4 Video Inspection of Sanitary Sewer

Select portions of the sanitary sewer system within the Kensico Reservoir watershed have been digitally mapped and video inspected. 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.

Collection of digital map data was essential for collection system assessment and maintenance. The data, 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
- 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 was intended to supplement DEP's previous effort in which some 50,000 linear feet of sewer were mapped and inspected. The contract to digitally map and inspect the entire remaining sanitary infrastructure in the Kensico watershed, estimated to be some 40,000 feet, was completed in 2006. The contract reports, completed by Tectonic Engineering Consultant, P.C., were submitted to HDR|LMS as part of the Kensico Action Plan to protect the Kensico watershed from point source and nonpoint source pollutants. Upon review of the inspection reports, HDR|LMS identified several possible areas of concern within the Town of Harrison that required further investigation and remediation. These areas of concern, listed in an evaluation memorandum prepared by HDR|LMS, were submitted to DEP in August 2007. DEP forwarded to the Town of Harrison Engineering Department the aforementioned evaluation memo along with copies of the pipe segment inspection reports and manhole reports for the areas indicated in the evaluation memo. DEP and the Town of Harrison will continue to coordinate any remediation of these conditions to prevent any possible contamination to the drinking water supply.

4.10.5 Septic Repair Program

In 2007, DEP began development of the Kensico Septic System Rehabilitation Reimbursement Program. The program will provide funding to reimburse a portion of the costs to repair, update, or rehabilitate eligible failing septic systems or connect those systems to an existing sewage collection system. The program is voluntary, with the goal of encouraging property owners to have their septic systems inspected, and if failing, rehabilitated. DEP intends to roll out the program in three priority phases, with those properties located closest to Kensico Reservoir and watercourses given higher priority (Figure 4.29). During the reporting period, DEP drafted program rules and submitted them for review and approval.

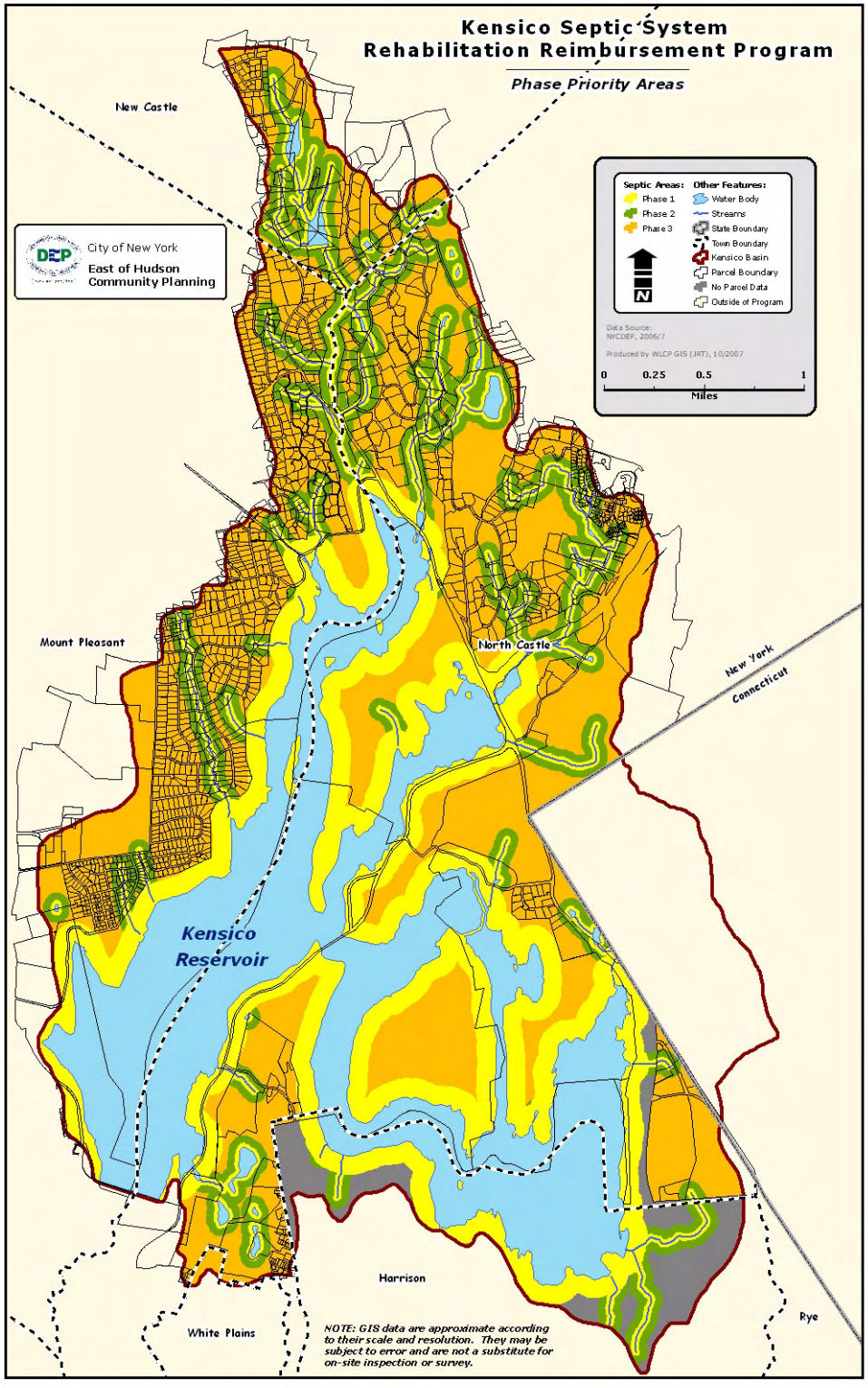

Figure 4.29. Kensico Reservoir Septic Program priority areas.

4.10.6 Turbidity Reduction

CATUEC is situated along the shore of a cove in the southwest section of Kensico Reservoir. The shoreline of this cove trends north to south, so that CATUEC faces east into the cove. Water from Kensico Reservoir enters CATUEC and is transported to the Catskill Lower Effluent Chamber (CATLEC) where the Kensico Reservoir's Catskill Lower Effluent Chamber monitoring site (CATLEFF) is located. To investigate whether wind speed and direction may have an effect on turbidity measured at CATLEFF, DEP reviewed eight years of data in order to conduct a turbidity assessment. In August 2007, DEP submitted the report, Review of Turbidity, Wind Speed and Direction Data Collected at or near the Catskill Lower Effluent Chamber, Kensico Reservoir (DEP 2007c).

The report found that prevailing winds near CATUEC typically originate from a westerly direction, so that in general winds are blowing away from this shoreline, and surface water is pushed away from CATUEC. Winds in this area are also typically less than 1.0 m/s in strength. Occasionally, weather conditions near Kensico Reservoir change so that the wind originates from an easterly direction, pushing directly onto the shoreline adjacent to CATUEC. When wind velocities are sufficient to create wave action or have a seiche effect on the shoreline in the cove near CATUEC, sediment in this area may become resuspended and entrained into the Kensico Reservoir effluent that enters the CATUEC, resulting in a short-term rise in turbidity values measured at CATLEFF. The report also found that bottom sediments within the cove are too deep to be impacted by this wind-induced wave action.

While DEP will continue to assess the turbidity issues at CATUEC, DEP has also determined that a shoreline stabilization project south of the chamber should be implemented to mitigate the erosion and possible resuspension of near-shore materials that may contribute to turbidity at CATUEC during wind events. Design of the shoreline stabilization project has been assigned to Malcolm Pirnie and Gannett Fleming. It is anticipated that design work will commence in the first half of 2008.

4.10.7 Route 120

During the 2007 reporting period, the New York State Department of Transportation submitted to DEP a proposal for resurfacing I-684 and constructing stormwater treatment basins in the I-684 median from just south of the new Lake Street overpass in New York northward to the bridge over Tamarack Swamp in Connecticut. It is anticipated that this project, which is a portion of the overall corridor project known as Routes 120 and 22/Exits 2 and 3 on I-684/Old Post Road, will begin in the autumn of 2008.

4.10.8 Westchester County Airport

The Westchester County Airport is located east of Kensico Reservoir in close proximity to Rye Lake. As such, DEP continues to review any activities that are being proposed at the airport. Two projects appeared in the SEQRA review during 2007, but at this time, DEP has not identified serious problems with either. The activities include the following:

- The relocation of the north perimeter road away from the northern end of Runway 16-34, and the removal of a portion of the existing north perimeter road. The north perimeter road will be relocated to increase safety at the north end of the runway, pursuant to FAA runway safety requirements. DEP issued a comment letter on the Lead Agency Notification for this proposal in April 2007.
- Proposed improvements to the existing terminal area aircraft deicing system and related improvements. This proposal was initially part of a larger overall Airport Layout Plan modification, now being considered a separate project as requested by the Westchester County Planning Department. DEP issued a comment letter on the Lead Agency Notification for this proposal in August 2007.

4.11 Catskill Turbidity Control

Due to the nature of its underlying geology, the Catskill watershed is prone to elevated levels of turbidity in streams and reservoirs. High turbidity levels are associated with high flow events, which can destabilize streambanks, mobilize stream beds, and suspend the glacial clays that underlie the streambed armor. The Catskill System's design takes account of the local geology by providing 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, under the Catskill Turbidity Control Study, 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) 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.

4.11.1 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 (Schoharie Reservoir)
- Permeable Turbidity Curtain (Schoharie Reservoir)
- In-Reservoir Baffle (Schoharie Reservoir)
- Modification of Reservoir Operations (Schoharie and Ashokan Reservoirs)
- Engineered Treatment Facilities (multiple locations)
- Ashokan Reservoir Hydraulic Modifications (Ashokan Reservoir)

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.

4.11.2 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. Summaries of the analyses performed for the alternatives at Schoharie under Phase II are described below, along with key Phase II findings. Turbidity control measures at Ashokan Reservoir are described under Phase III, below.

<u>Modification of Reservoir Operations</u>

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 the Catskill Aqueduct, respectively. In addition, alternative management strategies could also improve control over peak summer temperatures in water diverted to Esopus Creek. However, turbidity and temperature-driven changes in the timing and magnitude of withdrawals must 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 Scho-

harie, 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 ways to reduce 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 (MLI)

The existing Shandaken Tunnel intake has a single withdrawal level at the intake invert, some 80 feet deep. Multi-level withdrawal capability 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 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 suitable MLI 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 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 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 these 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, and to provide a robust framework for optimizing management of the reservoir system as a whole.

4.11.3 Catskill Turbidity Control Study: Phase III

The Phase III Catskill Turbidity Control Report, completed in December 2007, 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 for improving turbidity control in diversions from Ashokan Reservoir to Kensico Reservoir via the Catskill Aqueduct. A total of six potential turbidity control alternatives at Ashokan were identified and evaluated, as described below.

The water quality performance evaluation of Phase III alternatives was based on the OASIS-W2 platform developed in Phase II, with several major upgrades, including: linkage with Ashokan and Kensico W2 models, and development of water quality-based operating rules for diversions from the Catskill System; development of Esopus Creek streamflow forecasts for Ashokan Reservoir, and development of operating rules for existing and potential future hydraulic control structures at Ashokan; and development of inflow forecasts for the Catskill, Delaware, and Croton Systems and refinements to associated reservoir balancing rules.

Alternative 1: West Basin Outlet Structure

An Outlet Structure in the West Basin could reduce the number and magnitude of events during which there is uncontrolled transfer of turbid water from the West Basin over the Dividing Weir to the East Basin. During peak storm events, turbid inflows pass quickly into the East Basin without the full benefit of dilution and settling that the West Basin provides under normal flow conditions. At present, the only means available to release water from the West Basin and prevent spill to the East Basin is through the Waste Channel, which has a maximum capacity of 1200 MGD (after planned valve improvements). A new Outlet Structure would allow water to be

released from the West Basin during large storm events, thereby reducing spill to the East Basin. Conceptual designs were developed for single weir and multi-level outlet structures, with capacities ranging from 2,000 MGD to 6,000 MGD.

All West Basin Outlet alternatives represent conventional structures that are physically feasible and would be expected to provide long-term, reliable service. Although the structure could be constructed without major impacts on operation of Ashokan Reservoir facilities or surrounding areas, operation of the outlet at the rates being considered would have impacts on both the natural and man-made environment in the five-mile section of Esopus Creek extending downstream from Olive Bridge Dam to the spillway channel. Based on studies to date, it is known that releases within the design rate would inundate low-lying buildings within Ashokan Field Campus. If this alternative were selected for implementation, a detailed assessment would be required to evaluate downstream flooding and environmental impacts.

Long-term simulations using the OASIS-W2 linked model indicated that a West Basin Outlet Structure would be an effective means of reducing turbidity loads transferred to the East Basin during storm events. Reductions in turbidity loads transferred to the East Basin were predicted to provide associated improvements in East Basin water quality, including reducing the incidence of days with elevated (>8 NTU) turbidity in the Catskill Aqueduct, and reducing the number of days when alum application could be required at Kensico Reservoir.

Alternative 2: Dividing Weir Crest Gates

Inflatable crest gates could be installed on the Dividing Weir and could be operated to temporarily increase the West Basin overflow elevation by four feet to increase detention storage in the West Basin and reduce uncontrolled turbidity transfer to the East Basin. The gates could be installed with relatively minor construction-related impacts on Ashokan Reservoir operations; however, it is estimated that approximately 240 acres of DEP property would have to be cleared above the present shoreline of the West Basin. Affected areas also include an estimated 33 acres of jurisdictional wetlands. Existing points of public access, parking areas, and related facilities in these areas would have to be relocated upland to maintain recreational usage of the reservoir.

Long-term simulations using the OASIS-W2 linked model indicated that Dividing Weir Crest Gates would not provide substantial reductions in turbidity loads transferred from the West Basin to the East Basin, the number of days with elevated turbidity in the Catskill Aqueduct, or the number of days when alum application could be required at Kensico Reservoir. During the large storm events that give rise to elevated turbidity levels, the Crest Gates do not provide enough additional storage to effectively retain the large volumes of Esopus Creek inflow that enter the West Basin.

Alternative 3: East Basin Diversion Wall Improvements

The existing Diversion Wall in the East Basin is submerged by 20 feet or more and is not a fully effective barrier to flow that short-circuits over the Dividing Weir towards the Upper Gate Chamber. Extending the height and length of the Diversion Wall would direct flows from the West Basin farther out into the East Basin and would reduce short-circuiting to the Upper Gate Chamber and increase the travel time and dilution of flows prior to withdrawal. Conceptual designs and cost-benefit analyses were developed for three alternative wall lengths (750 feet, 1,700 feet, and 2,400 feet) using jetty wall and closed-cell coffercell construction methods. Issues that would be encountered during construction include accessibility (e.g., access road widths and weight limits), substantial truck traffic, and temporary impacts on reservoir operations and the reservoir environment.

The water quality performance evaluation of East Basin Diversion Wall Improvements relied on a three-dimensional water quality model of the East Basin that was developed for this purpose in Phase III. The performance evaluation indicated that Diversion Wall Improvements were generally effective in reducing short-circuiting and delaying the time it takes for peak turbidity levels to reach the Upper Gate Chamber; however, they provided negligible benefit after a period of several days. The Diversion Wall was predicted to improve turbidity control during small events and at the onset of large events, but provided minimal overall benefit during the major storm events that could require alum application.

Alternative 4: Upper Gate Chamber Modifications

Multi-level withdrawal capability at the Upper Gate Chamber is currently provided by an arrangement of fixed stop shutters and open ports in the four bays on the east and west sides of the intake. Adjustment of intake elevation in response to water quality conditions is currently feasible but involves a labor-intensive and time-consuming stop shutter removal process. The installation of operable gates within the existing stop shutter frames or at some or all of the ungated openings on the exterior walls of the intake while blanking off any unused ports would allow operators to readily adjust intake levels to withdraw water with the lowest turbidity during stratified conditions. This alternative could be implemented with moderate impacts on Ashokan Reservoir operations.

Improvements to selective withdrawal capability at the Upper Gate Chamber were predicted to provide some benefit during stratified conditions, but no benefit during storm events in fall, winter, and spring, thus limiting overall performance potential. Long-term simulations using the OASIS-W2 linked model indicated that modifications to the Upper Gate Chamber would provide relatively minor reductions in the number of days with elevated (>8 NTU) turbidity in the Catskill Aqueduct and the number of days when alum application could be required at Kensico Reservoir.

Alternative 5: East Basin Intake

Construction of a new intake towards the center of the East Basin would provide an alternative withdrawal location to the existing Upper Gate Chamber, where water quality is potentially less susceptible to elevated turbidity conditions. Conceptual designs were developed for a variety of single and multi-level intakes employing various construction methods (microtunneling, underwater pipelines, and regular tunneling) to connect to the Upper or Lower Gate Chamber or the Catskill Aqueduct. Construction of a new East Basin intake would be a major undertaking and would entail several construction-related impacts (e.g., suspension of withdrawals from the East Basin and Ashokan Reservoir, traffic) and environmental issues (such as impacts to land above and below water).

While the East Basin intake was predicted to reduce peak Catskill Aqueduct turbidity and turbidity load in many events, its performance was limited during large storm events of the magnitude that could require alum addition. Long-term simulations using the OASIS-W2 linked model indicated that a new East Basin intake would provide minor reductions in the number of days with elevated (>8 NTU) turbidity in the Catskill Aqueduct and the number of days when alum application could be required at Kensico Reservoir.

Alternative 6: Catskill Aqueduct Improvements and Modified Operations

Improvements to stop shutter facilities or outside community connections along the Catskill Aqueduct between Ashokan and Kensico would provide greater flexibility to reduce or eliminate diversions from the Catskill System during turbidity events. Ability to readily cut back flows in the Catskill Aqueduct and operate it at the minimum flow rate needed to satisfy demand would reduce turbidity loads entering Kensico Reservoir, and reduce the need for alum application.

Currently, a minimum flow of roughly 275 MGD is required to maintain supply to the 14 outside community connections along the Catskill Aqueduct, even though these utilities typically draw less than 15 MGD from the aqueduct. At flow rates below 275 MGD, supply to these outside communities can be maintained only by installing (and later removing) stop shutters at up to six locations. This is a time-consuming and labor-intensive procedure that is implemented only under emergency conditions. It is not currently feasible for DEP to readily reduce diversions from the Catskill System in response to elevated turbidity conditions.

Extended periods of reduced diversions from the Catskill System would require associated modifications to baseline system operating rules, since the reduced Catskill diversion must be compensated by increased diversions from the Delaware and Croton Systems. DEP's ability to reduce diversions from the Catskill System will increase substantially when the Croton Water Treatment Plant (WTP) is completed. The Croton WTP will effectively increase the transmission capacity from the Croton System to NYC by roughly 130 MGD compared to current conditions. Whereas in the past DEP has at times been obliged to operate the Catskill System at relatively

high flow rates during turbidity events in order to meet NYC and outside community demand, substantial reductions in Catskill diversions will be feasible once the Croton WTP comes on-line (in 2012). Lower diversion rates will decrease turbidity loads entering Kensico Reservoir and are expected to provide associated reductions in the need for alum application.

In addition to Catskill Aqueduct Improvements and associated modifications to system operations, two modifications to baseline Ashokan operating rules were also evaluated and included in Alternative 6. Drawdown of the West Basin by baseloading Catskill diversions from the West Basin whenever turbidity levels are acceptable was evaluated. This operation would help create or maintain a void in the West Basin to capture turbid inflows and reduce spill to the East Basin. Optimized use of the existing Waste Channel to release water from the West Basin was also evaluated. This facility could be used to release water from the West Basin for snowpack management and prior to or during inflow events that are expected to cause turbid spill to the East Basin.

Long-term simulations using the OASIS-W2 linked model indicated that improvements to the Catskill Aqueduct to facilitate operation at flow rates less than 275 mgd would provide substantial reductions in the number of days when alum application could be required at Kensico Reservoir. This benefit would be further enhanced by completion of the Croton Water Treatment Plant, since the Croton plant will reduce the amount of Catskill water needed to meet NYC demand. Drawdown of the West Basin and optimized use of the Waste Channel were predicted to reduce the number of days with elevated (>8 NTU) turbidity in the Catskill Aqueduct and the number of days when alum application could be required at Kensico Reservoir, with the latter alternative providing better performance. When combined, Catskill Aqueduct Improvements, West Basin Drawdown, and Optimized use of the Waste Channel provided substantial reductions in the number of days with elevated (>8 NTU) turbidity in the Catskill Aqueduct and the number of days when alum application could be required at Kensico Reservoir.

4.11.4 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 and 2007 with respect to spatial and temporal coverage to enhance the model testing process.

1. Robotic monitoring

Remote Underwater Sampling Station (RUSS) units continued to be deployed and operated in the Catskill System in 2005, 2006, and 2007 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 testing. 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 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. This was further expanded in 2007 to four deployments in Ashokan Reservoir, with three units in the West Basin and one in the East Basin. A single robot was deployed in the Catskill arm of Kensico Reservoir from spring to fall of 2005, 2006, and 2007.

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 unit (Coldbrook, E16i) continue to be operated. The E16i unit provides important turbidity loading information to support model testing for Ashokan Reservoir.

2. Non-robotic monitoring

UFI has conducted manual monitoring on these systems to provide ground-truth information for the robots and augment spatial characterization of water quality, particularly following runoff events, in support of model development and testing. This effort has 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 with rapid profiling instrumentation was regularly scheduled for the purpose of 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. The effort to assess these impacts with rapid profiling instrumentation continued in Ashokan Reservoir through 2007. Rapid profiling instrumentation measurements were made at multiple sites (20 to 29) throughout Kensico Reservoir weekly from April–November 2007, to support definition of spatial and temporal patterns for related model testing.

Modeling

1. Schoharie Reservoir

Mathematical models of transport, temperature, and turbidity were further developed, tested, and applied by UFI in 2005, 2006, and 2007. 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 conservative 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

2. Ashokan Reservoir

Modeling and related products completed by UFI through 2007 for Ashokan Reservoir included:

- two-dimensional hydrothermal-transport model set-up and successful testing
- two-dimensional turbidity model set-up and successful testing
- development of long-term datasets and empirical expressions to support long-term/probabilistic simulations of turbidity and thermal stratification/transport with the linked OASIS-W2 model
- three-dimensional hydrodynamic/transport model set-up and successful testing for the East Basin of Ashokan Reservoir
- application of three-dimensional model to evaluate performance of baffle (various lengths) adjoining the intake in the East Basin, for a number of historic runoff events

3. Kensico Reservoir

Modeling progress by UFI through 2007 for Kensico Reservoir included:

- two-dimensional hydrothermal-transport model successful preliminary testing
- two-dimensional turbidity model set-up and successful preliminary testing
- development of long-term datasets and empirical expressions to support long-term/probabilistic simulations of turbidity and thermal stratification/transport with linked OASIS-W2 model.

5. Watershed Monitoring, Modeling and GIS

5.1 Watershed Monitoring Program

DEP's monitoring activities are documented in the Integrated Monitoring Report, which was delivered to EPA and DOH in October 2003. This report presented descriptions of DEP's three key upstate watershed water quality monitoring programs: Hydrology, Limnology, and Pathogens. These programs 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 revised and updated plan will be discussed with regulators and submitted in October 2008.

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.

Monitoring plans such as this one must be flexible to accommodate changes in information needs over time. While changes to these monitoring programs have been formally documented and maintained as an annual addendum to the Integrated Monitoring Report, DEP (as noted above) is also in the process of reviewing and updating this plan, in accordance with the 2007 FAD. In 2008 the monitoring plan will be reissued for implementation in 2009 and renamed the "Watershed Water Quality Monitoring Program." By periodically updating this document, DEP addresses any changing needs of the monitoring program and ensures continued support for watershed management programs.

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 covering 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 2007 report (due 2008), the limnology and hydrology components of the document will draw largely from information obtained from approximately 241 routinely-sampled reservoir and stream sites, resulting in almost 6,000 samples and about 85,000 analyses. For the pathogen component, a total of 1,024 routine samples were analyzed for *Giardia*, *Cryptosporidium*, turbidity, pH, and temperature (5,731 analyses) at 83 sampling sites (including keypoints); 312 samples were collected for human enteric virus examination.

It is of great importance for DEP to remain aware of pathogenic protozoan concentrations in the water supply on an on-going basis and to be able to confirm that pathogens do not threaten the safety of the water supply. For this reason, pathogen data are reported frequently and in several different reports to maintain a constant flow of information. The following reports on protozoan pathogens were issued in 2007:

- Weekly results of *Cryptosporidium* and *Giardia* sampling at the three source waters posted on DEP's web site
- Monthly Filtration Avoidance Reports
- Monthly Croton Consent Decree Reports
- Semiannual reports on DEP pathogen studies of *Giardia* spp. and *Cryptosporidium* spp.
- Semiannual reports on human enteric viruses
- Research Objectives Report sections (annual)
- Kensico Reservoir Report (annual)
- Watershed Water Quality Annual Report

Additional reports are submitted as part of FAD Section 4.10, Kensico Water Quality Control Program. DEP submits a semiannual 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 and toxic substances, as well as from employment of the Kensico water quality model.

Finally, non-routine water quality monitoring is often conducted as a result of manmade or natural events occurring in the watershed. Sewage conveyance overflows and oil spills are anthropogenic events requiring monitoring. These events are documented in special investigation reports. Also, major storm and runoff events, such as the April 15-16, 2007 event, that impact the water supply may necessitate intense water quality monitoring to forecast the movement of the contamination and ensure the efficacy of treatment; these events are also documented in individual reports as appropriate.

5.2 WWTP Pathogen Monitoring

The purpose of the Wastewater Treatment Plant (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 10 WWTPs quarterly since July 2002, as stated in the Integrated Monitoring Report. These include: Hunter Highlands (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).

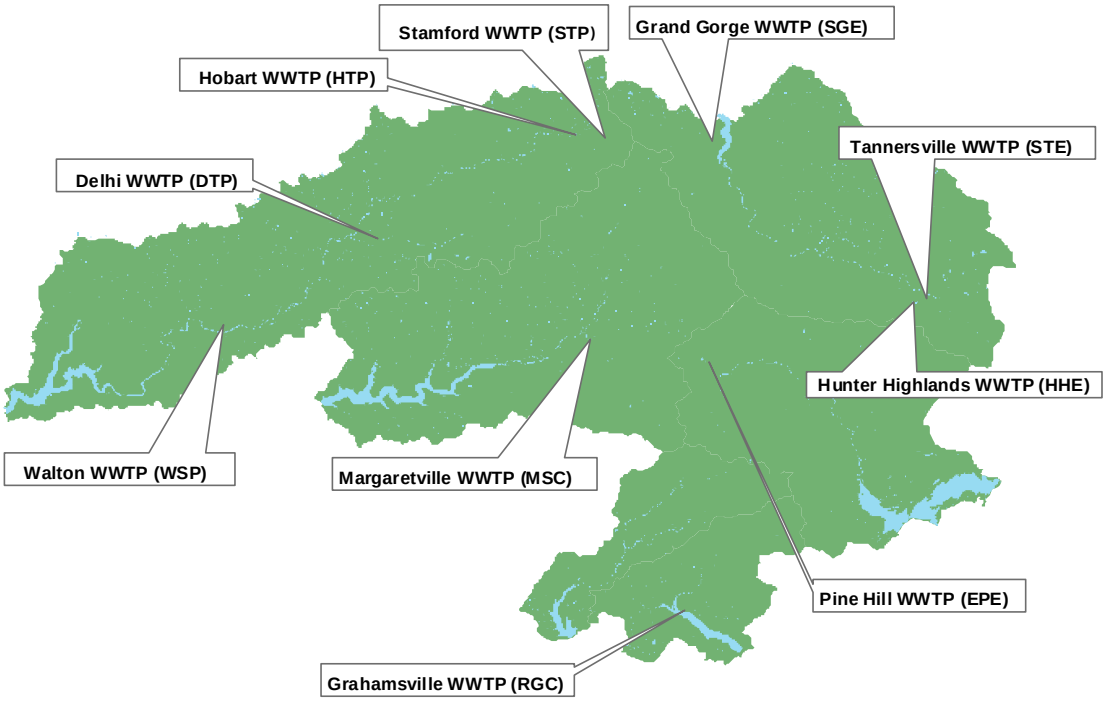

Figure 5.1. Locations for WWTP Pathogen Monitoring Program, DEP 2007.

All plants were sampled at least four times in 2007 for *Giardia*, *Cryptosporidium*, and human enteric viruses (HEV). The Grahamsville WWTP was sampled five times for protozoa in 2007 to follow up on 2 *Cryptosporidium* oocysts found in a sample collected on September 19. The follow-up sample, collected September 25, also resulted in 2 oocysts. A subsequent sample taken on November 27 was negative for *Cryptosporidium*. The other nine WWTPs were negative for *Cryptosporidium* oocysts in 2007.

Table 5.1. Protozoan and human enteric virus results for WWTPs, 2007. NI = non-isolated, N.S. = not sampled (protozoa and HEV samples were not always collected on the same day).

SITE	Date	*Giardia* $50L^{-1}$	*Cryptosporidium* $50L^{-1}$	Virus MPN $100L^{-1}$
DTP	27-Mar-07	0	0	NI (<1.02)
DTP	30-May-07	0	0	NI (<1.02)
DTP	01-Aug-07	0	0	NI (<1.02)
DTP	16-Oct-07	0	0	NI (<1.02)
EPE	05-Mar-07	0	0	NI (<1.02)
EPE	18-Jun-07	0	0	NI (<1.03)
EPE	17-Sep-07	0	0	NI (<1.03)
EPE	31-Oct-07	0	0	NI (<1.02)
HHE	19-Mar-07	4	0	NI (<1.03)
HHE	10-Apr-07	0	0	NI (<1.03)
HHE	10-Jul-07	1	0	NI (<1.03)
HHE	28-Nov-07	0	0	NI (<1.03)
HTP	12-Mar-07	0	0	NI (<1.03)
HTP	06-Jun-07	0	0	NI (<1.02)
HTP	24-Sep-07	0	0	NI (<1.02)
HTP	26-Nov-07	0	0	NI (<1.03)
MSC	05-Mar-07	0	0	NI (<1.03)
MSC	18-Jun-07	0	0	NI (<1.03)
MSC	17-Sep-07	0	0	NI (<1.02)
MSC	22-Oct-07	0	0	NI (<1.03)
RGC	22-Mar-07	1	0	N.S
RGC	26-Mar-07	N.S.	N.S.	NI (<1.02)
RGC	18-Apr-07	2	0	NI (<1.02)
RGC	19-Sep-07	0	2	NI (<1.03)
RGC	25-Sep-07	0	2	N.S.
RGC	27-Nov-07	1	0	N.S.

Table 5.1. Protozoan and human enteric virus results for WWTPs, 2007. NI = non-isolated, N.S. = not sampled (protozoa and HEV samples were not always collected on the same day). (Continued)

SITE	Date	*Giardia* $50L^{-1}$	*Cryptosporidium* $50L^{-1}$	Virus MPN $100L^{-1}$
RGC	28-Nov-07	N.S.	N.S.	NI (<1.03)
SGE	07-Feb-07	0	0	NI (<1.03)
SGE	24-Apr-07	1	0	NI (<1.03)
SGE	31-Jul-07	0	0	NI (<1.03)
SGE	9-Oct-07	0	0	NI (<1.02)
STE	19-Mar-07	0	0	NI (<1.02)
STE	26-Jun-07	0	0	NI (<1.02)
STE	10-Jul-07	0	0	NI (<1.02)
STE	29-Oct-07	0	0	NI (<1.02)
STP	12-Mar-07	0	0	NI (<1.02)
STP	06-Jun-07	0	0	NI (<1.03)
STP	24-Sep-07	0	0	NI (<1.02)
STP	26-Nov-07	0	0	NI (<1.03)
WSP	27-Mar-07	0	0	NI (<1.02)
WSP	30-May-07	0	0	NI (<1.02)
WSP	21-Aug-07	0	0	NI (<1.03)
WSP	16-Oct-07	0	0	NI (<1.02)

Seven of the 10 WWTPs were negative for *Giardia* cysts (Table 5.1). Hunter Highlands had two occurrences of *Giardia* this year (4 cysts and 1 cyst), while Grand Gorge had one occurrence in 2008 (1 cyst). Grahamsville had three sampling events when *Giardia* cysts were recovered (1, 2, and 1 cyst); interestingly, none of the three dates overlapped with the two dates on which *Cryptosporidium* were detected. Grahamsville has been the subject of additional sampling in the past due to its uncovered chlorine contact tank and the resulting potential for wildlife to contaminate the system post-microfiltration.

All results from the WWTPs were negative for human enteric viruses in 2007.

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 long-term watershed management, investigate effects of climate change on the water supply, and evaluate short-term operational strategies for maintaining high-quality NYC drinking water. These modeling applications are supported by model and data development activities, including the improvement and refinement of model algorithms and software, testing of models, acquisition of necessary model input data, and derivation of model parameters based on data.

During 2007, the modeling program focused efforts on the following modeling applications and development activities:

- Modeling of turbidity transport in Kensico Reservoir for short-term operational support
- Investigation of potential sources of suspended sediment loading in Schoharie Reservoir watershed and sensitivity of Shandaken Tunnel turbidity to reductions in reservoir loads
- Development of a climate change integrated modeling project
- Expansion of Nutrient Management Eutrophication Modeling System capabilities for the Catskill and Delaware Systems
- Modeling data acquisition and organization

Model Application: Short-Term Operational Support—Simulations of Kensico Reservoir Turbidity

During 2007, DEP used reservoir model simulations of turbidity transport through Kensico Reservoir to aid in operational decisions related to flows in the Catskill Aqueduct. These simulations (DEP 2007d) helped to avoid the use of alum during an early spring storm event.

During April 2007, a storm event led to elevated turbidity levels in the Catskill Reservoir system. In the days following the event, Ashokan West Basin turbidity ranged between 20–60 NTU and the turbidity entering the Catskill Aqueduct from the Ashokan East Basin withdrawal exceeded 20 NTU. To avoid alum use, a strategy was followed that relied on reducing the Catskill Aqueduct flow, while maximizing Delaware System withdrawal. Model simulations were used to predict the results of this operating strategy on the turbidity levels measured at Kensico Reservoir.

A first set of runs investigated the impact of various levels of constant turbidity input from the Catskill Aqueduct on Kensico effluent turbidity values. This set of simulations suggested that reduced Catskill Aqueduct flows, combined with dilution in Kensico, which was under isothermal conditions at the time, would reduce turbidity inputs sufficiently so that alum treatment would not be required. A second set of simulations was made three days after the event peak at Esopus Creek. At this point, it was necessary to increase Catskill Aqueduct flows in order to maintain necessary water levels in Kensico Reservoir. These simulations examined the effects on the tur-

bidity levels at the Kensico effluent withdrawals of either maintaining a low flow rate or increasing Catskill System flow rates. The simulations suggested an appropriate flow rate that would lead to relatively small increases in Kensico effluent turbidity and maintain acceptable water quality without the use of alum.

A final set of simulations was run about one week later, when Catskill System turbidity had begun to decline and Delaware System turbidity had reached slightly elevated levels. Although increases in Delaware turbidity were relatively small, they had the potential to have a major effect on Kensico effluent, as normally low turbidity Delaware flows are used to dilute the more turbid Catskill sources. The purpose of this final set of simulations was to analyze the effects of increases in Delaware System turbidity on the Kensico effluent turbidity levels while Catskill System flow was maintained at a level necessary to maintain the Kensico water elevation. These simulations suggested that there could indeed be a problem if higher than normal Delaware System turbidity persisted for a prolonged period of time. However, a sharp decline in Catskill System turbidity following these simulations made further consideration of alum treatment unnecessary.

In the case of this event turbidity increases were not extreme enough to demand immediate use of alum treatment. Rather, it was possible to mitigate the effects of elevated Catskill turbidity, by cutting back on the Catskill System flow entering Kensico Reservoir. The use of models to examine the potential impacts of changing conditions and constraints on operating conditions in order to help optimize reservoir operations during this event was a powerful tool which helped DEP avoid the use of alum treatment.

Model Application: Long-Term Impacts of Watershed Management—Support of Shandaken Tunnel SPDES Permit Requirements

During 2007, DEP's watershed and reservoir models were used in an analysis of potential reductions in Shandaken Tunnel turbidity resulting from the implementation of watershed protection and partnership programs. This analysis was presented in a report required under the Shandaken Tunnel SPDES permit entitled Schoharie Watershed Turbidity Reduction Report: Evaluation of Watershed Management Programs (DEP 2007e).

DEP water quality models were utilized for three aspects of the study, including (1) estimating the partitioning between landscape (or upland) erosion versus in-channel sources of sediment, (2) calculation of potential maximum reductions in landscape erosion sources, and (3) evaluation of how turbidity loading reductions might affect turbidity in the Shandaken Tunnel discharge.

A sediment rating curve for Schoharie Creek at Prattsville (DEP 2006f) was used with a long-term record of streamflow to derive average annual suspended sediment yield. Annual average landscape erosion rates for the basin were estimated using the Generalized Watershed Load-

ing Functions (GWLF) model (Schneiderman et al. 2002), which includes the Universal Soil Loss Equation (USLE) (Wischmeier and Smith 1978) for rural areas and a build up and wash off algorithm for impervious surfaces. The total erosion rate was then adjusted using a sediment delivery ratio to account for eroded material that is not transported to the watershed outlet. Four different methods were used to calculate sediment delivery ratios and thereby estimate the uncertainty in this parameter. The difference between the value of long-term sediment yield (from the rating curve) and the long-term annual erosion (from USLE adjusted by the delivery ratio) yielded an estimate of suspended sediment from channel sources. The results of this analysis suggested that only a relatively small proportion of suspended sediment yield is from landscape erosion sources.

Many of DEP's watershed management programs, including the Watershed Agricultural Program, the Watershed Forestry Program, and the Stormwater Retrofit Program, have a direct effect on landscape erosion. To find the maximum potential reduction in sediment supply due to watershed management programs addressing landscape erosion, current estimated watershed erosion rates were compared to projected erosion rates of an assumed completely forested watershed. Although a completely forested watershed is unrealistic, this scenario represented the lowest possible landscape erosion in the watershed and, therefore, set an upper bound on the reduction that could be gained from watershed programs addressing landscape erosion. The erosion rate of the completely forested watershed was about 17% less than the current conditions scenario. This result coupled with a small fraction of sediment yield being attributed to landscape erosion, translated into reductions of total watershed sediment yield of 5% or less.

Finally, the two-dimensional CEQUAL-W2 reservoir model for Schoharie Reservoir (DEP 2004d; Cole and Buchak 1995; Gelda and Effler 2007) was used to analyze the sensitivity of Shandaken Tunnel turbidity levels to varying reductions in reservoir loading from the watershed. The model was run from 1987–2004, to incorporate climatic variability and a range of reservoir operating conditions. A baseline scenario representing current loading conditions and nine reduced loading scenarios were run. The simulated baseline conditions were compared to the reduced loading scenarios, and the results were analyzed to determine the effects of load reductions on the number of days that Shandaken Tunnel turbidity would exceed certain critical threshold turbidity levels defined by the Shandaken Tunnel SPDES permit requirements. Specifically, two turbidity requirements were investigated: (1) turbidity at the Shandaken Tunnel outlet should not exceed the turbidity in Esopus Creek upstream of the tunnel outlet by 15 NTU and (2) Shandaken Tunnel turbidity should not exceed 100 NTU. Using a turbidity loading reduction of about 5%, which was the maximum estimated potential reduction due to landscape erosion, the model predicted a less than three-day reduction in the number of days per year that either threshold might be exceeded.

These analyses indicated that (1) the majority of suspended sediments are derived from in-channel sources and (2) estimated reductions in sediment loads due to maximum potential reductions in landscape erosion lead to only small reductions in the number of days during which Shandaken Tunnel turbidity might potentially exceed critical thresholds.

Modeling Application: Climate Change Impacts—Development of Climate Change Integrated Modeling Project

Planning began on an "Integrated Modeling Project for Water Quantity and Quality under Potential Climate Change." The goal of the integrated modeling project is to estimate the effect of future climate change on the quantity and quality of water in the NYC water supply. Under future climate conditions, it is expected that, on the whole, precipitation will increase in the NYC watershed area, which will bring more water and possibly more intense storms and lower water quality. Additionally, temperatures will increase, bringing more evaporation and less water, together with associated changes such as longer growing seasons, earlier snowpack melting, and changes in the timing of streamflow, sediment transport, and nutrient delivery. The effects of the interaction of these issues on water quantity and quality are as yet unknown. Given the potential climate changes, three areas of concern have been identified, and each will be addressed through model simulations:

- Overall quantity of water in the entire water supply. Possible effects include altered inputs to the system, potential changes in the dynamics of the system (e.g., change in the timing of inputs, spill, and drawdown), and resultant adjustments in reservoir operations.
- Turbidity in the Catskill System of reservoirs, including Kensico. Changes in the frequency, timing, and intensity of precipitation may lead to increases in turbidity loading to Catskill System reservoirs. Increased turbidity inputs could become a water quality concern that would limit the use of Catskill System water, and could also require treatment of Catskill System water with alum.
- Eutrophication in Delaware System reservoirs. Changes in the timing and magnitude of nutrient inputs to NYC reservoirs as well as changes in thermal structure, mixing, and stratification could potentially lead to changes in reservoir trophic status. If the frequency and/or intensity of algal blooms increase, water use from some reservoirs may need to be adjusted, and water treatment could become more costly.

The project is planned in two phases. Phase I is an initial phase aimed at providing a first-cut evaluation of the effects of climate change on water quantity and quality, using the existing modeling system and data readily available from existing global climate models. Phase I will examine, in a preliminary way, water quantity system-wide, turbidity in Schoharie Reservoir, and eutrophication in Cannonsville Reservoir. Phase II will be similar to Phase I, but with upgraded models and data sets. This phase will examine water quality as well as quantity on a system-wide basis.

After the project development process was completed, a workshop with invited outside experts was held in spring 2007 to review the project plan. The panel found that the project outline was basically sound and appropriate. In addition, valuable recommendations were obtained from the review related to all aspects of the proposed project.

Modeling Development: Expansion of Nutrient Management Eutrophication Modeling System Capabilities for Catskill and Delaware Systems

During 2007, DEP water quality modeling staff completed expansion of the Nutrient Management Eutrophication Modeling System (NMEMS) capabilities to Neversink, Rondout, West Branch, Ashokan, and Schoharie Reservoirs. The modeling system utilizes the VSLF (Variable Source Loading Functions) watershed model, linked with a one-dimensional hydrothermal and nutrient-phytoplankton reservoir model. These models are integrated with data on system characteristics (watershed and reservoir), meteorology, and management (watershed and reservoir operations). VSLF model simulations generate time series of loads which are then input to the reservoir model. Output from the reservoir model includes probability frequency distributions for water quality parameters that describe the trophic state of the reservoir for different watershed scenarios. A demonstration with results for each of the reservoirs was presented in the modeling FAD deliverable submitted July 31, 2007 (DEP 2007f).

Modeling Data Acquisition and Organization

GIS data for watershed soils were updated or improved in 2007. NRCS released soil data for Ulster County in the new Soil Survey Geographic (SSURGO 2) format. These data were appended to that for the other eight counties of the watershed to complete a watershed-wide thematic soil layer in the SSURGO 2 format. Updated attribute data for several counties were also released and incorporated into an ACCESS database. These spatial and attribute data were added to the DEP upstate GIS data library.

The SSURGO 2 data were used with the Soil Data Viewer extension for ArcGIS to derive frequently used soil parameters (e.g., hydrologic soil group, depth to restrictive layer, erosion potential factor). These parameters were appended to the SSURGO 2 spatial data in order to have them accessible within the geodatabase.

DEP's GIS data are regularly used to derive necessary inputs for DEP's modeling applications. During 2007, GIS data analyses were used to derive alternative estimates of the sediment delivery ratio (see above) and thereby define levels of uncertainty in the estimation of landscape erosion versus channel sediment sources for the Schoharie watershed. One of four methods of calculating the sediment delivery ratio made use of the Spatially Explicit Delivery Model (SEDMOD) (Fraser 1999). GIS inputs for the SEDMOD application included Land Cover/Land Use raster data; 10-meter Digital Elevation Models (DEM); delineation of the NHD (National

Hydrography Dataset) stream network; and SSURGO 2 soil data used to define percentages of clay-sized particles and saturated soil transmissivity. Also for the Schoharie application, the VSLF Model Inputs Tool was used to derive spatial inputs for all the forested modeling scenarios.

Time-series data used for modeling are collected at specific locations within the watershed and placed in a modeling time-series data library. Watershed modeling data currently in the time-series data library include:

- Meteorology data from Northeast Regional Climate Center (daily precipitation and min/max air temperature), pre-1960–2006
- Streamflow data from USGS (daily), pre-1960–water year 2006
- Stream chemistry data from DEP (routine and storm events), 1987–2006
- Stream chemistry data from DEC (West Branch Delaware River), water years 1992–2005
- Wastewater treatment plant data from DEP (monthly phosphorus loads), 1990–2006

Reservoir modeling data include reservoir morphometry GIS data and a daily time-series of meteorology, reservoir inputs, reservoir outputs, and reservoir operations. 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. Required reservoir operations data include aqueduct flows, reservoir discharge, spillage, and water level (stage). To verify and calibrate the models, water column measurements of temperature, chemistry, and phytoplankton biomass are needed. The modeling group now has the following reservoir modeling associated data in the library:

- Hourly meteorological data as collected by DEP, 1994–June 2005
- Daily water flow measurements of reservoir input (streams) from USGS, and outputs (aqueduct discharge, dam releases, and spill), 1987–2006
- Daily stream and aqueduct temperature data from DEP, 1987–2006
- Reservoir water quality and temperature profiles from DEP, 1992–2006

5.4 Geographic Information System

In fulfillment of the 2007 Filtration Avoidance Determination (FAD) requirement for an annual GIS status report, this section presents an overview of continued development and utilization of the upstate Geographic Information System (GIS) of DEP's Bureau of Water Supply (BWS). It describes progress in utilizing GIS for watershed management applications, completing new data layers, incorporating data layers into the modeling database, disseminating data to stakeholders and the public, including notification of data availability to communities and requests for data, and improving GIS infrastructure. It covers the period January 1, 2007 to December 31, 2007.

The BWS upstate GIS is used to create, store, visualize, and analyze spatial data of the watershed region in support of existing FAD and Memorandum of Agreement (MOA) programs. DEP staff utilize GIS resources for hardcopy mapping, geographic analyses, spatial data acquisition and development, visualization and analysis of remotely sensed imagery, data collection using Global Positioning System (GPS) technologies, and water quality modeling.

This section compiles information submitted by staff in two Directorates of the newly-reorganized BWS: Water Quality (WQ) and Watershed Protection and Planning (WPP). It presents an overview of accomplishments during 2007 and general description of ongoing GIS activity. There is reference to contractual work being performed by PAR Government Systems Corporation (PAR) of Rome, NY.

5.4.1 Progress in Utilizing GIS for Watershed Management Applications

DEP GIS staff generate hundreds of maps each year. These maps are used by virtually all directorates in the bureau to support an extremely wide range of specific needs. In addition to providing maps, GIS staff also provide technical support as well. These efforts are described below.

WQ Technical Support

Wildlife Program—Beaver: Beaver residing on or around the West of Hudson reservoirs and other DEP land are of particular interest to staff for two main reasons: nuisance species landowner liability and fecal matter effect on water quality. GIS was used for scouting potential target areas for beaver control, as well as storing information on beaver lodges found, including activity status and other attributes. This year, surveys were performed in Cannonsville, Rondout, and Ashokan Reservoirs; specific concerns were addressed in the Schoharie Reservoir basin.

Wildlife Program—Canada Goose: Staff actively control Canada Goose reproduction on 15 reservoirs via egg and nest depredation. Historically, there are over 200 nests visited each year with over 800 eggs addled. GIS was used to display historic nesting sites, which is helpful due to the high nest-site fidelity of the Canada Goose. Attributes that expedite report generation, such as activity status, number of eggs, incubation status, and bird identification information, are stored. Using this information, staff derive nest density per reservoir basin, average clutch size, and success of the program. Additionally, all field data forms for this effort are created with GIS.

Wildlife Program—Bald Eagle: GIS is used during the project review process, where federal and state endangered species are always considered. GIS supports this process via visual representation of known Bald Eagle nesting areas. Buffers are easily created, helping staff provide guidance for both successful completion of projects and maximum fitness for this endangered species.

Wildlife Program—Census Survey Data Forms: Waterfowl roosting surveys of selected reservoirs are conducted five days per week year-round, both by an outside contractor and DEP staff. Data forms are created in GIS utilizing reservoir, road, and planimetric coverages for optimal geo-referencing in the field. Forms contain such attributes as weather, bird identification numbers, and total birds observed by species.

Wildlife Program—City Environmental Quality Review (CEQR) Compliance: Upon completion of CEQR review by DEP, pyrotechnic restrictions were implemented for waterfowl hazing at Hillview Reservoir. Restrictions included buffer areas around residential streets surrounding the reservoir, from which no pyrotechnics may be launched. Using GIS buffer functions, staff created clear maps of where pyrotechnics may be used, so contractors can maintain strict compliance with restrictions.

Catskill Field Program—GIS is used to support various aspects of the Catskill Field Program, such as depiction of sample site locations and areas of special investigations. Parcel data is used to contact property owners and receive permission for installing remote sampling equipment. Hydrological tools for determining drainage basin size are valuable for comparing sampling sites.

Water Quality Modeling—Schoharie Basin Forested Scenarios: Minor modifications were made to the Variable Source Loading Function (VSLF) Inputs Tool so it would appropriately reference the revised locations of input data layers in the GIS coverage library. The modified tool was used in conjunction with modified land use data to prepare Constant Input (CIN) files of long-term means for the Schoharie Reservoir basin and drainage area above the USGS stream gage at Prattsville (Gage # 0135000). Land use data were reclassified to represent hypothetical scenarios that returned the watershed to an all-forested, “pristine” condition. CIN files were used to evaluate the maximum potential effects of best management practices (BMPs) designed to reduce landscape erosion.

Water Quality Modeling—Select Parameters of Watershed Draining to USGS Gage at Montague, NJ: Open source MapWindow GIS software was used in conjunction with the EPA Better Assessment Science Integrating Point and Nonpoint Sources (BASINS) hydrologic modeling interface to delineate the drainage basin for the USGS gage at Montague, NJ (#01438500). This was done using a mosaic of 90 meter USGS Digital Elevation Models (DEMs) to associate percent of impervious surface with land use areas derived from 30 meter National Land Cover Data (NLCD), and calculating thiessen polygon weights for meteorological stations relevant to the Montague drainage.

WPP and Regulatory Review & Engineering Technical Support

Watercourse/Wetlands Tracking: Staff used GIS to locate and investigate protected water resources on project sites. Maps were produced using hydric soils, DEM, Light Detection and Ranging (LIDAR) derived contours, and USGS contours to show potential watercourse/wetland

areas requiring US Army Corps of Engineers, DEC, or DEP involvement or permitting. Field data collected using Trimble and Magellan GPS units were combined with DEP GIS library data to support watercourse determinations and identify sensitive wetland areas.

Project Site Evaluation/Preparation of Site Reviews: Staff prepared numerous maps in support of environmental and State Environmental Quality Review Act (SEQRA) project reviews. GIS was used regularly in conjunction with site inspections and GPS field-collected data to evaluate environmental site constraints for new development. Prior to conducting a site inspection, staff use GIS to prepare maps depicting hydrography, soils, watercourse limiting distances, steep slopes, and other potentially sensitive features. Data were compared with orthoimagery to reveal potentially unmapped drainage features, and were used to prepare maps for subsequent field investigations. Sites under construction that were not covered under existing Stormwater Pollution Prevention Plans (SPPPs) were evaluated using GPS and GIS technology to determine if permit thresholds were exceeded, thereby triggering DEP or DEC regulatory review. GIS was used in the review of numerous projects to determine locations of political and property boundaries, to delineate regulated watercourses, and to assist in evaluating stream instability and erosion problems. In addition, GIS was used to support technical reviews of DEC and New York State Department of Transportation projects and permitting, and other applications.

Significant project reviews supported with GIS and GPS during this period include:

- DMV International, Town of Delhi, Existing Soils
- Breezy Hill Road Subdivision,
- Town of Middletown
- Recreational Acreage Exchange, Supplemental Access Road,
- Town of Conesville
- Shad Road Pond Construction,
- Town of Jewett
- Roark Timber Harvest,
- Town of Woodstock
- Pasternak Subdivision,
- Town of Middletown
- Eagle’s Landing Development,
- Town of Windham
- Pine Island Subdivision,
- Town of Gilboa
- Windham Heights Subdivision,
- Town of Windham
- Colgate Lake Dam Replacement,
- Town of Jewett
- Pine Hill Sewer Improvements,
- Town of Shandaken

WPP Watershed Lands and Community Planning (WLCP) Technical Support

WLCP GIS Program

General WPP Support: The WLCP GIS Program continues to provide staff support, technical support, and data development for all other WPP and WLCP programs as outlined below under each program's respective section.

Watershed Land Information System (WaLIS) Database Development Project: Under the management of WLCP GIS, PAR Government Systems continues to develop, upgrade, and maintain WaLIS to provide and manage information about the lands and resources owned by DEP. PAR developers have been dedicated solely to developing the Next Generation WaLIS Version 4 using VB.NET, ArcGIS Server, Smart Client, and other approved technologies. Coding of Version 4 is now approximately 90% complete, including most of the core development and user interface. This project will be ongoing through the end of May 2008 with remaining tasks including feature-specific programming, security, user testing, training, and deployment.

Natural Resources Management Program (NRM)

Annual Statistics Report of NYC-owned Land (fee and easement): DEP land statistics were generated based on hydrography, buffers, basin area, town and county area, cluster size, perimeter, road frontage, land use, slope, soils, and wetlands.

Baseline Documentation of Conservation Easements: GPS was used to map and inventory the condition of conservation easements at the time of acquisition by DEP.

Revocable Permit Inventory: GPS data were collected regarding the revocable permits issued on City-owned land.

Ecological Research and Assessment (ERA) Wetlands Monitoring Program: GIS was used in site selection for wetland monitoring wells along the mainstem of Esopus Creek and associated tributaries for a potential wetland functional assessment study in that area.

ERA Wetlands Permit Reviews: GIS was used to assist in assessing and commenting on approximately 24 wetland permit applications for federal, state, and local wetlands in the watershed.

ERA Project Review: Staff used orthoimagery, wetland, topography, and soil layers to determine whether wetlands or other sensitive features were present on numerous projects reviewed. Construction projects were reviewed on DEP lands during environmental impacts assessment and design phases, and on private lands under SEQRA review. Determination of soil types assisted in identifying potential wetland areas and in providing planting recommendations for site restoration purposes. Orthoimagery and topography were useful in identifying potential wetlands (areas not currently mapped as wetlands).

ERA Invasive Species Program: GIS and GPS were used to collect and analyze invasive species occurrence. Data were compiled from several sources (NRM inventory and field observation, NYFLORA database, The Nature Conservancy's 2005 Catskill region invasive plant inventory, and an Esopus Creek fisherman's report). Occurrence data for several species of concern were shared with regional invasive species organizations (Lower Hudson and Catskill Regional Partnerships for Invasive Species Management).

ERA Watershed Boundary Delineation Protocol: Staff used GIS in the interpretation of the watershed boundary in cases where a parcel under consideration for purchase straddled the boundary.

ERA Forest Science Program: GIS was used to review soils data in a Schoharie forest sediment study. Sites were chosen to represent several soil groups, slopes, and aspects that were thought to show different susceptibilities to erosion in the presence of gypsy moth defoliation.

ERA Fisheries Research: GIS-developed transects were used in the Hydroacoustics Program at Kensico Reservoir to collect fish population and biomass data. Surveys will be conducted to develop baseline fisheries data for impact analyses, and to support site selection for the new Kensico intake.

Forest Resource Management Program: GIS and WaLIS were used routinely to produce maps and evaluate geographic data in support of forest management activities. Work included soils map evaluations, Natural Heritage data assessment, location of significant natural resources/features, forest stand reconnaissance, forest type location, inventory planning, site evaluation, fire-fighting/incident command support, deer management, project review on DEP and privately owned lands, and forest management project maps.

Watershed Agricultural and Forestry Programs

Watershed Forestry Program: Staff continued to update locations of Forest Management Plans based on a plan's status as being complete or on application. This dataset is updated quarterly as plans are continually added to the program.

Stream Management Program (SMP)

Riparian Vegetation Classification Project: Staff continued to develop riparian vegetation classification coverage, with Greene County Soil and Water Conservation District completing work on Schoharie Creek and East Kill. DEP analyzed land cover maps for all areas completed to date. This information will be shared with the Riparian Buffers Working Group and the DEC Natural Heritage Program in preparation for the Streamside Assistance Program under the 2007–2012 FAD.

Stream Assessment: GIS and GPS were used to assess and map stream characteristics and conditions. Affected landowners near stream project/research sites were identified using WaLIS. Partnering with Soil and Water Conservation Districts, DEP provided GIS support in producing stream management plans for priority sub-basins, including provision of GIS datasets, assistance with data management, training in GIS and GPS technologies, and map production for stream management plans.

Stream Management Geodatabase: Work continued on integrating stream survey data into a geographically-referenced database. PAR continues to provide support for the SMP Geodatabase and Stream Analyst extension. Data collected by program partners continue to be entered into the geodatabase, which now includes Esopus Creek, Schoharie Creek, East Kill, Stony Clove, Broadstreet Hollow, and East Branch Delaware River. Additionally, the SMP research dataset is now being converted into the SMP geodatabase.

Land Acquisition Program (LAP)

"Takings Maps" Scanning Project: Previously scanned "Takings Maps", atlas sheets, and release maps were georeferenced and have since been used by LAP, DEP Legal, NRM, and outside parties for many purposes. These include tax assessments, land use permitting, resolving drainage and dumping issues, surveying, and review of DEP construction projects. Additional maps are scanned as needed, then reproduced and georeferenced in the GIS.

WAC Whole Farm Easements: Applications to rank WAC Whole Farm Easements were developed based on a GIS ranking system using soil characteristics, hydrography, priority areas, road frontage, distance from hamlets, and parcel size. Staff utilized orthoimagery, digital surveys, tax parcels, soils, planimetrics, topography, and hydrography to develop basemaps for overlay of different use areas making up farm easements.

Conservation Easement (CE) Design: GIS and WaLIS were used to design acquisition configurations and negotiate easements. Contracts for CEs contain GIS orthoimagery maps depicting CE configurations on a detailed parcel scale. Annotated orthoimagery contract maps are used to inform surveyors of CE configurations. Modifications of these project maps are then used in the community review process. If requirements exist for pre-approved activities on a CE property, NRM uses WaLIS maps to illustrate those uses.

Solicitation and Resolicitation: To implement new solicitation goals established in LAP's 2007 Solicitation Plan, staff performed extensive GIS analysis to update ownership and natural features overlays related to tax parcels. This serves as input to revised LAP parcel rankings for the 2007 Plan. On resolicitation, staff perform GIS analysis to re-contact current owners of parcels solicited in the past but not acquired. In both cases, parcels are targeted based on priority area of their basin/sub-basin and presence of natural features with significant water quality impact.

Land Acquisition Tracking System (LATS) Database: Staff continued to maintain LATS, WLCP's database application that manages LAP's activities, including parcel solicitations, contracts, and closings. This is an ongoing task as additional parcels are solicited, contracted, or acquired, and as additional annual updates of county parcel data are received and integrated into the GIS.

Environmental Review: As a part of the environmental review (under SEQRA and CEQR) of LAP for the 2007 FAD, staff performed extensive GIS analysis of land acquisition and development activity in the West Branch and Boyd Corners basins during the 1997–2007 period. This involved identifying developable versus undevelopable land, quantifying existing development, and consulting with both DEP and outside environmental professionals regarding LAP impacts in those basins.

5.4.2 Completion of New Data Layers

Several new data layers were created and placed in the GIS Library in 2007, including:

- Potential inundation areas below Merriman and Kensico Dams (given hypothetical dam failure) were compiled into single layers of inundation boundary, cross-sections, and cross-section annotation
- SSURGO2 soil data for Ulster County were downloaded from the Natural Resources Conservation Service (NRCS) web site and integrated with previously available SSURGO2 data
- Additional 2004 orthoimagery was acquired from the NYS Digital Orthoimagery web site for several towns and cities outside the watershed where DEP has property easements and infrastructure, including Yonkers, Newburgh, Cornwall, Montgomery, and New Windsor
- Contractor-supplied data related to Task 1 of the Kensico Action Plan
- Westchester County 2-foot topographic contours, derived from LIDAR, were added to the Westchester County data repository on DEP's GIS server

Several existing data layers were updated during 2007, including:

- DEP LAP fee and easement properties through December 31, 2007
- DEC Water Classification line and poly feature classes
- Hydric soils recreated using SSURGO 2 soil data with the Soil Data Viewer extension for ArcGIS
- 2001 land use raster datasets recreated to correct a misalignment issue
- DEP meteorological stations
- Reservoir stems and continuity throughout both watersheds to better represent hydrography
- Pre-1997 MOA land updates via takings maps and 2006 tax parcels
- Titicus Reservoir bathymetry updated via DEC Morphometric Atlas
- NYS-owned land updated via 2006 tax parcels

Migration from the GIS coverage library to the geodatabase continued as flags were established in the coverage library to indicate those archived data layers now found only in the geodatabase. Where possible, only the geodatabase is now updated, with all users directed to its use. Summary metadata is being created for the feature classes in the geodatabase.

5.4.3 Incorporation of Data Layers into the Modeling Database

Data Development

Staff appended new Ulster County SSURGO2 soils into a dataset of detailed soil polygons and properties now complete for the watershed and added to the GIS Library. They are used with the Soil Data Viewer extension for ArcGIS to derive soil property datasets.

The Spatially Explicit Delivery Model (SEDMOD) used DEMs, hydrography, and soils as spatial inputs to calculate a raster layer indicating Sediment Delivery Ratio (SDR) values within the Schoharie basin. The SDR is useful for estimating the amount of eroded material transported out of a drainage area.

Interface/Tool Development

Minor edits were made to the VSLF Inputs Tool to develop Constant Input (CIN) files within the Schoharie basin. CIN files were based on hypothetical scenarios of change in forested land cover. The tool was also used to develop long-term means CIN files for each West of Hudson basin.

EPA BASINS4 software was installed as a plug-in to MapWindow, an open source GIS. There is initial interest in exploring BASINS4 WDMUtil module for managing time-series data. The software was also used to delineate the drainage area of the USGS gage at Montague, NJ and produce summary statistics of land cover and percent impervious surface using the national Multi-Resolution Land Cover (MRLC) data.

5.4.4 Data Dissemination to Stakeholders and the Public, including Notification of Data Availability to Communities and Requests for Data

In cooperation with DEP Legal, GIS staff have developed data sharing policies. GIS staff continue to review all outside requests for GIS data, forward requests for data deemed “sensitive” to appropriate upper management or security personnel, and either email or write approved GIS data to CDs as required for data sharing. Stakeholders and communities that are on a schedule to receive semiannual data updates, such as newly-acquired lands, are sent data via email or CD as they become available.

Newly-acquired and pre-MOA NYC land updates were distributed to DEC, State University of New York College of Environmental Science and Forestry, Catskill Center for Conservation and Development, Catskill Watershed Corporation, Watershed Agricultural Council, Scenic Hudson, Hudsonia, Columbia Land Trust, Delaware County Planning Department, Delaware

County Soil and Water Conservation District, Greene County Soil and Water, Ulster County Soil and Water, Westchester County GIS, Open Space Institute, The Nature Conservancy, Appalachian Mountain Club, and Adirondack Mountain Club.

Numerous other individual GIS data layers were sent to contractors and consultants working on various DEP-related projects throughout the watersheds, including dam rehabilitation and other DEP construction and engineering projects.

5.4.5 GIS Infrastructure Improvement

Of particular significance during 2007, DEP prepared for the migration of the BWS GIS from an aging Unix/Oracle platform to a DEP Office of Information Technology (OIT) standard Windows 64-bit/SQL Server platform. This migration is anticipated to be complete in April 2008. In addition to improving performance for users of native-GIS software such as ArcMAP, this migration will simplify the manner in which the GIS is integrated into other database management systems such as WaLIS and LATS, due to the fact that SQL Server is the common database platform. This platform will also be more easily supported by in-house DEP OIT resources.

Until the server migration is complete, a contracted GIS System Administrator continues to support the existing UNIX GIS infrastructure. This includes performing and monitoring backups, auditing system logs on UNIX servers, maintaining and upgrading ArcGIS client software on GIS workstations, and assisting in maintaining GIS data libraries on UNIX servers. This support will transition over to DEP OIT once migration to the Windows 64-bit platform is complete.

During 2007, new high capacity tape drives used for backing up UNIX servers in Kingston were installed and tested. These tape drives are also compatible with the new 64-bit Windows production GIS servers scheduled for arrival winter/spring 2008. Twenty-three new GIS workstations were procured, configured, and deployed to power GIS users in Kingston, Grahamsville, and Downsville, to replace aging equipment. A method of providing updated GIS Library data to remote sites (Grahamsville, Shokan, Downsville, Mahopac) via a replicated File Geodatabase (FGDB) was devised and implemented.

The Software Development Environment (SDE) Database Administrator (DBA) has continued to maintain and enhance ArcSDE to streamline performance and improve the integrity of the central BWS geodatabase, as follows:

- Upgraded servers to Oracle 10gR2 10.2.0.2 and ArcSDE 9.2 (service pack 4)
- Applied 2007 Daylight Savings Time patches to Oracle installations on servers
- Created new and updated existing geodatasets in the production ArcSDE geodatabases, including several parcel updates
- Created two ARCLIB file geodatabases: an up-to-date copy of all vector and selected raster datasets from SDE, and an historical archive of SDE geodatasets
- Supported WaLIS v4 geodatabase development: created and loaded geodatasets upon request; created spatial views; wrote SQL Server triggers, functions, and ArcObjects-based scripts to

automatically update and maintain selected geodatasets
- Supported Stream Program geodatabase: loaded data upon request, performed check-in/ check-out replication for field offices, and assisted users with in-house versioned editing

In preparation for the migration of SDE from Oracle to SQL Server, the DBA coordinated with GIS staff to clean up and reorganize both vector and raster geodatasets. Best practices for SQL Server and ArcSDE were researched and a tentative database layout with ArcSDE configuration files was created. Once the new Windows 64-bit development server running Microsoft Windows Server 2003 operating system was received, the following related tasks were performed:

- Installed and configured both SQL Server 2005 (64-bit) and ArcSDE 9.2
- Migrated all vector and raster datasets from Oracle to SQL Server 2005, currently synchronizing "development" SQL Server geodatabase with "production" Oracle geodatabase updates on Unix
- Created new raster dataset
- t color infrared (CIR) and color imagery mosaics in the SQL Server geodatabase for Orange, Putnam, and Westchester Counties
- Wrote an ArcObjects-based utility to update layers in ArcMap documents (*.mxd) by pointing them to geodatasets on a different server (e.g., a new Windows server running ArcSDE). This can be run in batch mode to update several directories of ArcMap documents at once to enable GIS users to update existing ArcMap documents at the time of the server migration
- Assisted GIS Staff in conceiving a hierarchy of ArcGIS layer files (*.lyr) as an alternative to exploring SDE data through an ArcCatalog spatial database connection

Hardware

New hardware installed in 2007 included:

- T3 disk array firmware for image server
- High capacity tape drives for server backup
- HP Windows 64-bit Development GIS server 23
- DELL GIS workstations in Kingston, Grahamsville, and Downsville
- HP4000PS large-format replacement plotter for GIS Lab in Kingston

Software

Software upgrades in 2007 included:

- Solaris 10 Unix (server operating system)
- Oracle 10gR2 10.2.0.2 (server database)
- ArcGIS 9.2 SP2, 3, and 4 (GIS desktop)
- ArcSDE 9.2 SP2, 3, and 4 (server geodatabase)
- ApexSQL (database auditing)

Professional Development

Training

Staff participated in the following ESRI on-line seminars: *ArcGIS Server; Working with CAD Data in ArcGIS;* and *Introduction to ArcGIS Image Server.*

Staff provided individual ArcGIS training as needed to other users on staff, as necessary.

Conferences and User Groups

Staff attended two workshops presented by the NYS Office of Cyber Security and Critical Infrastructure Coordination (CSCIC) in Highland, NY. The first offered an overview of the revised NYS Strategic Plan for GIS, where staff offered comment on the orthoimagery program and participated in a discussion of statewide wetlands mapping. The second, "Introduction to GIS Web Services," focused on emerging technologies for distributing and consuming spatial data and geoprocessing tasks via the Internet.

A staff member attended the annual NYS GIS Conference in Albany, NY. The conference provided a diverse selection of workshops, updates on NYS GIS efforts, and opportunity for networking.

Staff provided input via the NYS Remote Sensing Work Group to the state's 2007 request for proposal for digital orthoimagery and LIDAR.

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&R), also promulgated as state law, the federal Clean Water Act, National Pollutant Discharge Elimination System (NPDES), and State Environmental Quality Review Act (SEQRA), as well as local ordinances. Of these, the primary mechanism for protection of the water supply is promulgation and enforcement of the WR&R. 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&R, 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. In addition, 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 lists project applications received in the Boyd Corners, West Branch, Croton Falls, Cross River, and Kensico Reservoir basins for the 1st, 2nd, 3rd, and 4th quarters of 2007. The new, delegated, and remediated individual septic systems are listed in Table 6.2. The project locations are depicted on Figures 6.2 through 6.3.

Table 6.1. Boyd Corners, West Branch, Croton Falls, Cross River, and Kensico Reservoirs new projects for 2007.

Reservoir Basin	Project Name	Town	DEP Approval Required	Project Status as of 12/31/07
Cross River	Lewisboro Elementary School	Lewisboro	SPPP	Incomplete
Cross River	Meadows at Cross River	Lewisboro	Other	No Application
Cross River	Michelle Estates	Lewisboro	Other	No Application
Cross River	St. John's Church	Lewisboro	SPPP	Approved
Cross River	Leitner/Hubsher Subdivision/2 Lots	Lewisboro	Other	No Application
Cross River	Dover Barn/Studio	Lewisboro	Other	No Application
Cross River	Nastasi Residence Addition	Lewisboro	Other	No Application
Cross River	Lewisboro Volunteer Ambulance Corp. Addition	Lewisboro	Other	No Application
Cross River	Dale Nan Residence Reconstruction	Lewisboro	Other	No Application
Cross River	Lebowitz Wetlands Application	Lewisboro	Other	No Application
Croton Falls	Somers Hills Subdivision, Lot 27/ KTT Builders	Carmel	Other	No Application
Croton Falls	Wixon Pond Development	Carmel	SPPP	Incomplete
Croton Falls	Mahopac Highlands Lot 15	Carmel	SPPP	Incomplete
Croton Falls	Tompkins Recycling Facility	Carmel	SPPP	Incomplete
Croton Falls	Mahopac Town Center	Carmel	SPPP	Incomplete
Kensico	Quarry Heights-Sewer Dist	North Castle	Sewer Collection	New
Kensico	CRO-417 Kensico Dredging	Mount Pleasant	SPPP	Incomplete
Kensico	Autera Tennis Court	Greenwich	Other	No Application
Kensico	Robert Heath Property	North Castle	Stream Disturbance	No Application
West Branch	Lands of Dierze	East Fishkill	Variance.1	Denied
West Branch	Lands of Dierze	East Fishkill	Variance.2	Complete
West Branch	Kasper Residence	East Fishkill	Variance	Approved
West Branch	CRO-421	Multiple	Other	No Application

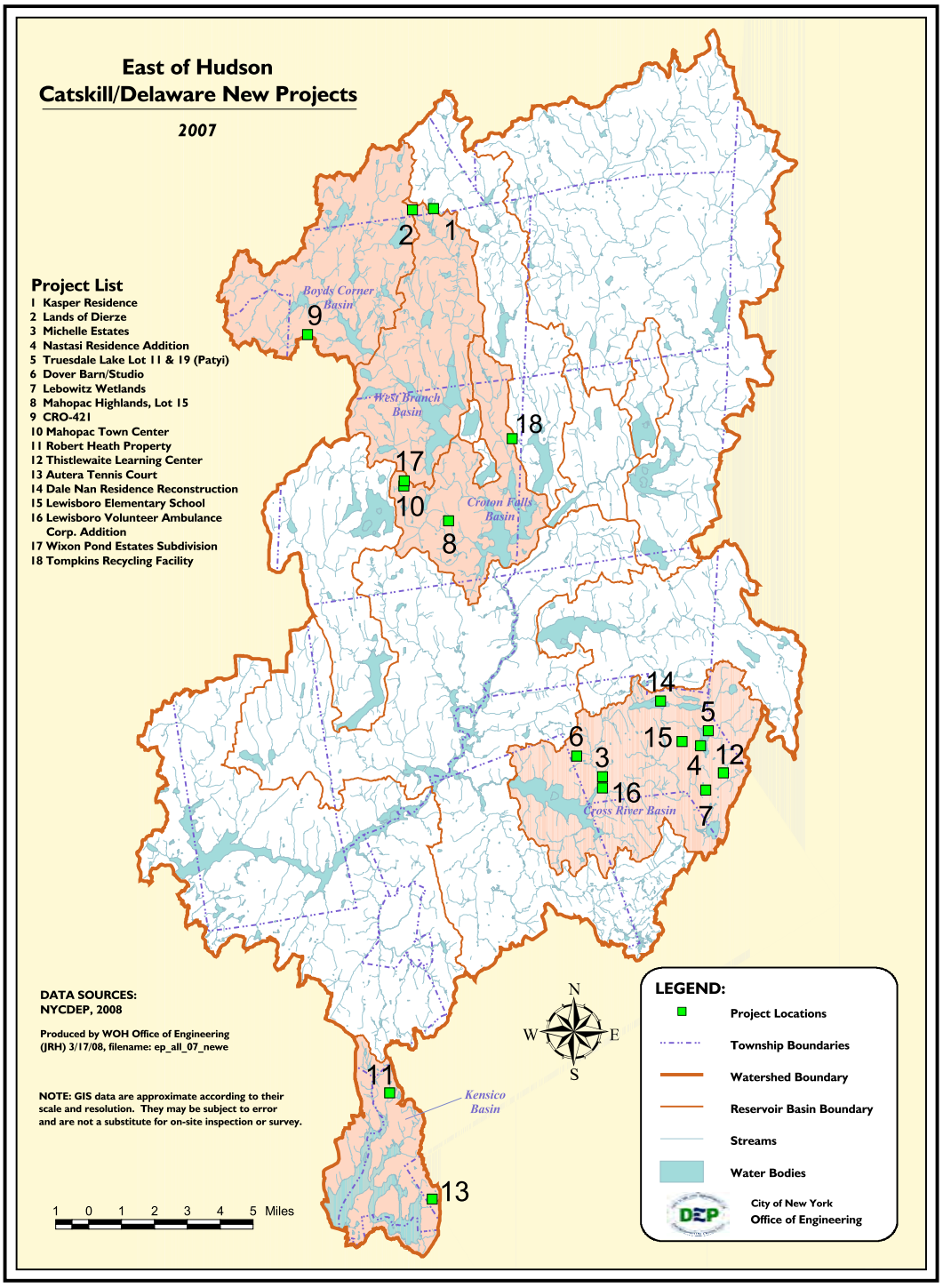

Figure 6.1. East of Hudson, Catskill/Delaware new projects, 2007.

All new individual septic system applications in Kensico, West Branch, Boyd Corners, Croton Falls, and Cross River basins are subject to delegated review by the Putnam and Westchester County Health Departments.

Table 6.2. Boyd Corners, West Branch, Croton Falls, Cross River, and Kensico Reservoirs individual SSTSs for 2007.

Reservoir	Town	# of Delegated Septics	# of New Septics	# of Septic Repairs	# of Approvals	# of Constructions
Boyd Corners	East Fishkill	NA	3	0	3	0
Boyd Corners	Kent	4	N/A	4	6	0
Boyd Corners	Putnam Valley	0	N/A	0	0	0
Cross River	Bedford	6	N/A	0	7	3
Cross River	Lewisboro	13	N/A	0	10	3
Cross River	Pound Ridge	3	N/A	0	2	2
Croton Falls	Carmel	8	N/A	4	12	5
Croton Falls	Kent	2	N/A	0	0	0
Croton Falls	Southeast	2	N/A	1	1	1
Croton Falls	Somers	0	N/A	0	0	0
Kensico	Mt. Pleasant	0	N/A	0	0	0
Kensico	New Castle	1	N/A	0	2	2
Kensico	North Castle	3	N/A	0	2	3
Kensico	Harrison	1	N/A	0	1	1
Kensico	Greenwich Ct.	NA	0	0	0	0
West Branch	Carmel	3	N/A	6	11	4
West Branch	East Fishkill	NA	0	6	17	2
West Branch	Kent	6	N/A	0	1	6
West Branch	Putnam Valley	0	N/A	0	0	0
Totals		52	3	21	75	32

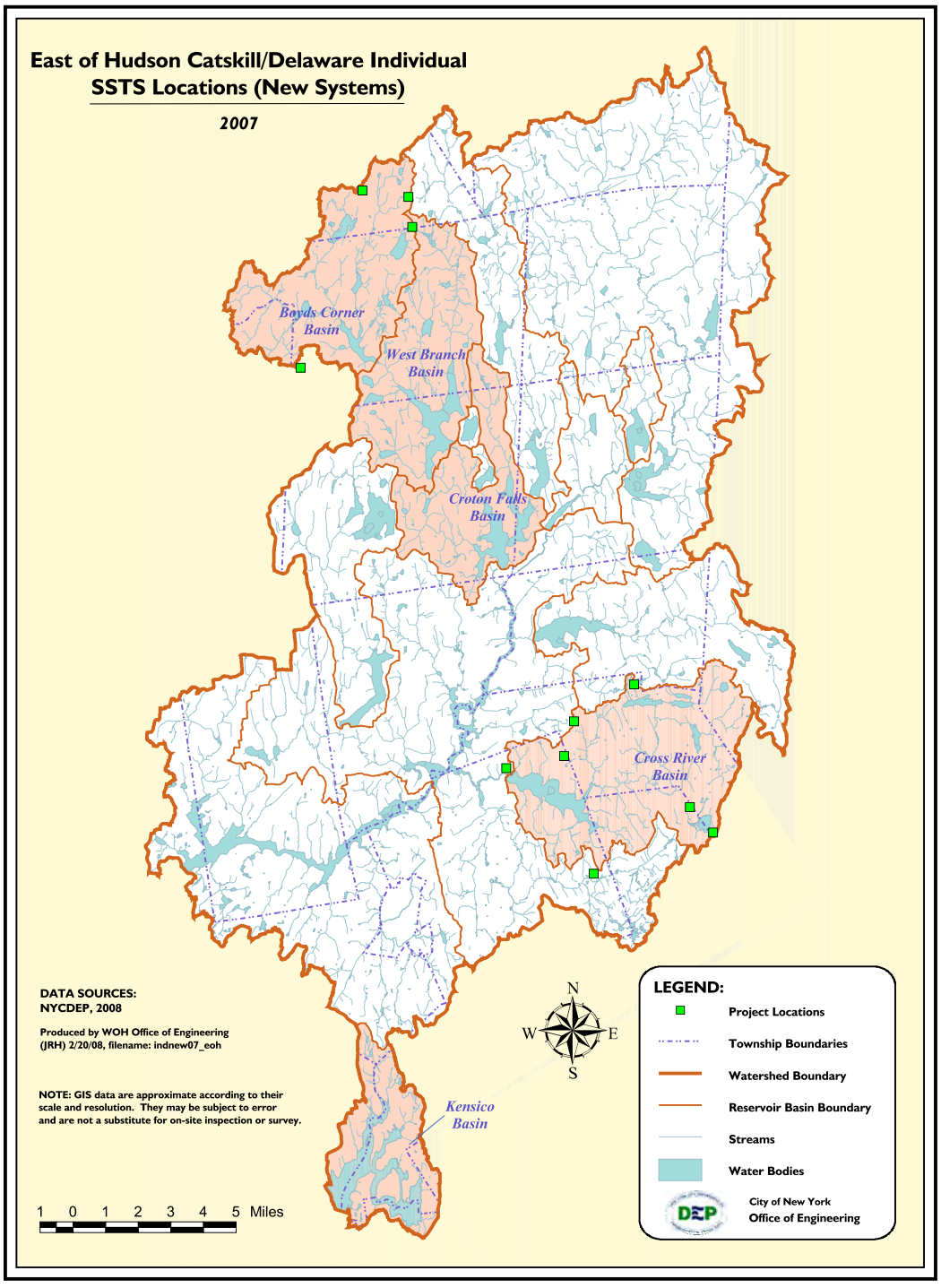

Figure 6.2. East of Hudson Catskill/Delaware individual SSTS locations (new systems) 2007.

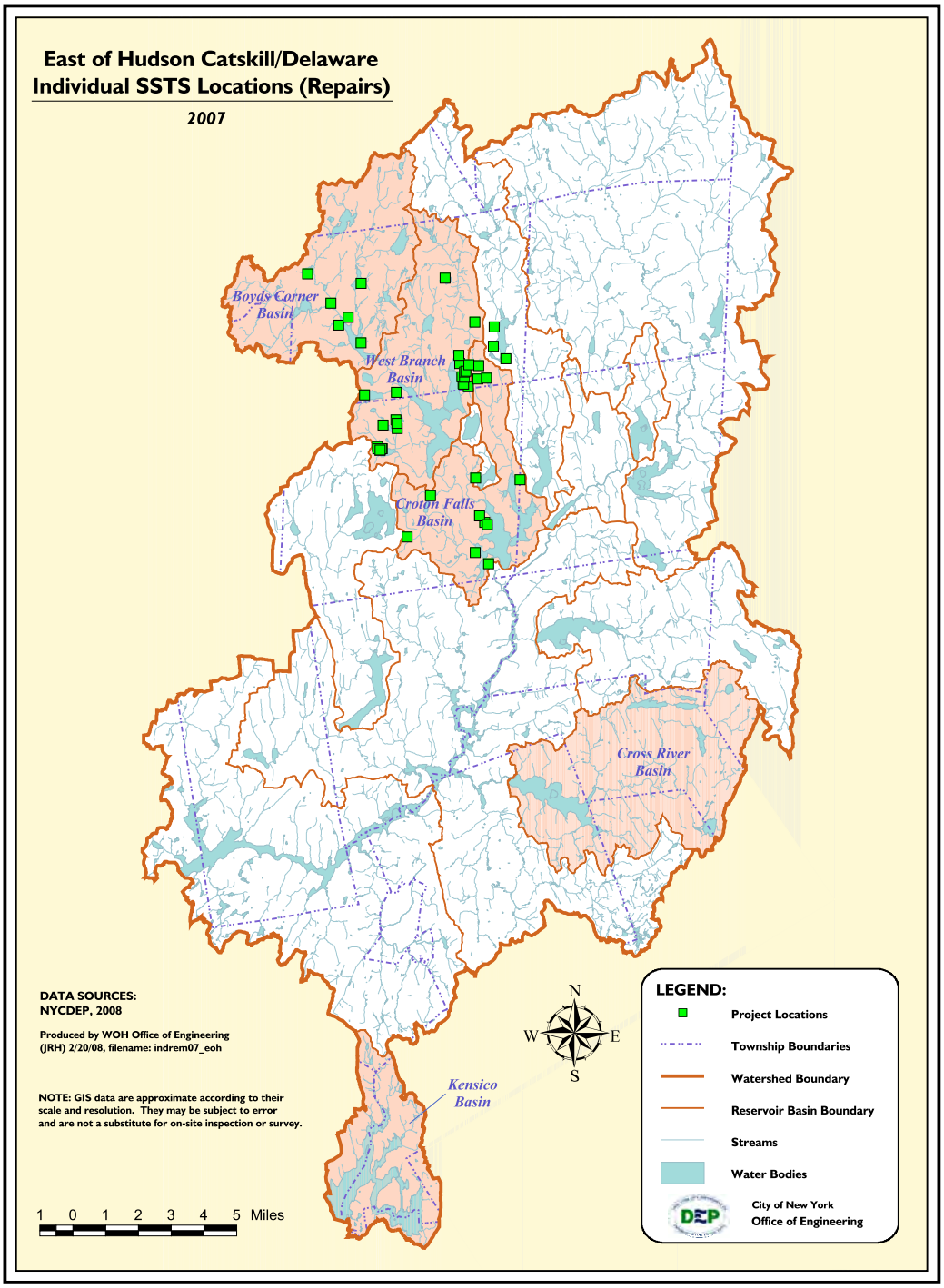

Figure 6.3. East of Hudson Catskill/Delaware repair individual SSTS locations.

Table 6.3 lists all projects received in 2007 in the Cannonsville, Pepacton, Rondout, Neversink, Schoharie, and Ashokan basins in the Delaware and Catskill Systems. The "Other" projects consist of NYS Department of Transportation (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). Figures 6.4 through 6.9 show the locations of these projects. The new, delegated and remediated individual septic systems are listed in Tables 6.5 and 6.6.

The reader will note that in 2007, activity in the Cannonsville Reservoir basin was very high, particularly stream disturbance permit requests. High flow storm events in the region in June 2006 and June 2007 contributed to extensive flooding in the region.

Table 6.3. Ashokan, Cannonsville, Neversink, Pepacton, Rondout, Schoharie Reservoirs new projects for 2007.

Reservoir Basin	Project Name	Town	DEP Approval Required	Project Status as of 12/31/07
Ashokan	Bristol Hills Stormwater Retrofit Planning and Assessment	Hurley	Other	Closed
Ashokan	Brooks, Christopher & Dina	Olive	SSTS	Approved
Ashokan	Christie, Arthur	Shandaken	Variance	Denied
Ashokan	Estin Timber Harvest	Woodstock	Timber Harvest	Closed
Ashokan	Glenford/Wittenberg Stormwater Retrofit Planning & Assessment	Hurley	Other	No Application
Ashokan	Hanowitz, Geoffrey & Jehu, Roberta	Woodstock	SSTS	Approved
Ashokan	Juliano Ventures	Olive	SSTS	New
Ashokan	NYSDOT - Route 214 Culvert Replacement	Shandaken	Other	Closed
Ashokan	Roark Timber Harvesting	Woodstock	Timber Harvest	No Application
Ashokan	Uram-Greenberg, Marty & Susan	Woodstock	SPPP	Complete
Ashokan	Pokolk, Matthew (Mt. Tremper Arts, LLC)	Shandaken	SSTS	New

Table 6.3. Ashokan, Cannonsville, Neversink, Pepacton, Rondout, Schoharie Reservoirs new projects for 2007. (Continued)

Reservoir Basin	Project Name	Town	DEP Approval Required	Project Status as of 12/31/07
Ashokan	Woodstock Farm Animal Sanctuary	Woodstock	SSTS	Complete
Cannonsville	Antionette Budine Property Stream Disturbance	Walton	Stream Disturbance	Closed
Cannonsville	Austin Lincoln Park Stream Disturbance	Walton	Stream Disturbance	Closed
Cannonsville	Barbour Brook Road Stream Disturbance	Tompkins	Stream Disturbance	Closed
Cannonsville	Barbour Brook Road-3 sites Stream Disturbance	Tompkins	Stream Disturbance	Closed
Cannonsville	Beers Brook Road Stream Disturbance	Walton	Stream Disturbance	Closed
Cannonsville	Boye Property	Walton	Stream Disturbance	Closed
Cannonsville	Breakly Motors Property Stream Disturbance	Walton	Stream Disturbance	Closed
Cannonsville	Carroll Hill Road Stream Disturbance	Tompkins	Stream Disturbance	Closed
Cannonsville	Chambers Hollow Road Stream Disturbance	Hamden	Stream Disturbance	Closed
Cannonsville	County Route 16 Stream Disturbance	Delhi	Stream Disturbance	Closed
Cannonsville	County Route 67 Stream Disturbance	Tompkins	Stream Disturbance	Closed
Cannonsville	Dailey Property Stream Disturbance	Walton	Stream Disturbance	Closed
Cannonsville	DCMO BOCES - Educational Buildings	Sidney	SPPP	Approved
Cannonsville	DCSWM Center - Streambank Repair	Walton	Stream Disturbance	Closed

Table 6.3. Ashokan, Cannonsville, Neversink, Pepacton, Rondout, Schoharie Reservoirs new projects for 2007. (Continued)

Reservoir Basin	Project Name	Town	DEP Approval Required	Project Status as of 12/31/07
Cannonsville	DCSWM Center - Stream Disturbance	Walton	Stream Disturbance	Closed
Cannonsville	DCSWMC - Annual Report	Walton	Other	No Application
Cannonsville	DCSWMF - 1st Quarter 2007	Walton	Other	No Application
Cannonsville	Dry Brook Road Streambank Stabilization	Tompkins	Stream Disturbance	Closed
Cannonsville	Dryden Brook Stream Disturbance @ Barbour Brook Rd.	Tompkins	Stream Disturbance	Closed
Cannonsville	Dryden Brook Stream Disturbance @ Finch Hollow	Tompkins	Stream Disturbance	Closed
Cannonsville	Dryden Road over Dryden Brook	Tompkins	Steam Disturbance	No Application
Cannonsville	Dryden Road Stream Disturbance	Tompkins	Stream Disturbance	No Application
Cannonsville	East Brook Road Stream Disturbance	Hamden	Stream Disturbance	Closed
Cannonsville	East Brook Stream Disturbance	Walton	Stream Disturbance	Closed
Cannonsville	East Brook/Union Street Stream Disturbance	Walton	Stream Disturbance	Closed
Cannonsville	Elm Street at Steele Brook	Delhi	Stream Disturbance	Closed
Cannonsville	Finch Hollow Road Stream Disturbance	Tompkins	Stream Disturbance	Closed
Cannonsville	Fleming Road Stream Disturbance	Delhi	Stream Disturbance	Closed
Cannonsville	Gardepe Property Stream Disturbance	Tompkins	Stream Disturbance	Closed
Cannonsville	Gaschler Property Stream Disturbance	Tompkins	Stream Disturbance	No Application

Table 6.3. Ashokan, Cannonsville, Neversink, Pepacton, Rondout, Schoharie Reservoirs new projects for 2007. (Continued)

Reservoir Basin	Project Name	Town	DEP Approval Required	Project Status as of 12/31/07
Cannonsville	Gerald Dewitt Property	Delhi	Stream Disturbance	No Application
Cannonsville	Glenn Burnie Creek Stream Disturbance	Delhi	Stream Disturbance	Closed
Cannonsville	Harry Westfall Stream Disturbance	Stamford (V)	Stream Disturbance	Closed
Cannonsville	Herzog Property Stream Disturbance	Walton	Stream Disturbance	Closed
Cannonsville	Houck Property Stream Disturbance	Walton	Stream Disturbance	No Application
Cannonsville	Hoyt Road Culvert	Hamden	Stream Disturbance	Closed
Cannonsville	Johnson Hill & Palmer Hill Stream Disturbance	Walton	Stream Disturbance	No Application
Cannonsville	Kallergis Property Stream Disturbance	Walton	Stream Disturbance	No Application
Cannonsville	Kilmer Stream Disturbance	Walton	Stream Disturbance	Closed
Cannonsville	Laird Property Stream Disturbance	Hamden	Stream Disturbance	Closed
Cannonsville	Lower Third Brook	Walton	Stream Disturbance	Closed
Cannonsville	Marshfield, Wayne	Hamden	Stream Disturbance	Closed
Cannonsville	Marvin Hollow Road Stream Disturbance	Walton	Stream Disturbance	Closed
Cannonsville	Michel Tokes Property	Walton	Stream Disturbance	No Application
Cannonsville	Middlemist Road Stream disturbance	Delhi	Stream Disturbance	Closed

Table 6.3. Ashokan, Cannonsville, Neversink, Pepacton, Rondout, Schoharie Reservoirs new projects for 2007. (Continued)

Reservoir Basin	Project Name	Town	DEP Approval Required	Project Status as of 12/31/07
Cannonsville	Murphy Hill Road Drainage Improvements	Walton	Other	Closed
Cannonsville	N of Ogden Street Bridge & Third Brook	Walton	Stream Disturbance	No Application
Cannonsville	NYSEG Tap Replacement	Walton	SPPP	Closed
Cannonsville	O'Brian, Tom aka: Watershed Agricultural Council Office	Walton	SSTS Repair	Approved
Cannonsville	Phoenix Property Stream Disturbance	Hamden	Stream Disturbance	Closed
Cannonsville	Pines Brook Stream Restoration	Walton	Stream Disturbance	Closed
Cannonsville	Platner Brook Road @ Platner Brook	Delhi	Stream Disturbance	Closed
Cannonsville	River Run Senior Housing (Hayes, Cole)	Delhi	Variance	Incomplete
Cannonsville	River Run Senior Housing (Hayes, Cole)	Delhi	Sewer Collection	Incomplete
Cannonsville	River Run Senior Housing (Hayes, Cole)	Delhi	Stormwater	Incomplete
Cannonsville	Rockefeller Property Stream Disturbance	Meredith	Stream Disturbance	Closed
Cannonsville	Silvestri Property	Hamden	Stream Disturbance	No Application
Cannonsville	Snyder Property Stream Disturbance	Delhi	Stream Disturbance	Closed
Cannonsville	Spencer Property Stream Disturbance	Walton	Stream Disturbance	No Application
Cannonsville	SUNY Delhi Honors Housing Complex	Delhi	Sewer Connection	Approved
Cannonsville	SUNY Delhi Honors Housing Complex	Delhi	SPPP	Approved

Table 6.3. Ashokan, Cannonsville, Neversink, Pepacton, Rondout, Schoharie Reservoirs new projects for 2007. (Continued)

Reservoir Basin	Project Name	Town	DEP Approval Required	Project Status as of 12/31/07
Cannonsville	SUNY Delhi Honors Housing Complex	Delhi	Variance	Approved
Cannonsville	T/Bovina New Road @ CR 6 Stream Disturbance	Bovina	Stream Disturbance	No Application
Cannonsville	T/Bovina Weber Road Stream Disturbance	Bovina	Stream Disturbance	No Application
Cannonsville	T/Walton Highway Management Plan	Walton	Other	No Application
Cannonsville	Third Brook Flood Mitigation/ Watershed Management Plan	Walton	Other	No Application
Cannonsville	Third Brook-Route 10 & Ogden Street Bridges	Walton	Stream Disturbance	No Application
Cannonsville	Townsend Street Stream Disturbance	Walton	Stream Disturbance	No Application
Cannonsville	Turner Property	Walton	Stream Disturbance	Closed
Cannonsville	V/Delhi Reservoir Dam Stabilization	Delhi	Stream Disturbance	No Application
Cannonsville	Walton Central School District (Townsend Elem. School)	Walton	Stream Disturbance	Closed
Cannonsville	Walton CSD @ School Bus Garage - Stream Disturbance	Walton	Stream Disturbance	Closed
Cannonsville	West Branch Delaware Gravel Bar	Hamden	Stream Disturbance	Closed
Cannonsville	West Branch Delaware River Stream Corridor Restoration	Walton (V)	Stormwater	New
Cannonsville	Woolerton Street Stream Disturbance	Delhi	Stream Disturbance	Closed
Neversink	DEL-68 Electric Service Replacement	Neversink	Other	No Application

Table 6.3. Ashokan, Cannonsville, Neversink, Pepacton, Rondout, Schoharie Reservoirs new projects for 2007. (Continued)

Reservoir Basin	Project Name	Town	DEP Approval Required	Project Status as of 12/31/07
Pepacton	Andes Stormwater Culverts	Andes	Stream Disturbance	No Application
Pepacton	Barkaboom Road Stream Disturbance	Andes	Stream Disturbance	No Application
Pepacton	Beech Hill Road Stream Disturbance	Andes	Stream Disturbance	Closed
Pepacton	Carol Adams Stream Disturbance	Roxbury	Stream Disturbance	No Application
Pepacton	Cowan, Douglas	Middletown	Intermediate SSTS	Approved
Pepacton	Delaware County Highway Management Plan	Andes	Other	No Application
Pepacton	Eugene Cronk Property	Roxbury	Stream Disturbance	No Application
Pepacton	Margaretville Village Park	Middletown	Stream Disturbance	No Application
Pepacton	McMurray Stream Disturbance	Middletown	Stream Disturbance	No Application
Pepacton	Pasternak, Kenneth	Middletown	SPPP	Incomplete
Pepacton	Radbell, Joseph	Andes	Variance	Complete
Pepacton	Reservoir Road Bridge Stream Disturbance	Middletown	Stream Disturbance	No Application
Pepacton	Roxbury Hamlet Stormwater Assessment	Roxbury	Other	No Application
Pepacton	T/Middletown Comprehensive Plan Update Project	Middletown	Other	No Application
Pepacton	Town of Andes Stormwater Retrofit Project	Andes	Other	No Application
Pepacton	Tuttle Streambank Stabilization	Andes	Stream Disturbance	No Application

Table 6.3. Ashokan, Cannonsville, Neversink, Pepacton, Rondout, Schoharie Reservoirs new projects for 2007. (Continued)

Reservoir Basin	Project Name	Town	DEP Approval Required	Project Status as of 12/31/07
Pepacton	V/Fleischmanns Comprehensive Plan and Zoning Project	Fleischmanns	Other	No Application
Rondout	Higgins, David Subdivision	Neversink	Intermediate SSTS	Approved
Rondout	Higgins, David Subdivision	Neversink	SPPP	Closed
Rondout	Smith, George	Neversink	Variance	Denied
Schoharie	Accardi Property Stream Disturbance	Jewett	Stream Disturbance	No Application
Schoharie	Bear Kill Road over Bear Kill	Conesville	Stream Disturbance	Closed
Schoharie	Botti Drive Stormwater Retrofit Program	Hunter	Other	No Application
Schoharie	Bush Road over Trib. 9-3 of Manor Kill	Conesville	Stream Disturbance	No Application
Schoharie	Conine Stream Restoration Project	Prattsville	SPPP	Approved
Schoharie	Copper Ridge, LLC	Windham	Sewer Collection	Withdrawn
Schoharie	Copper Ridge, LLC	Windham	SPPP	Withdrawn
Schoharie	Dzenis Property Stream Disturbance	Hunter	Stream Disturbance	No Application
Schoharie	Eagle's Landing - Lot #22	Windham	SPPP	Incomplete
Schoharie	Eagle's Landing - Lot #24	Windham	SPPP	Incomplete
Schoharie	Etienne Property Stream Disturbance	Lexington	Stream Disturbance	Closed
Schoharie	Falke Road @ Schoharie Creek	Lexington	Stream Disturbance	Closed
Schoharie	Four Season's Stormwater Improvements	Hunter	SPPP	New

Table 6.3. Ashokan, Cannonsville, Neversink, Pepacton, Rondout, Schoharie Reservoirs new projects for 2007. (Continued)

Reservoir Basin	Project Name	Town	DEP Approval Required	Project Status as of 12/31/07
Schoharie	Garden of Eden Café	Ashland	SSTS	Approved
Schoharie	Hirsch, Frederick & Constance	Ashland	Variance	New
Schoharie	Hunter Brook Residential Condominium Development (aka:Tres Gringos)	Hunter (V)	Sewer Collection	Incomplete
Schoharie	Hunter Brook Residential Condominium Development (aka:Tres Gringos)	Hunter (V)	SPPP	Complete
Schoharie	Hunter Corridor GEIS-LTAP	Hurley	Other	No Application
Schoharie	Hunter Inn Condominium Expansion	Hunter (V)	Sewer Connection	Approved
Schoharie	Hunter Inn Condominium Expansion	Hunter (V)	SPPP	Approved
Schoharie	Jewett Stormwater Analysis	Jewett	Other	No Application
Schoharie	Lake in the Sky - Lot #31 (Smith)	Gilboa	SPPP	Incomplete
Schoharie	Lighthouse on the Hill (Conforti, Michael) (Echo Valley Motel)	Lexington	SSTS Repair	Complete
Schoharie	Manorkill Watershed GEIS - LTAP	Conesville	Other	No Application
Schoharie	Marron, Gary (Hyflex Office Building)	Ashland	SSTS	Approved
Schoharie	Michael's Diner Stormwater Retrofit	Windham	Other	No Application
Schoharie	Pine Island - Lot #38 (Hill)	Gilboa	SPPP	New
Schoharie	Roxbury Comprehensive Plan Addendum and GEIS - LTAP	Roxbury	Other	No Application
Schoharie	Rufa, Larry (Windham Heights)	Windham	SSTS	Incomplete

Table 6.3. Ashokan, Cannonsville, Neversink, Pepacton, Rondout, Schoharie Reservoirs new projects for 2007. (Continued)

Reservoir Basin	Project Name	Town	DEP Approval Required	Project Status as of 12/31/07
Schoharie	Rufa, Larry (Windham Heights)	Windham	SPPP	Incomplete
Schoharie	Shadow Mountain Road Bridge	Jewett	Stream Disturbance	Closed
Schoharie	T/Windham Stormwater Planning & Assessment	Windham	Other	Closed
Schoharie	The Cottages at Winwood (Windham Mountain Partners)	Windham	Sewer Collection	Incomplete
Schoharie	The Cottages at Winwood (Windham Mountain Partners)	Windham	SPPP	Incomplete
Schoharie	Tocci, Peter & Marcia	Prattsville	Variance	Denied
Schoharie	Town of Jewett Groundwater Study	Jewett	Other	Closed
Schoharie	Town of Windham GEIS - LTAP	Windham	Other	No Application
Schoharie	Windham Hollow Acres	Windham	SSTS	Incomplete
Schoharie	Windham Mountain Club - Phase 3	Windham	Sewer Collection	Approved
Schoharie	Windham Mountain Club - Phase 3	Windham	SPPP	Approved

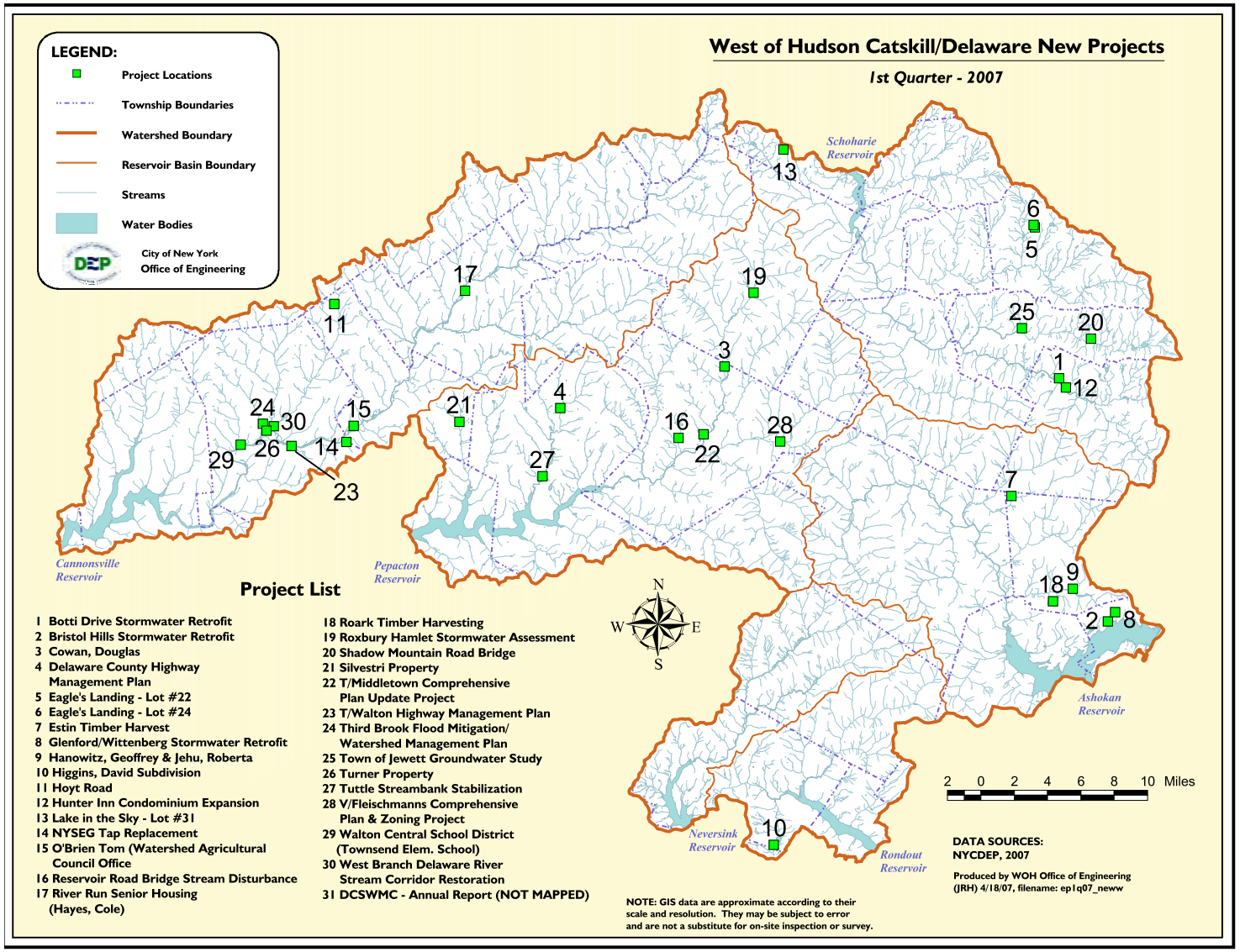

Figure 6.4. West of Hudson Catskill/Delaware New Projects – 1st Quarter.

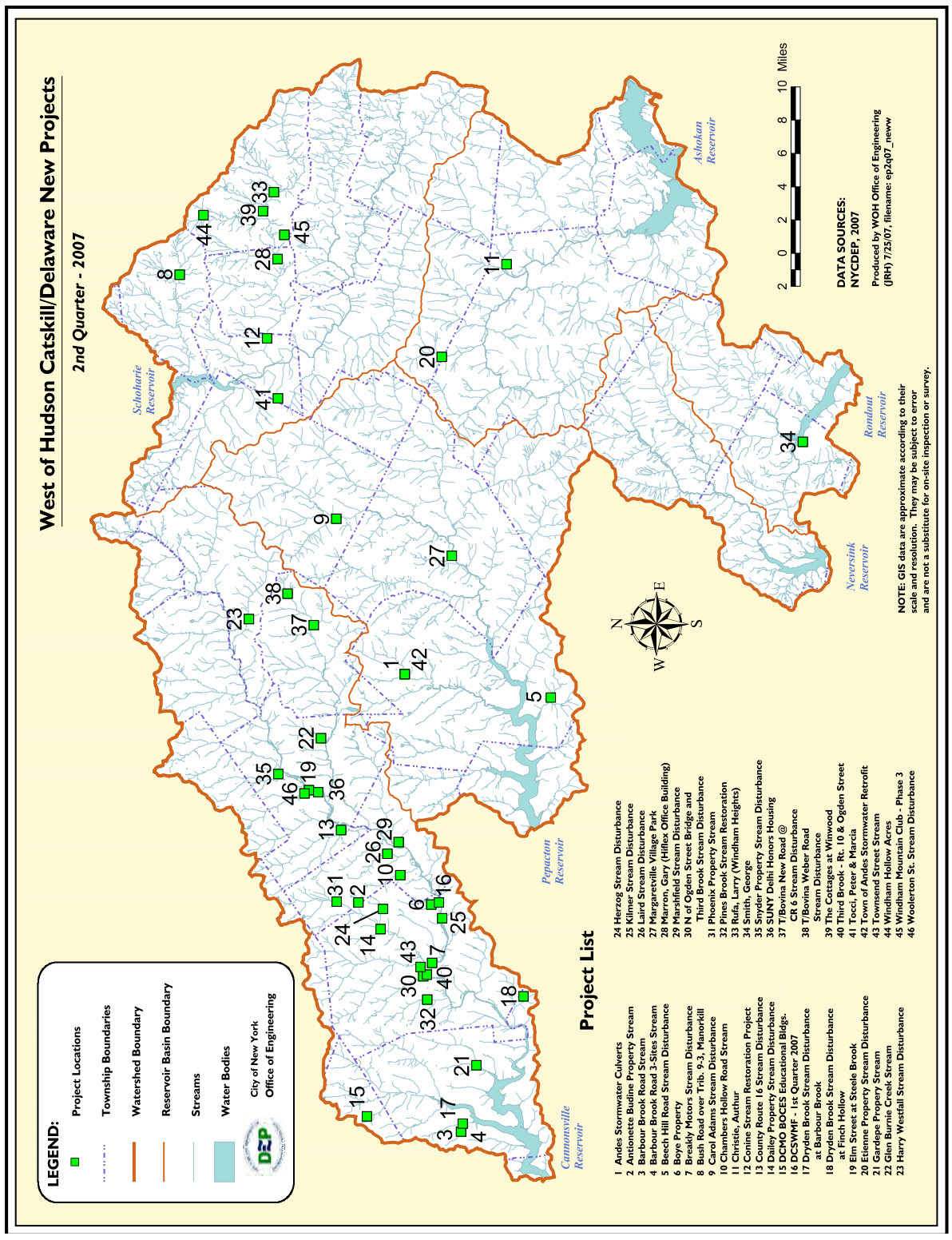

Figure 6.5. West of Hudson Catskill/Delaware New Projects – 2nd Quarter.

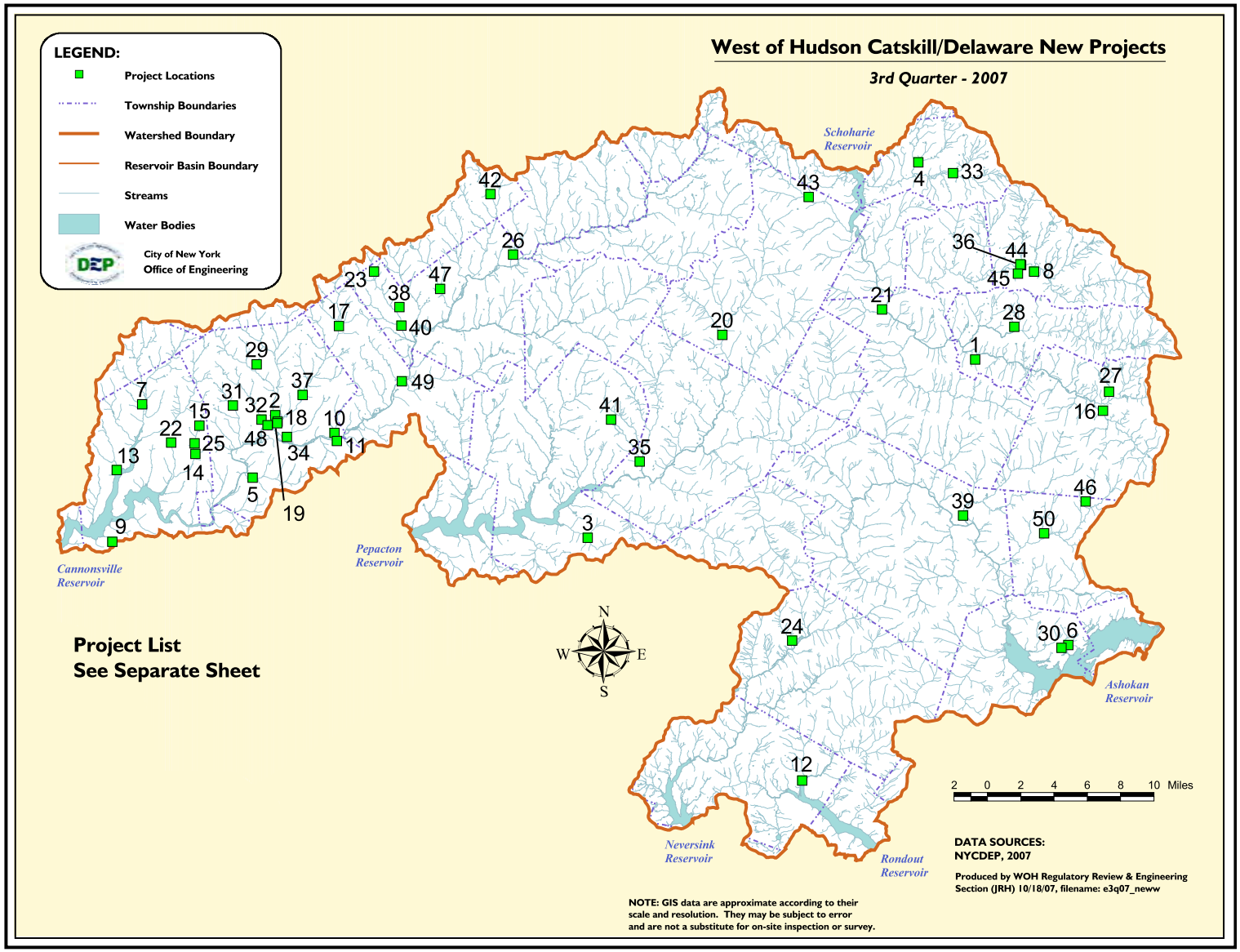

Figure 6.6. West of Hudson Catskill/Delaware New Projects – 3rd Quarter.

Table 6.4 is a list of West of Hudson Catskill/Delaware new projects for the 3rd quarter. Location of each new project is shown in Figure 6.6.

Table 6.4. List of West of Hudson Catskill/Delaware new projects – 3rd quarter.

Map #	Project Name
1	Accardi Property Stream Disturbance
2	Austin Lincoln Park Stream Disturbance
3	Barkaboom Road Stream Disturbance
4	Bear Kill Road over Bear Kill
5	Beers Brook Road Stream Disturbance
6	Brooks, Christopher & Dina
7	Carroll Hill Road Stream Disturbance
8	Copper Ridge, LLC
9	County Route 67 Stream Disturbance
10	DCSWM Center - Stream Bank Repair
11	DCSWM Center - Stream Disturbance
12	DEL-68 Electric Service Replacement
13	Dry Brook Road Streambank Stabilization
14	Dryden Road over Dryden Brook
15	Dryden Road Stream Disturbance
16	Dzenis Property Stream Disturbance
17	East Brook Road Stream Disturbance
18	East Brook Stream Disturbance
19	East Brook/Union Street Stream Disturbance
20	Eugene Cronk Property
21	Falke Road @ Schoharie Creek
22	Finch Hollow Road Stream Disturbance
23	Fleming Road Stream Disturbance
24	Frost Valley - Staff Housing
25	Gaschler Property Stream Disturbance
26	Gerald Dewitt Property
27	Hunter Corridor GEIS-LTAP
28	Jewett Stormwater Analysis
29	Johnson Hill & Palmer Hill Stream Disturbance
30	Juliano Ventures
31	Kallergis Property Stream Disturbance
32	Lower Third Brook
33	Manorkill Watershed GEIS - LTAP
34	Marvin Hollow Road Stream Disturbance
35	McMurray Stream Disturbance
36	Michael's Diner Stormwater Retrofit

Table 6.4. List of West of Hudson Catskill/Delaware new projects – 3rd quarter.

Map #	Project Name
37	Michel Tokes Property
38	Middlemist Road Stream disturbance
39	NYSDOT - Route 214 Culvert Replacement
40	Platner Brook Road @ Platner Brook
41	Radbell, Joseph
42	Rockefeller Property Stream Disturbance
43	Roxbury Comprehensive Plan Addendum and GEIS - LTAP
44	T/Windham Stormwater Planning & Assessment
45	Town of Windham GEIS - LTAP
46	Uram-Greenberg, Marty & Susan
47	V/Delhi Reservoir Dam Stabilization
48	Walton CSD @ School Bus Garage - Stream Disturbance
49	West Branch Delaware Gravel Bar
50	Woodstock Farm Animal Sanctuary - Education Center (Abel/Brown)

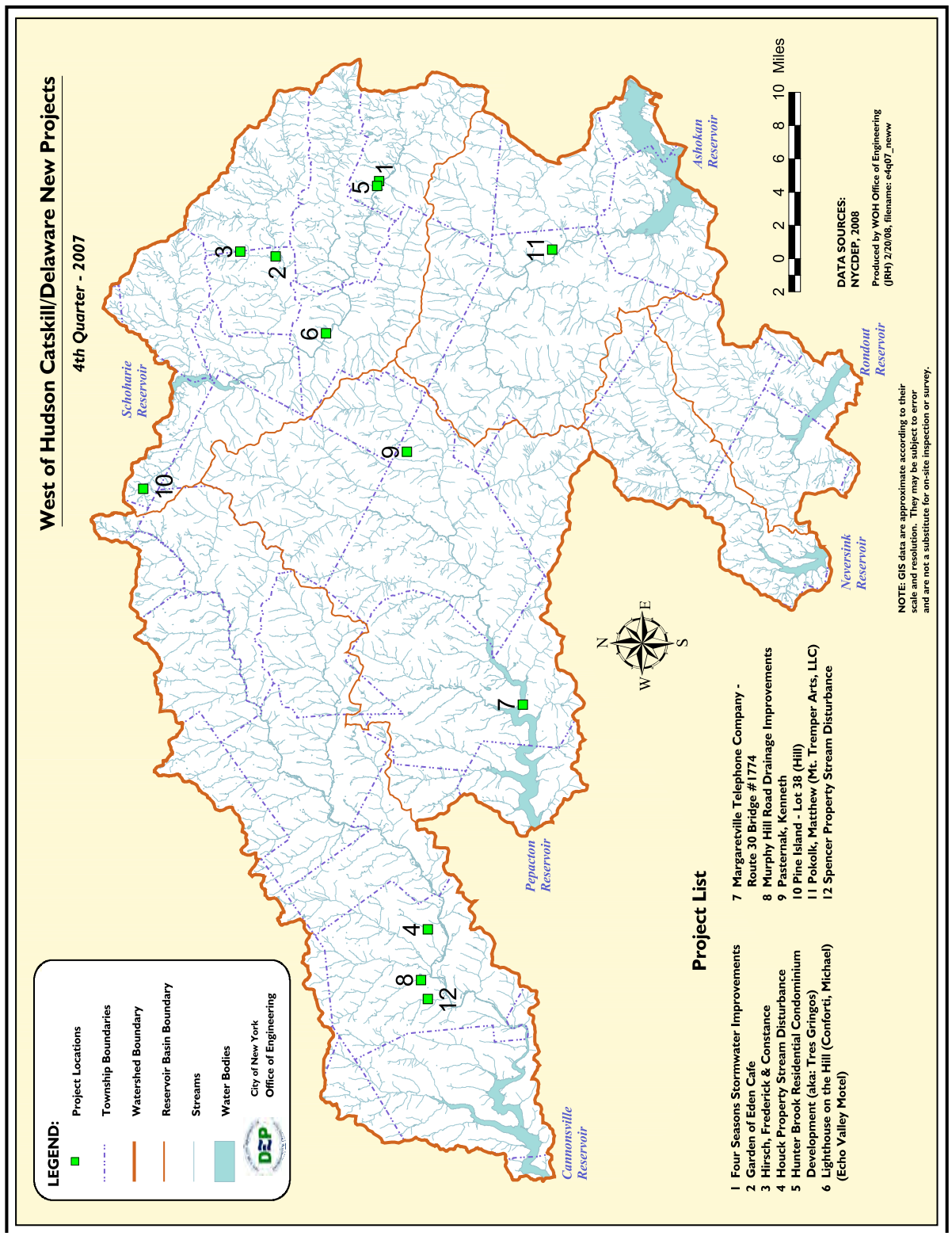

Figure 6.7. West of Hudson Catskill/Delaware New Projects – 4th Quarter.

Table 6.5. Ashokan and Schoharie Reservoirs individual SSTSs for 2007.

Reservoir	Town	# of Delegated Septics	# of New Septics	# of Septic Repairs	# of Approvals	# of Constructions
Ashokan	Hurley	2	N/A	5	10	6
Ashokan	Marbletown	0	N/A	0	0	0
Ashokan	Olive	9	N/A	18	34	31
Ashokan	Shandaken	17	N/A	25	46	24
Ashokan	Woodstock	11	N/A	6	26	24
Schoharie	Ashland	N/A	9	1	11	11
Schoharie	Conesville	N/A	2	1	5	1
Schoharie	Gilboa	N/A	9	1	8	6
Schoharie	Halcott	N/A	0	0	0	0
Schoharie	Hunter	N/A	11	5	20	16
Schoharie	Hunter (V)	N/A	0	0	0	0
Schoharie	Jewett	N/A	10	4	21	22
Schoharie	Lexington	N/A	8	6	14	10
Schoharie	Prattsville	N/A	1	2	2	6
Schoharie	Roxbury	N/A	2	2	5	7
Schoharie	Stamford	N/A	0	0	0	0
Schoharie	Tannersville (V)	N/A	0	0	0	0
Schoharie	Windham	N/A	14	2	21	23
Totals		39	66	78	223	187

Table 6.6. Cannonsville, Pepacton, Rondout, Neversink Reservoirs individual SSTSs for 2007.

Reservoir	Town	# of Delegated Septics	# of New Septics	# of Septic Repairs	# of Approvals	# of Constructions
Cannonsville	Bovina	N/A	3	3	6	6
Cannonsville	Delhi	N/A	10	15	21	22
Cannonsville	Franklin	N/A	3	0	3	1
Cannonsville	Hamden	N/A	4	21	25	35
Cannonsville	Harpersfield	N/A	0	1	1	5
Cannonsville	Hobart (V)	N/A	0	0	0	0
Cannonsville	Jefferson	N/A	0	0	0	1
Cannonsville	Kortright	N/A	7	5	13	15
Cannonsville	Masonville	N/A	0	0	0	2

Table 6.6. Cannonsville, Pepacton, Rondout, Neversink Reservoirs individual SSTSs for 2007. (Continued)

Reservoir	Town	# of Delegated Septics	# of New Septics	# of Septic Repairs	# of Approvals	# of Constructions
Cannonsville	Meredith	N/A	2	3	5	10
Cannonsville	Sidney	N/A	1	0	1	1
Cannonsville	Stamford	N/A	4	2	5	6
Cannonsville	Tompkins	N/A	7	5	12	10
Cannonsville	Walton	N/A	6	20	25	31
Neversink	Denning	4	N/A	1	4	6
Neversink	Hardenburgh	0	N/A	0	0	0
Neversink	Neversink	N/A	2	4	6	11
Pepacton	Andes	N/A	14	12	24	20
Pepacton	Bovina	N/A	0	0	0	0
Pepacton	Colchester	N/A	1	1	2	6
Pepacton	Fleischmanns	N/A	0	0	0	0
Pepacton	Halcott	N/A	4	1	5	6
Pepacton	Hamden	N/A	0	0	0	1
Pepacton	Hardenburgh	N/A	0	0	1	1
Pepacton	Middletown	N/A	14	23	37	59
Pepacton	Roxbury	N/A	8	7	15	24
Pepacton	Wawarsing	N/A	0	0	0	0
Rondout	Denning	0	N/A	1	1	3
Rondout	Fallsburg	N/A	1	1	2	3
Rondout	Hardenburgh	0	N/A	0	0	0
Rondout	Neversink	N/A	6	2	9	11
Rondout	Rochester	0	N/A	2	2	1
Rondout	Wawarsing	0	N/A	3	5	9
Totals		4	97	133	230	306

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

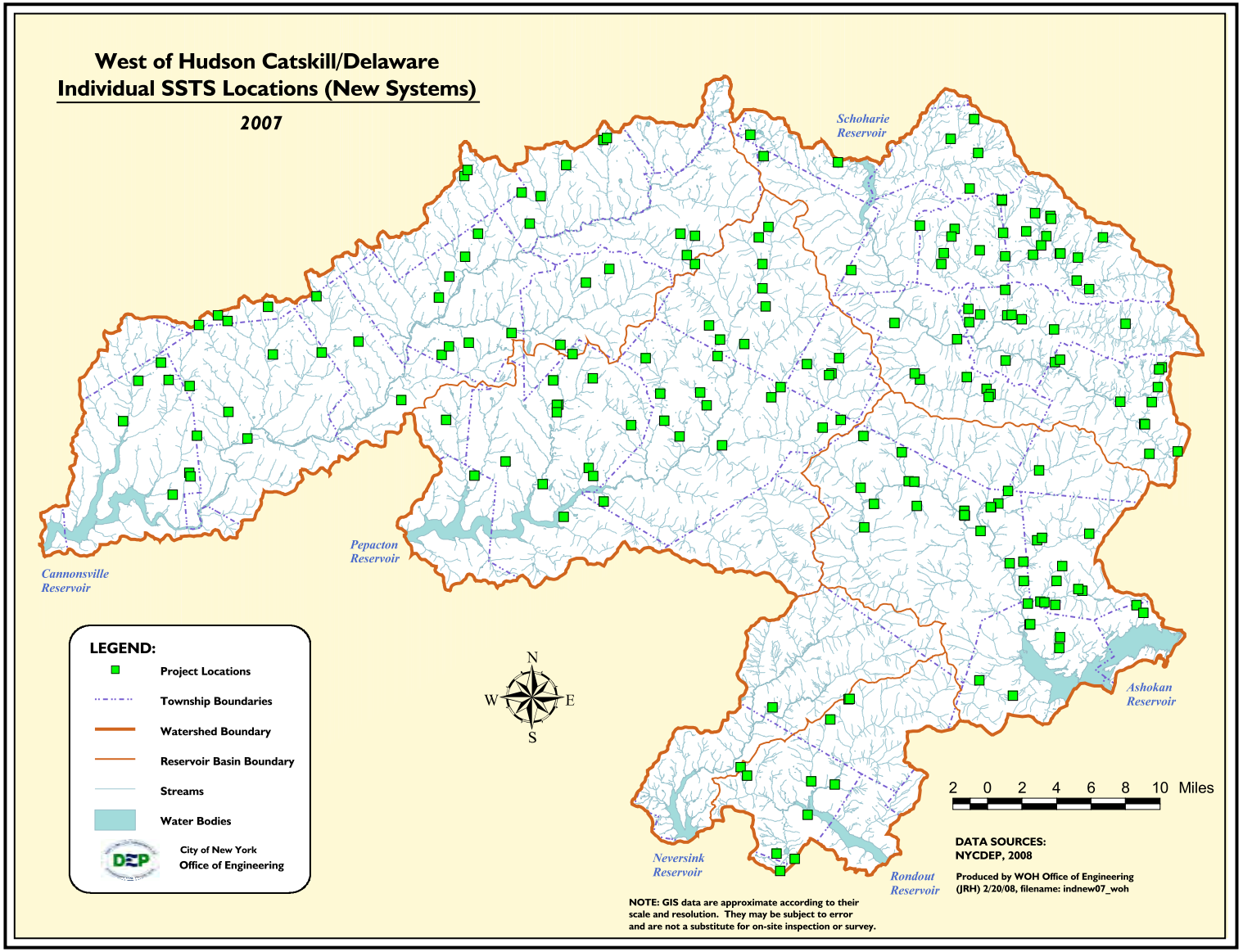

Figure 6.8. West of Hudson Catskill/Delaware new individual SSTS locations.

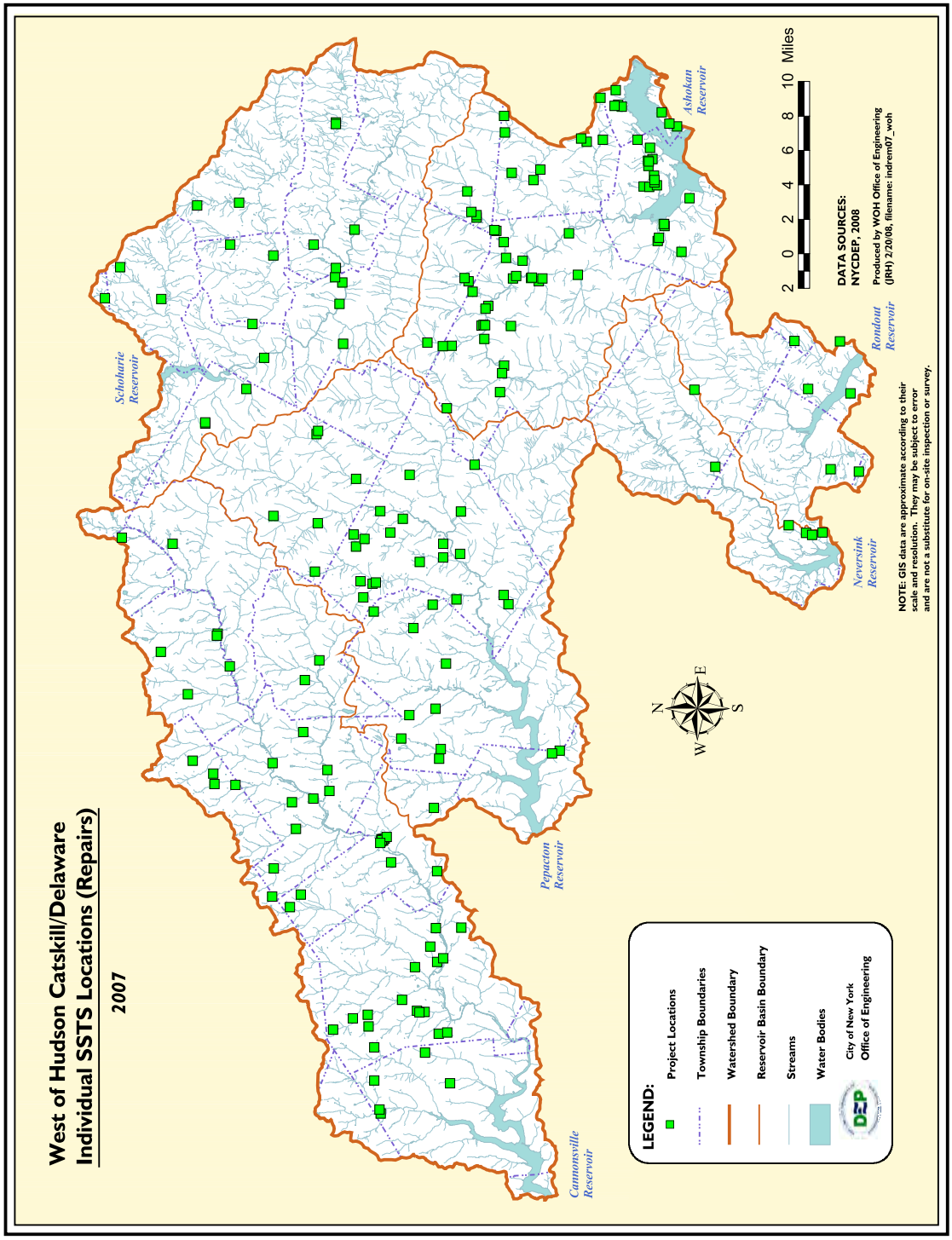

Figure 6.9. West of Hudson Catskill/Delaware repaired individual SSTS locations.

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.

The Regulatory & Engineering Programs (REP) Division 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 Systems. On a limited basis, the REP 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 City Law Department, local county health departments, local building inspectors, and the Catskill Watershed Corporation if the activity is in an MOA program area.

DEP Environmental Police patrol the watershed on a daily basis. The police receive over 300 hours of training in environmental law and services, as well as 170 hours of practical field training in environmental and infrastructure protection. They are prepared to issue summonses or Notices of Warning for violations of the New York State Environmental Conservation Law and WR&R, as well as other state and local laws. The DEP Environmental Police coordinate with other DEP divisions to be aware of ongoing construction sites in the watershed, and to ensure that areas of special concern are being monitored. Currently, members of the DEP Environmental Police attend the REP monthly enforcement meetings for both EOH and WOH.

In 2007, the DEP Police completed 23,662 hours of training; conducted 5,632 preliminary investigations; conducted 69 long-term investigations related to pollution, crime, or terrorism; conducted 60 suspicious incident investigations related to terrorism; patrolled 2,228,893 miles; and conducted 152,572 physical security inspections.

Also in 2007, the DEP Police made 189 arrests, issued 2,151 summonses, and served 134 Notices of Warning for violations of the New York State Penal Law, New York State Environmental Conservation Law, New York State Vehicle & Traffic Law, the WR&R, and various other state and local statutes.

The 2007 Regulatory & Engineering Program activities for the East of Hudson Watershed are specific for the following basins: Boyd Corners, West Branch, Croton Falls, Cross River, and Kensico.

Table 6.7. 2007 Regulatory & Engineering Programs activities.

	East of Hudson	Catskill	Delaware
New or Delegated Onsite SSTSs Design Approved	48	142	110
Remediated Onsite SSTSs Design Approved	44	4	1
SSTSs Construction Approved (New, Remediated or Delegated)	54	77	101
SPPP, IRSP and CPDP Approvals	6	6	3
WWTP or Sewer Connection, Sewer Extension Approved	2	4	4
NOVs/NOFs for SSTS	0	16	8
NOVs/NOFs for SPPP	1	7	0
Other Application Received (Non Regulated)	12	21	85

6.1.3 Delegation Agreements

In 2007, 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 their delegation agreements. DEP received documentation concerning the review of 468 delegated systems during the calendar year 2007.

Of the total 228 delegated septic systems, a total of 152 systems were reviewed by the county health departments in the Catskill and Delaware Systems.

6.1.4 Winter Road Deicer Policy and Protection Development

As a part of the Northern Westchester Watershed Committee, DEP is a member of the deicing task force. In 2007 this group, which includes representatives of local highway officials, Westchester County, DOT, Riverkeeper, New York Public Interest Research Group, and DEP, completed development of a set of best management practices for deicing strategies in the Croton Watershed. The “Northern Westchester Watershed Committee Highway Deicing Task Force Report” (Westchester County 2007) includes information on existing conditions and practices in northern Westchester, environmental impacts of deicers, safety, public education, new technologies, deicing best management practices, and specific recommendations for action.

6.2 Wastewater Treatment Facility Compliance Inspection Program

At each surface discharging wastewater treatment plant (WWTP) that operates on a year-round basis, the DEP's Wastewater Treatment Plant Compliance & Inspection (WWTP-CI) Programs 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, WWTP-CI 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 collects 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 the New York State Department of Environmental Conservation (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. In attendance at these proceedings are representatives from the United States Environmental Protection Agency (EPA), New York State Department of Health (DOH) and the New York State Attorney General's Office.

Facility Compliance in Catskill/ Delaware Watershed

There are 36 West of Hudson (WOH) WWTPs, including the New Infrastructure Program (NIP) facilities and their respective connections, that are inspected by WWTP-CI on a regular schedule. Of those, 29 facilities are permitted for year-round discharge and seven 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. The WOH WWTP-CI Section conducted 234 scheduled compliance, emergency response and WWTP upgrade construction inspections in 2007.

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.

WWTP-CI staff participates in Compliance Conferences (CC) with those facilities that continue to violate their SPDES permit limits and/or monitoring requirements. CCs are usually conducted after repeated attempts by WWTP-CI staff to remediate the problem with the facility owner and/or operator have failed. WWTP-CI staff, in conjunction with the DEC and local regulatory authorities, sends out a Notice of Violation (NOV) letter prior to calling for a CC. Due to the fact that many problematic and outdated facilities which exceeded their permits on a regular basis have

been 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 CCs has also decreased.

A CC was held in June 2007 for the Camp L'man Achai WWTP. Although this facility was upgraded in 2007 and operated under an interim SPDES permit during the Startup and Performance testing (SPT) period, the facility continually violated its SPDES permit limitations for Total Phosphorus. WWTP-CI staff recommended that the facility monitor this parameter 2-3 times per week. They will also start to feed the system prior to the start of the season to avoid any ammonia violations. The facility will also complete the repair work on the Orenco valves for proper distribution on the recirculating sand filters. They will replace each broken valve and use flexible pipe for a five foot length at each connection to make removal and installation easier.

A CC was held on September 26, 2007 for the Mountainside Farms - Worcester Creameries WWTP. The facility experienced an overflow of a small amount of secondary wastewater onto ground outside the clarifier. The cause was a pump failure in the water well supply which triggered a polymer overdose, blinded the sand filters causing them to go into continuous backwash to overflow the clarifier. The feed water in the sand filter overflowed into a wetwell and damaged the plant flow meter. The high level in the filter failed to trigger a call out alarm because the phone bill was not paid. The well water supply was fixed and the filters had to be cleaned to return to operation. WWTP-CI staff learned that continuing lack of dial out capability prevented full treatment and continued to cause several days of partial bypass. The facility continued to experience problems maintaining the computer because it is located within the process area and is routinely compromised by the moisture and chemicals present within the building. The computer controls the programmable logic controller, or PLC, for the new process equipment and has needed to be replaced on three different occasions. WWTP-CI staff recommended the following actions: The facility should install an insulated room attached to the main building, along with electrical and communication lines, for the computer. The facility will present evidence that they have established a secure method of payment of their phone bills. The facility has solicited an estimate from Delaware Engineering based on the scope of work provided by their previous consultant, HDR | LMS. DEC conducted a facility inspection on October 16, 2007. The facility reported another overflow of the clarifier on October 12, 2007 where the high level alarm didn't sound. This overflow was included within the existing draft consent order.

A CC was held on June 07, 2007 for the Roxbury Run Village WWTP. The ammonia and phosphorus violations for 2005, 2006 and 2007 were discussed as well as the Infiltration & Inflow (I&I) problems at the facility. WWTP-CI staff determined that the orthophosphate used as an additive in the drinking water supply was being overdosed and the operators were not testing the influent phosphorous values at the WWTP. The drinking water dose was corrected and they have been testing the influent phosphorous levels four times a week. The ammonia SPDES limit is 1.3 mg/l and there were 10 violations from 2005 through 2007 with nine of the violations during the

winter months. The facility agreed to continue to investigate and reduce the level of I & I in the collection system. Prior to the start of the winter season, the facility agreed to feed nutrients into the treatment system with dog food and urea to as part of a start-up procedure to get ready for the busy ski season and holiday weeks. During the winter months, the facility agreed to sample and analyze for alkalinity, temperature and dissolved oxygen on the inlet and outlet of the aeration tank

WWTP-CI personnel reviewed, approved and monitored the implementation and construction of the connections several WWTPs to NIP facilities. Crystal Pond and Windham Ridge have received approval to connect to the new Village of Windham WWTP. Regis Hotel has been connected to the new Fleischmanns WWTP this summer. Camp Loyaltown's connection to the Hunter was completed prior to the start of their 2007 operating season.

WWTP-CI personnel were instrumental in the progress made in DEP's Regulatory Upgrade Program. During 2007, more stringent SPDES limits were almost immediately met at wastewater treatment plants that completed their upgrades. DEP's WWTP-CI staff performed construction inspections, start-up surveillance, performance testing data and review of operating and maintenance manuals and record drawings. Two notable upgrades were completed at the end of 2007 which would meet these more stringent requirements. Mountain View I & II has been completed, with the two discharge points now tied into one common facility and Elka Park whose completed upgrade will now meet is recently approved, year-round SPDES permit requirements.

In 2007, two WWTPs were converted from surface dischargers to subsurface disposal systems or were approved for conversion. Camp Nubar completed installation of the subsurface disposal system and began operation prior to the start of their 2007 operating season. The SEVA WWTP conversion to subsurface disposal is currently under construction and completion is expected for the middle of 2008.

Facility Compliance in East of Hudson Watershed

The East of Hudson (EOH) WWTP-CI Section ensures that adequate measures are taken to enforce compliance with the SPDES permits issued to the seventy-two WWTPs and the thirty-eight groundwater remediation systems, landfills, oil/water separators and wastewater collection systems that discharge into the EOH watershed. The EOH WWTP-CI Section conducted 444 scheduled compliance, emergency response and WWTP upgrade construction inspections in 2007. 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 active WWTPs and one inactive WWTP located within these drainage 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.

All of the nine active WWTPs that discharge in the West Branch, Croton Falls and Cross River basins operated satisfactorily during the 2007 monitoring period. The Carmel Sewer District #2 WWTP did experience some minor overflows that were contained at the facility and did not impact water quality.

WWTP-CI performed inspections of the West Lake Trunk Sewer monthly throughout 2007 in conjunction with regularly scheduled stormwater BMP inspections within the Kensico Basin. The inspections revealed no abnormal conditions.

WWTP-CI performed compliance inspections of the Town of North Castle and Harrison pump stations and collection system throughout the 2007 monitoring period. On August 1, 2007, WWTP-CI responded to a report of a sewage spill which took place on July 31, 2007 at the North Castle Sewer District Pump Station located at 9 New King Street. Mr. Sal Misiti, Assistant Superintendent of North Castle Sewer and Water Department, originally estimated the spill at 200-300 gallons. The sewage spilled onto the ground and into a stream that leads to the Kensico Reservoir. DEP Water Quality responded to the spill and collected water quality samples. The North Castle Sewer and Water Department made temporary repairs to the system and spread HTH over the spill to disinfect the area. The pump station failure was caused by storm damage on Monday July 31, 2007. DEP DWQC later determined that the spill estimate was closer to 20,000 gallons. WWTP-CI issued a Notice of Violation for the overflow.

On October 16, 2007, WWTP-CI staff received a letter from the Town of North Castle Sewer & Water Department. The letter outlined the overflow event that took place on July 31, 2007 along with remedial actions that included installing signs with contact information at each station, replacement of auto-dialers and control panels, installation of surge suppressors and instituting a preventative maintenance procedure to eliminate grease accumulations in the stations. The DEC issued a consent order to include the remaining capital improvement and abatement procedures listed within the October 16th memo and a payable fine of $1,000.

On October 30, 2007, WWTPCI staff issued a letter to the Town of North Castle Sewer & Water Department regarding the contract reports for the sewer line inspections conducted in the Towns of North Castle and Harrison as part of the Kensico Water Quality Control Program. Upon review of this report, it appears that the sewer lines mapped, inspected and cleaned within the Town of North Castle did not show any defects that could lead to exfiltration of raw sewage and subsequent discharge into the Kensico Basin.

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 Grahamsville Laboratory in the Delaware System and Ben Nesin Laboratory in the Catskill System. East of Hudson sampling and analyses are performed by 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 in their SPDES permits. In the Catskill System in 2007, composite samples were collected from Hunter Highlands, Village of Hunter, Town of Prattsville, and Village of Windham WWTPs. In the Delaware System, composite samples were collected from Village of Andes, Village of Delhi, Village of Hobart, Village of Stamford, Village of Walton, and Mountainside Farms. A special case is the non-contact cooling water discharge at Kraft, which is routinely sampled only twice yearly, by composite sample.

At City-owned plants, DEP laboratories analyze compliance samples, including grab and composite samples, for reporting on Discharge Monitoring Reports (DMRs).

Total phosphorus concentration data are used to develop point source phosphorus loads, and 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.

In 2007, Ben Nesin Laboratory conducted 3,099 analyses on 500 effluent samples and Grahamsville Laboratory conducted 2,821 analyses on 309 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), Brewster Laboratory collected 223 effluent samples and conducted 2,055 analyses.

6.3 SEQRA Coordination

To better coordinate State Environmental Quality Review Act (SEQRA) activity in the watershed, DEP created the SEQRA Coordination Section in January 2004. This 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 offi-

cials 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.

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.

Table 6.8. SEQRA actions 2007.

Received	Reviewed	Comment Letters Issued	Ongoing Reviews	SEQRA Process Closed
68	68	57	59	16

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. (SEQRA Type I actions are those actions or projects that the Lead Agency determines may have a significant adverse impact on the environment and require the preparation of an EIS.)

Table 6.9. 2007 SEQRA Activity and Status for Type I Actions.

Project Name	Project Description	Town/ County	Basin	Project Status
Adoption of Westchester County Greenway Compact Plan, North Castle	Adoption of Westchester County Greenway Compact Plan under Section 44-0119 of the NYS Environmental Conservation Law (ECL), including amendment of Zoning Ordinance and Subdivision Regulations so as to make reference to the Compact Plan and direct reviewing agencies to consider the Plan	North Castle/ Westchester	Kensico	DEP received Lead Agency Neg. Dec.

Table 6.9. 2007 SEQRA Activity and Status for Type I Actions. (Continued)

Project Name	Project Description	Town/ County	Basin	Project Status
Boiceville-Proposed WWTF	MOA provision for a program to construct and install WWTPs or Community septic systems with collection systems; or septic districts to correct water quality problems due to failing septic systems up to 48,000gpd	Olive/Ulster	Ashokan	DEP received Lead Agency Neg. Dec.
Crossroads Ventures, LLC	The project is divided into two related but geographically distinct developments with a total of 400 hotel rooms, 351 additional hotel and housing units, a 21-lot single-family residential subdivision, two 18-hole golf courses, infrastructure and two WWTPs	Shandaken/ Ulster	Pepacton	DEC issued an extension for the Supplemental Draft Environmental Impact Statement (SDEIS) scoping document.
Hamden-Proposed WWTF	provision for a program to construct and install WWTPs or Community septic systems with collection systems; or septic districts to correct water quality problems due to failing septic systems; 31,000gpd	Hamden/ Delaware	Cannonsville	DEP received Lead Agency Neg. Dec.
Hunter Mountain Diversion Weir	Hunter Mountain Ski Resort water diversion from Schoharie Creek; expanding the storage reservoir; stream disturbance all under DEC Consent Order	Hunter/ Greene	Schoharie	DEP reviewed and commented on the Draft Environmental Impact Statement (DEIS)
McMurdy Brook Farm (Alan Lord – NY Land and Lakes)	Proposed 20 lot subdivision	Kortright/ Delaware	Cannonsville	DEP attended the Public Hearing and answered questions on SEQRA, zoning, septic and stormwater.

Table 6.9. 2007 SEQRA Activity and Status for Type I Actions. (Continued)

Project Name	Project Description	Town/ County	Basin	Project Status
River Run Senior Housing	Proposal for 70 senior housing units as part of a mine reclamation site	Delhi/ Delaware	Cannonsville	SCS issued a letter stating that DEP has no objection to the Village Planning Board being Lead Agency for the purposes of SEQRA.
Rufa, Lary (Windham Heights)	17 single family residences with 75 bedrooms total - as proposed it is a reality subdivision.	Windham/ Greene	Schoharie	DEP received the Lead Agency Neg. Dec.
The Legion of Christ, Westchester University	Development of University containing buildings and facilities having a total floor area of 1,053,400 sf and accommodating a total enrollment of 3,000 students.	Mount Pleasant/ Westchester	Kensico	DEP reviewed and commented on the DEIS
The Putnam Comm. Foundation Senior Housing	Proposed 240 unit senior citizen housing with support facility to include a caretaker cottage and community center. The April 2006 submission indicates that the proposal has been scaled down to a 120 unit complex.	Carmel/ Putnam	Croton Falls	DEP reviewed and commented on the DEIS
Westchester County Airport ARFF Road Rehabilitation	Relocation of north perimeter road away from north end of runway 16-34 and removal of a portion of the existing north perimeter road. Road will be extended approx 450 feet further north to increase safety at north end of runway.	North Castle/ Westchester	Kensico	DEP issued a letter stating that DEP has no objection to agency being Lead Agency for the purposes of SEQRA.

7. Catskill/Delaware UV Disinfection Facility

DEP's UV Disinfection Facility will be constructed along the Eastern side of the City-owned Eastview Parcel (Towns of Mount Pleasant & Greenburgh, Westchester County). At start-up, water from the Delaware Aqueduct will enter the facility through the North Forebay and will be delivered to downstream consumers through the Catskill and Delaware Aqueducts. Provisions have been made for future connections to be made from the Catskill Aqueduct once it is pressurized, as well as from the proposed Kensico-City Tunnel and Catskill/Delaware water filtration facility, if built. The current design also provides design elements to facilitate connections for local consumers and for the delivery of finished water to the Kensico City Tunnel should it someday be constructed at this site.

To maintain its dual track approach for meeting the goals of the Surface Water Treatment Rule of the federal Safe Drinking Water Act, DEP continues to perform biennial updates of the preliminary designs for a Catskill/ Delaware Ozone/Direct Filtration facility that can be advanced to final design and construction in the event that filtration of the Catskill and Delaware water supplies is deemed necessary. The most recent update was completed in September 2007.

7.1 Ultraviolet Disinfection Facilities

7.1.1 Site Preparation

With the exception of backfilling and landscaping the Catskill and Delaware aerators, the scope of work for the site preparation contract was substantially completed as of the end of December 2007.

Eastview Project Site

In addition to the primary goal of excavating soil from the eastern side of the Eastview site, ECCO III Enterprises Inc. (ECCO III), the site preparation contractor, installed permanent soil erosion control and stormwater control measures and stabilized large tracts of exposed soil. In preparation for future contractors, ECCO III was also responsible for the installation of site utilities, paved internal roadways, and site lighting.

By the close of 2007, 680,000 cubic yards of material had been excavated and 60,000 square feet of soldier piles and lagging had been installed at the Eastview project site. Excavated material is stockpiled on site in anticipation of the future tasks of transferring soil to the Catskill and Delaware aerators at Kensico Reservoir and backfilling certain portions of the Eastview project site. Volumes in excess of these proposed uses are to be removed from the site in accordance with applicable state standards. As material was excavated, it was sampled and characterized using DEC standards for reuse and disposal. The majority of the soil stockpiled at the site met 6 NYCRR Part 375-1.8(g)(1)(i) “unrestricted use” criteria and has been classified as non-regulated material that can be reused without restriction. As the contractor encountered suspect material

during excavation, separate stockpiles were established pending the results of soil analysis. In some cases concentrations of certain parameters exceeded regulatory limits for unrestricted use and the material will be removed from the site as regulated non-hazardous waste.

Aerators at Kensico Reservoir

To fill and landscape the aerators, ECCO III and their subcontractors will transfer 100,000 cubic yards of soil from the Eastview site. Before the aerators can be filled and landscaped the subsurface conduits will need to be dewatered and cleared of sediment. The top surface of the Catskill aerator will need to be cleared of its seal coating and a layer of brick. Removal of the bronze nozzles from the surface of the Delaware aerator is underway. Once these preparation measures are completed the remaining aerator structure can be crushed and left in place. To facilitate proper placement and future stability of the soil, the area around each aerator will need to be dewatered prior to and throughout the soil transfer operation.

Moretrench, a subcontractor to ECCO III, has been tasked with the design, installation, and operation of the dewatering system. In late December, groundwater samples were collected from several piezometer wells in the proposed dewatering zones. These samples will be analyzed and the findings used to characterize the groundwater and make certain that it meets the standards appropriate for surface discharge to nearby Clove Brook/Davis Brook, a tributary to the Bronx River.

To reduce the impact of truck traffic during the transfer of soil, DEP agreed to make improvements at the intersection of Routes 100 and 100C. To this end, new traffic poles, underground conduit, pull boxes, and a new concrete controller pad have been installed at the intersection. New traffic signals are to be installed, tested, and placed in service in early 2008.

DEP has also agreed to convene a committee with representatives from Mount Pleasant, Greenburgh, and other private and municipal entities, to coordinate details of the soil hauling operations. This committee will review plans for traffic control and address issues that arise as the soil is transferred from Eastview to Kensico. The committee will also establish a means of communicating during events such as funeral processions in the cemeteries that abut portions of the proposed truck route.

7.1.2 Design of Ancillary Projects

Work resumed on the design of the wetland mitigation areas along Kaysal Court in North Castle and on the Greenburgh parcel of the Eastview site. DEP and its design consultants Hazen and Sawyer/CDM, a joint venture, intend on completing the design in the coming year. DEP will use these drawings and specifications to solicit bids for the creation, restoration, stabilization, and maintenance of wetland areas in accordance with U.S. Army Corps of Engineers Protection of Waters permit requirements.

To meet certain requirements of the Mount Pleasant Site Plan Approval, DEP is planning to construct a pipeline between the Delaware Aqueduct on the Kensico campus and the town's Commerce Street Pumping Station. The design process had been placed on hold pending approval of change orders for this work. Data collected from geotechnical borings and subsequent soil analysis will be incorporated into the design materials.

7.1.3 Permitting

Westchester County Water District 3 Connection

The effort to secure approval from Westchester County for potable water at the work site connection is ongoing. Throughout the year representatives of DEP and Westchester County met to develop the terms of an agreement concerning myriad water-related issues of interest to both parties. Through this process, Westchester County agreed to put before their Board of Acquisitions and Contracts a permit application by ECCO III for a connection to a Westchester County Water District 3 water main at the Grasslands campus. At year's end, DEP was awaiting confirmation that the permit request was under review. In the event that the Board rules favorably, a renewable one-year permit will be issued to ECCO III and a connection between the project site water supply infrastructure and the county's water system will be completed and placed in service.

New York State Department of Transportation

To provide space for the proposed UV facility and related structures, the former driveway at Grasslands Road/Route 100-C will need to be relocated to the east. DEP is seeking permission from the New York State Department of Transportation (DOT) for the relocation of the secondary access road along Grasslands Road/Route 100-C. The application for this work also provides for the installation of utility structures near the secondary access road. This application is under review by DOT.

Following a series of submittals to and meetings with DOT, DEP secured preliminary approval for a cut and cover crossing of Grasslands Road/Route 100-C. This crossing will be implemented by the Skanska JV to install the treated water conduits for the Catskill Aqueduct. Skanska JV will be required to make the final application and provide detailed descriptions about how the work will be completed prior to the release of a permit to complete the work.

Greenburgh Work Permits

Following a series of meetings and public hearings in the Town of Greenburgh that concluded in May 2007, DEP received permits for working in wetlands and areas of steep slopes. These two permits, combined with a third granting permission for tree-cutting, have been issued in lieu of site plan approval. The Town of Greenburgh will also need to review and approve an application for a building permit to construct a small superstructure that will provide access to the proposed treated water connection to the Catskill Aqueduct.

Air Quality Permits

Permission to construct sources of air contamination such as facility boilers and emergency and life safety generators has been obtained from both the Westchester County Department of Health and DEC.

7.1.4 Project Schedule

The project schedule is prescribed in both the Filtration Avoidance Determination and an Administrative Consent Order between DEP and EPA. Monthly reports are submitted in accordance with the Administrative Order of Consent (AO) and describe progress on the project and provide a mechanism for describing any known or anticipated non-compliant milestones.

7.1.5 Facility Construction Contracts

On January 22, 2007, DEP advertised the project and solicited bids for four separate contracts associated with the second phase of construction for the Catskill/Delaware UV disinfection facility. Due to the size and complexity of the project and the coincidence of the bid development periods for this and the Croton Water Filtration project, DEP received requests to delay the bid submittal date. The original bid date was postponed on several occasions to allow prospective bidders the opportunity to absorb minor modifications to the project specifications and to address bonding requirements by forming joint ventures. A request to modify the AO milestone for issuing the Notice to Proceed was sent to EPA on May 30, 2007. On June 12, 2007, approval to postpone the October 31, 2007, milestone due date to December 31, 2007, was granted. Bids for the four facility construction contracts (CAT-210G, H, P&E) were received on September 7, 2007. As a result, DEP entered into contracts with L. J. Cuppola, Inc. for the plumbing and HVAC contracts and to Welsbach Electric Corp. for the electrical work.

A single bid for the general construction contract was submitted by the Joint Venture of Skanska USA Northeast/ECCO III Enterprises /J.F. White Contracting Company (Skanska JV). Since bid for this contract was substantially higher than any estimates previously prepared for this portion of the work, DEP convened an expert panel to address the disparity between the engineer's estimate and the bid submitted by the Skanska JV. Though the City considered reissuing a solicitation for bids and evaluated the possibility of repackaging the work into smaller contracts, it was determined that it was in the best interest of the project to seek a best and final offer from Skanska JV and enter into contract with them. DEP intends to issue a Notice to Proceed in early 2008.

7.1.6 Pilot Studies (UV Lamp Fouling Study)

Due to the lack of sufficient industry information regarding the potential for lamp fouling by an unfiltered water supply, DEP conducted a pilot testing program to develop information for establishing a cleaning regimen for the exterior surfaces of the quartz sleeves. The pilot facility included three treatment systems operated in parallel—two featuring pairs of low-pressure high-output (LPHO) units by Trojan and Wedeco, and one with a single medium pressure unit by Tro-

jan. Since naturally occurring iron, manganese, and other mineral or organic compounds could be oxidized by the chlorine that is to be added upstream of the future Catskill/Delaware UV disinfection facility, each of the LPHO systems featured a chlorinated and unchlorinated process train. Based on the extremely low concentration of iron and manganese in the Catskill and Delaware supplies, the effect on the fouling potential of the chlorinated influent was expected to be minimal.

The original protocol intended to address seasonal variations of water quality and temperature. The first two test runs in summer and autumn 2006 yielded considerably different fouling rates and a third test run was established to investigate the repeatability of fouling under summer conditions in 2007. Following a peer review session conducted on June 20, 2007, additional test runs were developed to address the impact of chlorine detention time and variables in water chemistry such as pH suppression and fluoride addition. Each of the variables was shown to have some effect on the kinetics associated with lamp sleeve fouling.

By the close of the year, six test runs were completed and demobilization of the pilot facilities was underway. Results of the pilot study will be compiled in a report and will be used to develop operation and maintenance procedures for the full-scale facility.

7.2 Filtration Planning Design Update

7.2.1 Facility Design Update

In accordance with the terms for relief from completing final designs for a filtration facility, a preliminary design update was completed in September 2007 for a 2,110 MGD ozone/direct filtration facility for the Catskill/Delaware supplies. The design update was presented as a supplement to the 2003 Preliminary Design Update and incorporated all modifications previously presented in the 2005 design update.

Site plan and grading changes reflect the relocation of the main entrance, the administration building, oxygen production plant, and electrical substation. Also among the recent changes to the facility design is an expansion of the process area and minor modifications to the hydraulic profile. An extensive evaluation of the post-treatment chemicals as well as their storage facilities and injection points was conducted. As a result, a staged implementation plan has been proposed and the post-treatment chemical building has been relocated.

Relocation of Main Entrance and Administration Building

The main entrance has been relocated to the northwest corner of the site, into the area previously reserved as a potential site for the Croton water treatment plant. This change eliminates overlap between the proposed entrance and the newly constructed DEP Police administration facility. With the relocation of the driveway and security entrance, the Catskill/Delaware UV

administration building has also been moved to the northern boundary of the site. These changes will provide easier access to the site, facilitate isolation of the oxygen production plant, divert traffic flow from critical infrastructure, and reduce the impact to wetland areas on the site.

Process Design Changes (Filter Modules and Ozone Facilities)

To better address the 2005 modification of the design flow from 1,840 MGD to 2,110 MGD, space was allocated in the process area and an additional filter was added to each module for a total of four additional filters.

Relocation of Electrical Substation

To provide additional protection for the electrical substation, emergency generators, and fuel tanks, this infrastructure has been relocated to the north of the UV facility from the previous location near Grasslands Road/Route 100-C.

Post-Treatment Chemicals

Basic design considerations such as application rates and plans for storage were presented for four post-treatment chemicals (sodium hypochlorite for disinfection, sodium hydroxide for pH adjustment, phosphoric acid for corrosion control, and hydrofluosilicic acid for dental hygiene) in previous design updates. For the most recent update, an extensive study was conducted to define how post-treatment chemical additions should be implemented at the Catskill/Delaware UV facility. At present, chlorination is performed at the Kensico campus, and at the time of the 2007 design, a pilot study was underway to determine the effects of upstream chlorination on the quartz sleeves used in ultraviolet disinfection. Due in part to the City's interest in eliminating the use of chlorine gas at Kensico Reservoir and the potential for the Kensico City Tunnel to have a connection point at the project site, this design update evaluated a phased implementation plan for bringing post-treatment chemicals to Eastview. Potential application points for the these chemicals are also defined in the 2007 design update.

7.2.2 Future Updates

The next filtration facility design update is to be submitted in September 2009.

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 developed and implemented in order to:

- 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
- attempt to determine the contribution (if any) of tap water consumption to gastrointestinal disease

In 2007, active surveillance for giardiasis and cryptosporidiosis continued as in prior years. Forty-seven clinical laboratories located in New York City performing parasitology examinations for *Giardia lamblia* and *Cryptosporidium*, as well as seven laboratories in the NYC vicinity, were contacted on a regular basis to solicit case reports on all positive specimens. In September and October 2007, two New York City laboratories discontinued parasitology services, leaving 45 New York City laboratories that are currently performing parasitology examinations. For all cryptosporidiosis cases, and as needed for giardiasis cases, public health epidemiologists contact patients to (1) verify the data collected on the case report, (2) collect additional demographic and clinical information, and (3) identify possible sources of exposure. At the time of this writing, the 2007 *preliminary* count of cases reported to DOHMH among NYC residents is 854 cases of giardiasis, and 106 cases of cryptosporidiosis.

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 medication (ADM). The City's ADM monitoring activities have included three components: one in which the weekly volume of sales of non-prescription ADM 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 received data from a national retail data source. In November 2007, DOHMH stopped receiving data from the national retail data source. The other two components of ADM monitoring are still in operation. Additional results and program information can be found in the WDRAP semi-annual and annual reports.

8.2 Cross Connection Control Program

Pursuant to the July 2007 FAD, the Cross Connection Control Program provided a separate annual report on January 31, 2008.

9. Education and Outreach

DEP's Watershed Education and Outreach Program strives to advance the City's long-term watershed protection strategy through substantial stakeholder involvement. Towards this end, DEP collaborates with numerous local partners to inform and teach watershed residents and water consumers alike about the importance of source water protection and conservation, watershed stewardship and sustainability, and best management practices that prevent or minimize non-point source pollution. The unifying message is that a well-managed watershed landscape provides multiple benefits for both upstate and downstate constituents: clean water, clean air, rural character, economic values, job opportunities, traditional local products (e.g., food, fiber, wood, art, specialty items), and a protected open space for future generations.

Since the early 1990s, DEP's Watershed Education and Outreach Program has included both program-specific educational activities geared towards a particular target audience and broad-based community outreach to enhance public confidence in the safety and quality of the City's water supply. In many cases, DEP's program-specific educational efforts are conducted in collaboration with key local partners such as the Watershed Agricultural Council (WAC), Catskill Watershed Corporation (CWC), Cornell Cooperative Extension (CCE), Soil and Water Conservation Districts (SWCDs), Catskill Center for Conservation and Development, Trout Unlimited, Frost Valley YMCA, Ashokan Field Campus, private consultants, and others.

The 2007 FAD requires DEP to continue implementing and reporting on several program-specific education efforts (Watershed Agricultural and Forestry Program, Stream Management Program, CWC Public Education Program), school-based education efforts, general outreach (e.g., fairs, exhibits, local events, publications, website), and partnerships with regulatory and local government officials. This annual report organizes and summarizes key education and outreach accomplishments according to their primary target audience. For additional information about specific programs, please refer to other sections of the report.

Watershed Landowners

The majority of land in the watershed (about 70%) is privately owned by thousands of individuals having diverse property goals and management objectives. Although many landowners are full-time watershed residents, this audience also includes second-home owners, absentee landowners, and other part-time residents. In terms of the City's Long-Term Watershed Protection Program, landowners are generally targeted through the specific protection and/or remediation programs for which they are eligible. For example, the Watershed Agricultural Program provides services to farmers, the Watershed Forestry Program targets holders of forest land, the Stream Management Program works with riparian landowners, and the Land Acquisition Program targets owners of vacant land meeting certain criteria. The following highlights represent 2007 accomplishments targeting watershed landowners:

- In April, DEP supported and participated in the Catskill Institute for the Environment (CIE) annual symposium, "Rural Life in the Catskills: A Forum on Food, Water and Wood for the Future," held at the Andes Hotel and attended by over 100 people.
- In September, DEP collaborated with WAC, CCE, and the Delaware County Department of Public Works to support the 11th annual Clean Sweep Household Hazardous Waste and Farm Pesticide Collection Day which attracted 223 households, 19 farmers, and 27 businesses. More than 28 tons of waste products were collected in total.
- Through the Watershed Forestry Program, WAC hired Cornell University to conduct an invasive species public awareness survey for private forest landowners in both the Catskill/Delaware and Croton Watersheds. Four thousand questionnaires were mailed and 1,047 surveys were returned, for an adjusted response rate of 29%. In April, a landowner workshop was held at the Lennox Model Forest for 20 landowners and 7 other participants. In May, a dedication ceremony was held at the Siuslaw Model Forest for approximately 30 participants. WAC also entered into an agreement with Clearpool Environmental Education Center in Putnam County to sponsor two East of Hudson landowner workshops planned for April and September 2008.
- Through the Watershed Agricultural Program**,** WAC and CCE implement a farmer education program that supports the ongoing implementation of Whole Farm Plans and the operation and maintenance of agricultural best management practices. In January, the Catskill Regional Dairy Conference attracted 73 participants, including 19 farmers. A series of three workshops held in March and April (hoof assessment, nutrient management, no-till production) attracted 72 participants, including 28 farmers. A series of seven pasture walks and farm tours attracted 158 participants, including 71 farmers. In May, WAC sponsored its second annual "Down off the Farm Day" at the Walton Fairgrounds, and in June WAC sponsored an East of Hudson program participant event.
- Through the Stream Management Program, DEP partners with CCE and county SWCDs to educate streamside landowners about water quality protection and riparian buffer management practices. Throughout the year, numerous landowner events were sponsored and attended by hundreds of participants. Key projects included a pilot knotweed management educational program in Halcott, public demonstrations about stream processes, an Esopus Creek clean-up day, publication of an Esopus Creek newsletter, the first-ever "Paint The Stream" community mural project in Phoenicia with 45 people attending the opening reception, a collaborative landowner workshop that focused on erosion and flooding problems, and the launch of a new website for streamside landowners (www.catskillstreams.org) which is designed to complement the *Living Streamside in the Catskill Region* landowner guide that was published in 2006. The website has received more than 1,400 unique visits since April 2007.
- Through the Land Acquisition Program, DEP continues reaching out to watershed property owners to assess their interest in selling certain eligible lands to the City or an affiliated land trust as well as entering into a DEP conservation easement. A total of 965 landowners were solicited or re-solicited during 2007 via mailed letters or phone calls. DEP continues to provide interested landowners with Land Acquisition and Conservation Easement brochures during meetings, site visits, workshops, and other events. In particular, when DEP conducts annual site visits for landowners having a conservation easement, this represents a valuable outreach opportunity for personal interaction and communication about specific land use activities. To promote good stewardship on conservation easement properties, in 2007 DEP

finalized a new landowner fact sheet for Agriculture, Forestry, and Bluestone Mining, with Pond and Stream Work guidelines planned for 2008.

- In the East of Hudson Watershed, DEP continues working with Putnam and Westchester municipalities to educate landowners about the pollution impacts from lawn fertilizers. DEP published 25,000 additional copies of a phosphorus reduction brochure (50,000 copies were originally published during 2004–2005) with the intent of distributing these brochures to East of Hudson home owners in 2008. DEP also continues to support the Kensico Environmental Enhancement Program (KEEP) to protect and enhance water quality in Kensico Reservoir. KEEP involves coordinated surveillance of the reservoir, community outreach, and environmental education programs that teach watershed residents how they can prevent nonpoint source pollution. In May, KEEP held its annual Art & Poetry Contest for over 100 sixth and seventh grade students.

Water Consumers

Given that nine million people depend on DEP to deliver a reliable supply of safe, clean water to meet their daily needs, New York City water consumers represent another priority audience for education and outreach. This urban downstate population, which comprises nearly half the total population of New York State, should understand and appreciate the upstate source of their unfiltered water supply while learning how to conserve and protect it over the long term. The following activities represent 2007 highlights targeting the New York City water consumer:

- In cooperation with the Department of Health, DEP launched a tap water marketing campaign to promote the benefits of drinking tap water over bottled water and to inform consumers about the environmental impacts of disposing of plastic water bottles.
- Both the official DEP website (www.nyc.gov/dep) and the DEP watershed protection website (www.nyc.gov/watershed) continue to provide New York City water consumers with timely information about drinking water quality, reservoir water levels, water conservation tips, and watershed protection/education programs.
- DEP published 900,000 copies of its annual drinking water statement which is geared almost exclusively to the water consumer. DEP also produces and distributes an assortment of other publications and giveaways that promote the concepts of water conservation, proper disposal of litter, and watershed protection and stewardship.
- DEP worked with the American Museum of Natural History to help incorporate a New York City water supply and watershed component into their exhibition, "Water H20 = Life." Specifically, DEP provided technical assistance, numerous public programs, material for distribution, and professional training for educators.
- DEP launched a new in-City initiative, the Hydrant Education Action Team (HEAT), which represents an outreach and education pilot program for teenagers to combat misuse of fire hydrants. DEP also opened a self-guided Nature Walk alongside Newtown Creek, on the border between Brooklyn and Queens, to introduce visitors to numerous water stories, artwork, and science topics. A water-based scavenger hunt booklet was also produced during 2007 and is currently available on DEP's website.
- In September, WAC participated in the Farm Aid cultural event held for the first time in New York City. WAC hosted a watershed farm tour and local dinner for several of the Farm Aid organizers, in addition to serving on a Farm Aid panel discussion that was attended by 220

people. WAC also staffed a watershed exhibit viewed by hundreds (possibly thousands) of Farm Aid concert attendees from New York City.

Local Municipal Officials

The City's water supply system spans both sides of the Hudson River and comprises portions of eight New York counties and a small portion of Connecticut. Within New York State, West of Hudson Watershed communities include 41 towns and 9 villages, while East of Hudson Watershed communities include 20 towns and 3 villages. Pursuant to the 2007 FAD, DEP is committed to strengthening its partnership with local municipal officials through collaborative education, outreach, and training that promote the merits and principles of land use planning, stream corridor protection, and stormwater management. The following highlights represent 2007 activities and accomplishments targeting local municipal officials:

- In January, CWC sponsored the Schoharie Watershed Summit in Hunter, which attracted more than 120 local government employees, highway departments, and community leaders who learned about watershed stormwater issues, septic systems, and stream management programs and opportunities.
- In March, DEP and several watershed partners (including WAC, DEC, Catskill Forest Association, Empire State Forest Products Association, and others) participated in New York State Forestry Awareness Day held in Albany. This annual event attracts hundreds of legislators and policy makers who are educated about the benefits of healthy forests.
- In May, DEP attended and supported, along with CWC and other local partners, a 10-year anniversary dinner held in Kingston to celebrate the signing of the New York City Watershed Memorandum of Agreement (MOA). Approximately 80 people attended this event, primarily local government officials and watershed community leaders. To help commemorate this milestone, CWC produced a video ("Of Streams and Dreams"*)* which highlights their history and current watershed programs. Approximately 800 DVDs were produced and distributed to watershed municipalities and other local partners.
- In October, CWC sponsored the seventh annual Catskills Local Government Day which attracted approximately 120 participants. This all-day conference included six training workshops, two of which were specifically designed to help planning and zoning board members meet new annual training requirements. Forty people attended the two special training courses, with another 57 people attending a repeat training held in November.
- Through the Stream Management Program, DEP supports and participates in various Project Advisory Committees comprised mainly of local officials and community leaders in the West of Hudson Watershed. During 2007, Delaware County SWCD conducted visioning sessions with 11 towns to explore the implementation of stream management plan recommendations at the local level. Additional key activities included: supporting and attending the Hudson River Watershed Alliance annual conference attended by 180 participants; conducting public outreach in relation to the Shandaken SPDES permit; meeting with the Schoharie County Planning Department and approximately 20 Conesville residents to discuss stream management planning for the Manor Kill watershed; and conducting specialized presentations about specific stream management planning and restoration projects for the New York State Nonpoint Source Coordinating Committee, Watershed Protection and Partnership Council, Lex-

ington Town Board, and other entities. DEP also participated in a Schoharie watershed event that was attended by approximately 75 people and culminated in the towns of Hunter and Windham receiving awards for their adoption of the Stony Clove and Batavia Kill stream management plans, respectively.

- In partnership with Cornell University, WAC conducted an invasive species public awareness survey for local government officials in both the Catskill/Delaware and Croton Watersheds. More than 370 questionnaires were mailed and 104 surveys were returned, for an adjusted response rate of 28%. Results from this survey are discussed in the Watershed Forestry Program section of this report.
- With funding from the USDA Forest Service and DEP staff support, WAC initiated a municipal forestry training program in the East of Hudson Watershed with a goal of educating local officials about the benefits of privately owned forests and the importance of supporting a working landscape through appropriate town ordinances. During 2007, WAC conducted presentations for the Yorktown Environmental Advisory Board, North Salem Planning Board, Kent Town Board, Carmel Town Board, Patterson Town Board, and the Hudson Valley Chapter of the New York Society of American Foresters. More than 70 people attended these meetings, with additional presentations planned for 2008.
- DEP continued to participate in regional New York ReLeaf efforts in addition to serving on the Board of Directors for the New York State Urban and Community Forestry Council. ReLeaf supports urban forestry partnerships and educational programs for municipal officials and community leaders. In January, DEP and WAC co-sponsored a ReLeaf workshop in Westchester County that was attended by more than 150 participants. In July, DEP co-sponsored and attended the New York ReLeaf Annual Conference in Saratoga Springs that attracted several hundred participants.

School Groups and Youth Audiences

School-based education programs, especially upstate and downstate school partnership programs, are an important and popular component of DEP's Long-Term Watershed Protection Program. The West of Hudson Watershed contains 12 public school districts, 4 private schools, and 6 vocational schools. More than 1,400 schools operate throughout the five boroughs of New York City, whereas several dozen school districts serve the student populations of Dutchess, Putnam, and Westchester counties (East of Hudson). The watershed also contains numerous environmental education facilities and cultural institutions which conduct education programs for school and youth audiences. The following highlights represent the major school-based programs and youth-oriented outreach accomplishments of 2007:

- DEP continues to support and participate in the Watershed Environmental Education Alliance (WEEA), which is comprised of nearly 40 environmental facilities, cultural institutions, organizations, and agencies throughout the watershed region that develop, support, and implement school-based education programs. DEP helped produce the *2007-2008 New York City Watershed Environmental Education Resource Directory*, a comprehensive field trip guide for school teachers and educators, which was printed in limited quantities and posted online at various partner websites.

- Throughout the school year, DEP conducts or participates in numerous professional development workshops for teachers and educators. For example, DEP attended the Science Council of New York City (SCONYC) annual teacher conference with an informational exhibit and educational materials. Several hundred teachers attend SCONYC each spring, which makes the event an important venue for promoting water conservation and shared upstate/downstate watershed connections. Additional 2007 workshops included the annual Operation Explore teacher training and both the New York City Department of Education and New York State Education Department Science Core Curriculum Materials training. DEP also serves on the New York City Department of Education Science Education Task Force.
- DEP continues to host and supervise the New York City coordinator of the Trout Unlimited Trout in the Classroom (TIC) education program. TIC teaches students about stewardship and science through the rearing and caring of brown trout from egg to fry. Each spring, thousands of students release their trout into watershed streams during a full day of environmental education, forestry interpretive hikes, and water quality monitoring activities. More than 150 total classrooms participate in TIC, including more than 50 New York City schools, about 20 East of Hudson schools, and about 24 West of Hudson schools. A TIC teacher training workshop held in October was attended by more than 180 participants from the City, the watershed, and other parts of New York.
- In July, the Catskill Center implemented the ninth annual Watershed Forestry Institute for Teachers for 19 participants from New York City and watershed schools. More than 160 teachers have been trained through the Institute since 1999. The Catskill Center also implements the annual Green Connections educational partnership program. In June, the 2006–2007 program was completed for more than 300 students in five watershed schools and five New York City schools. In September, the 2007–2008 program commenced with more than 250 students from six City schools and six watershed schools.
- The Catskill Center also implements the Catskill Stream and Watershed Education Program (CSWEP), which is designed to foster a greater appreciation and understanding of the Catskill landscape and local stream ecology among West of Hudson Watershed students. Approximately 470 students from 29 classrooms participated in CSWEP, which in 2007 included a student stream monitoring congress co-sponsored by Hudson River Basin Watch. CSWEP has reached more than 1,500 students to date.
- In July, DEP joined the Stroud Water Research Center, Catskill Center, Riverkeeper, Catskill Mountainkeeper, New York Harbor School, Sidney Central School, and others in supporting the first-ever "Mountaintop to Tap" Watershed Trek for six New York City students and six upstate watershed students. During the course of three weeks, all 12 students were accompanied by their teachers and a trained outdoor expedition leader as they followed the path of the New York City water supply from Belleayre Mountain to Central Park using as little motorized transportation as possible. The students hiked, camped, floated down the Esopus Creek on tubes, rowed down the Hudson River in wooden boats, conducted water quality monitoring experiments, and participated in numerous interpretive education activities taught by dozens of local professionals and community leaders. The entire trek was filmed by a documentary camera crew, and the resulting 35-minute film premiered at Sidney Central School in November. A museum exhibit of the students' art work, photographs, and journal entries is planned for 2008.
- Through the Stream Management Program, DEP conducted the 11th annual season of the Watershed Conservation Corps for six Ulster County Community College students who

received training in stream assessment techniques and subsequently performed approximately 1,500 hours of field work during the summer field season. DEP also participated in the Ulster County Environmental Awareness Day which attracts several hundred middle school students who spend a full day learning about the environment.

- During its Round 10 grant funding cycle, CWC awarded 27 education grants totaling $125,439, in addition to supporting three special performances of the Arm of the Sea Theater's production of "The City That Drinks the Mountain Sky" (in New York City and both the East of Hudson and West of Hudson Watersheds) and providing special project funding to the Delhi-based Calliope Foundation to complete the "Mountaintop to Tap" watershed trek documentary. It is worth noting that more than 2,500 students attended the "The City That Drinks the Mountain Sky" performance at the Tribeca Performing Arts Center in October. To date, CWC has awarded more than 261 education grants totaling over $1.3 million. The majority of these funds support school-based programs in the West of Hudson Watershed and New York City.
- In October, CWC compiled and distributed a packet of watershed educational materials to 40 teachers in 24 West of Hudson schools, in addition to helping DEP distribute 20 of these packets to New York City teachers. The resource packets included CDs, DVDs, books, and teacher guides, and other materials produced using CWC education grants.
- With funding from the USDA Forest Service and DEP staff support, WAC continued to support a Watershed Forestry Bus Tour Grants Program in partnership with a local consulting business, Common Ground Educational Consulting. During 2007, 29 bus tours were conducted for approximately 1,230 participants.
- DEP sponsored the 21st annual Water Conservation Art and Poetry Contest for New York City fifth and sixth grade students. More than 800 people attended the award ceremony held at The Cooper Union in Manhattan.
- In addition to school groups, DEP also works with boy scouts, girl scouts, 4-H clubs, and other youth groups to promote watershed stewardship education through various hands-on activities such as scout badge service projects, watershed tree-planting projects, and community clean-up projects. In particular, 2007 marked the fifth year that DEP, CCE, Catskill Outdoor Education Corps, and the Council on the Environment of New York City collaborated to facilitate watershed tree planting activities for 17 upstate and 21 downstate students. More than 170 students have participated to date.

9.1 Watershed Professionals, Businesses, and Industry Groups

Generally speaking, this audience includes agency staff, private contractors, and various business or industry groups with a potential role in helping to protect the watershed. Some key examples of this target audience include: consulting foresters, loggers, nursery and greenhouse operators, landscapers, arborists, engineers, construction contractors, and local highway officials. The following are 2007 education and outreach highlights for this particular audience:

- In March, WAC launched the Catskill WoodNet website (www.catskillwoodnet.org) using funds provided by the USDA Forest Service. The website has about 40 members and is designed to market local wood-using businesses to potential customers in New York City and elsewhere. In support of the website and to help recruit members, WAC sponsored four on-

line training sessions in addition to a series of technical assistance workshops geared towards the local forest products industry and covering topics such as hardwood value improvement and lumber grading.

- Through the Watershed Agricultural Program, WAC continued to implement the Pure Catskills Branding Campaign (www.buypurecatskills.com), which included the annual publication of 10,000 "buy local" farm product directories and the sponsorship of 15 Pure Catskills events held throughout the watershed and attended by over 4,500 participants.
- Through the Watershed Forestry Program, WAC hired Cornell University to conduct an invasive species public awareness survey of local forestry and tree professionals in both the Catskill/Delaware and Croton Watersheds. More than 950 questionnaires were mailed and 243 surveys were returned, for an adjusted response rate of 28%. In addition, WAC sponsored three forester training workshops in 2007 while continuing to partner with CCE and New York Logger Training to promote voluntary participation in the state-wide Trained Logger Certification (TLC) Program. During 2007, 12 logger training workshops were held for approximately 90 participants. To help promote the TLC program, WAC distributed 600 logger training calendars, 8 TLC promotional signs for use at watershed logging operations, and 8 logger first aid safety kits.
- DEP and numerous local partners continue to participate in the Catskill Regional Invasive Species Partnership (CRISP) and the Lower Hudson Partnership for Invasive Species Management (PRISM). These voluntary regional partnerships are among eight formed across the state for the purpose of implementing the recommendations of the New York State Invasive Species Task Force on a collaborative local basis. One of the highest priorities of CRISP and the Lower Hudson PRISM is to develop and implement a comprehensive education and outreach program that slows the spread of invasive species.
- In October, DEP supported and participated in the 40th annual New York State Outdoor Education Association Conference in Hunter. DEP's Deputy Commissioner for the Bureau of Water Supply provided the opening address, DEP conducted an educational presentation and staffed a DEP exhibit, and WAC sponsored a pre-conference watershed bus tour for approximately 25 people. During the conference, which attracted more than 250 environmental educators from across the state, DEP joined CWC, Trout Unlimited, and the Catskill Center in presenting five Outstanding Teacher Awards and six Special Achievement Awards to 11 school teachers from New York City and the watershed.
- Through the Land Acquisition Program, DEP reaches out to realtors, land trusts, local roundtables, and landowner associations to educate them about the benefits of the City's acquisition and easement programs and to encourage their support of these efforts. Examples of key activities for 2007 include: meetings with over two dozen land trusts and other non-governmental organizations, attending the New York State Land Trust Rally and National Land Trust Rally (both sponsored by the Land Trust Alliance), and participating in the Ulster County Land Trust Conference.
- DEP collaborated with the New York City Department of Parks and Recreation (DPR) to sponsor and coordinate a native seed collection training workshop in Phoenicia that was attended by nearly two dozen professionals from various watershed agencies and organizations. DEP also convened a series of meetings between DPR, WAC, and CWC to explore potential watershed linkages in support of the City's PlaNYC goal of planting one million new trees by 2017. These discussions focused on helping to mobilize the watershed nursery and

greenhouse industries to grow trees and provide planting stock over the long term. This fledgling effort will continue in 2008.
- In collaboration with DEP's Stream Management Program, Delaware County SWCD initiated a flood recovery training program for local contractors and highway superintendents, in addition to attending a DEC floodplain management training workshop, the Mid-Atlantic Stream Restoration Conference, and the Eastern Geographic Information Systems Conference. Delaware County SWCD also completed three stream restoration demonstration projects.

9.2 Tourists, Recreationalists, and Volunteer Community Groups

In light of the City's ongoing acquisition of vacant water supply lands and the opening of certain City-owned properties for public recreation, watershed tourists and outdoor recreationalists increasingly represent an important target audience for watershed education and outreach. The City currently owns more than 123,000 acres of watershed land, of which more than 76,000 acres are open for public recreation (including 33,000+ acres of reservoirs that are open for fishing). DEP works closely with local watershed volunteers and community groups on miscellaneous stewardship projects, many of which take place on City-owned lands. The following education/outreach and recreation-based activities were accomplished during 2007:

- DEP issued more than 13,260 Access Permits and 12,260 hunting permits, including nearly 12,000 Access Permits issued online. To date, more than 125,000 people have received a DEP Access Permit and more than 10,000 people have DEP boating tags. All of these people receive the DEP newsletter, *Watershed Recreation*, which is mailed twice annually. DEP also produces an annual hunting guide for City-owned lands in addition to utilizing the watershed recreation website (www.nyc.gov/watershed).
- DEP maintains two bald eagle observation sites, one at Rondout Reservoir and a second at Ashokan Reservoir, where watershed visitors may learn about the resurgent bald eagle population, an important indicator of ecosystem health. In addition, CWC completed repairs and improvements on all six West of Hudson reservoir kiosks that were originally installed in 2002.
- Throughout May and June, DEP joined DEC, CWC, and other partners to support "Take A Kid Fishing Day" at several water supply reservoirs (Ashokan, Rondout, Cannonsville, Pepacton). The event was attended by more than 100 people. DEP also conducted fishing demonstrations at Lake Gleneida for a dozen members of three local fishing clubs.
- DEP staff conducted six interpretive hikes on City-owned watershed lands in both the Catskill/Delaware and Croton Watersheds for 40 total participants. DEP also assisted with several tree planting projects on City-owned lands, in addition to sponsoring 18 reservoir clean-up projects between April and September which attracted approximately 200 total participants in the Catskill/Delaware and Croton Watersheds.
- DEP participates in the Westchester County Deer Task Force and Greene County Mountaintop Communities Recreation and Tourism Task Force. Both of these entities provide valuable opportunities for DEP and other watershed stakeholders to discuss relevant issues relating to public recreation, land management, and ecotourism.
- Between May and October, DEP collaborated with DEC and the Student Conservation Association (SCA) to implement a firewood outreach pilot project for the West of Hudson Water-

shed. As part of this effort, a firewood outreach coordinator visited eight state-owned campgrounds in the Catskills to educate campers about the movement of invasive insects via firewood, survey adult campers about their firewood transport habits, and provide campground operators with information about invasive insects.
- In August, DEP co-sponsored and participated in the first annual Batavia Kill Stream Celebration Day along with Greene County SWCD and other local partners. The event attracted over 1,200 community members who enjoyed stream walks, educational exhibits, hands-on activities and outdoor entertainment. In November, 20 volunteers planted a 100-foot wide riparian buffer along 300 feet of eroding streambank on Esopus Creek in an event coordinated by Ulster County CCE in cooperation with DEP.

General Public

DEP maintains an active community presence at watershed county fairs, public events, and other venues within New York City and elsewhere. DEP staff also participate in various conferences and speaking engagements throughout the year to promote and support the City's Long-Term Watershed Protection Program. Key highlights and accomplishments for 2007 include:

- DEP staff participated in more than 100 events throughout the East of Hudson and West of Hudson Watershed region where thousands of people received information about the New York City water supply and the City's watershed protection efforts. Major events included the Cauliflower Festival, Cobleskill Sunshine Fair, Delaware County Fair, Dutchess County Fair, Grahamsville Little World's Fair, Hunter Mountain Culture Festival, Putnam County 4-H Fair, Rondout Valley Job Fair, Sullivan County Community College Water Expo, Ulster County Agricultural Fair, Westchester County 4-H Fair, Woodstock Environmental Day, Yorktown Grange Fair, and others.
- In May, at least 340 people packed the SUNY Delhi theater to watch the premier of a new 40-minute video, "Shavertown: Reservoir of Memories." This documentary was produced by two teachers from Andes Central School using DEP funding provided through the CWC Public Education Grants Program.

In August, a dedication ceremony was held in Arkville for the proposed Water Discovery Center (formerly the Catskill Watershed Museum). CWC presented a $1 million symbolic check (City funds provided through the Catskill Fund for the Future) to help the Water Discovery Center hire staff and begin a capital funding campaign.

10. Miscellaneous Reporting Provisions

10.1 Water Conservation

Water demand in the City of New York increased more than 1% per year through the 1950s, 1960s, 1970s, and early 1980s. Drought warnings and emergencies occurred during the 1980s, 1990s, and 2002. At the same time, wastewater flows to the Ward's Island, Newtown Creek, North River, and Coney Island water pollution control plants (WPCP) either exceeded or approached permit levels. In an effort to avoid the capital cost of expanding the water supply and wastewater treatment infrastructure, and the costs incurred by droughts, New York City has developed a lower cost plan of conservation for water and sewer services.

The best proof of the success of these conservation plans is the drop in New York City's water consumption. Consumption has continuously dropped from an average of 1,450 million gallons per day (MGD) in 1990 and 1991, to under 1,300 MGD since 1996, to under 1,200 MGD since 2001, and under 1,150 MGD since 2002. Consumption has been recorded under 1,100 MGD for three out of the last five years although New York City has experienced some of the hottest summers on record.

Since 1990 water conservation programs implemented by DEP have resulted in a decrease of approximately 22% in in-City water consumption and wastewater flow. At the same time the City's population increased by approximately 12%. All WPCPs that were exceeding dry weather flow limits in the 1980s are all operating well under their allowed flow rates. Per capita use has declined from more than 200.0 gallons per capita per day (gcpd) around 1990 to 139.1 gcpd in 2007.

The most important components of DEP's ongoing water efficiency program are leak detection, water metering, water main replacement, toilet replacement, locking hydrant caps, and educational programs. Significant achievements in 2007 include the following:

- In fiscal year 2007 (July 1, 2006 through June 30, 2007), DEP surveyed more than 3,850 miles (56.6% of the total number of linear feet) of the City's water mains, a greater percentage of water mains than planned. As a result of these surveys, 159 leaks/breaks were found and repaired for an estimated savings of 4.6 MGD. The entire city is on a three-year survey schedule while the drainage areas for the Ward's 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. The leak detection program has brought the distribution system leakage rate down to about 10-15% of the rate in the 1980s.
- Each year since 1970, with a small number of exceptions, DEP has replaced an average of 55-60 miles of old cast iron water mains with ductile iron pipes. This is equal to 1-2% of the total length of water mains in the system.

- DEP has substantially completed the largest water meter installation program in North America and is moving towards a radio-based Automatic Meter Reading (AMR) program during the 2007–2010 period. AMR will provide daily meter readings and, eventually, monthly billing.
- DEP began the software development work for Phase I of the next toilet replacement program, aimed at high-density apartment buildings applying for the New York City Water Board's "Multifamily Conservation Program" rate. A more expansive fixture replacement program and other new end user efficiency programs will be implemented based on the schedule for the agency's "Dependability Program."

10.2 Drought Management Plan

In 2007, 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 dewatering and repair plans for, the Rondout-West Branch Tunnel (RWBT) have been ongoing in 2007 and involve the following components:

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

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 2007. The object of this program is to determine if tunnel conditions are changing. On a routine basis DEP monitors tunnel flow rates, operational trends, and surface expressions to determine the quantity of the leak.
- The Tunnel Testing Program is also underway. During 2007, DEP conducted a hydrostatic test, five backflow tests and one dye test. 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 flowmeter to "feed the leak" is measured as a negative number, and is interpreted as the net leakage. The dye test shows the time of travel, and therefore the flow rate of the water at the end of the tunnel. Flowmeters at the beginning of the tunnel allow the Department to compare values, so leakage can be estimated. None of these tests showed results that indicated an increase in leakage.
- During 2007, work commenced under the Tunnel and Shaft Rehabilitation Program construction contract. The work included upgrades to the dewatering station at Shaft 6, site improvements at various shaft locations to provide improved access to and ventilation of the tunnel, 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), and installation of tunnel hydraulic grade line measurement equipment. In 2007, site work at Shafts 1, 2A, and 6 began and the Shaft 6 dive work was prepared.

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 to perform additional inspections of the RWBT commenced in 2007. The vehicle underwent upgrades to its cameras and other systems and general maintenance in 2007. 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 that the AUV could not perform. The ROV inspections will be performed under four 10-day shutdowns. In 2007, DEP's consultant commenced design of the custom vehicle.

Water Supply Dependability Analysis

In 2007, DEP continued a capital program that will provide for the reliable supply of drinking water for the period necessary to take critical aging elements of the water delivery system out of service for inspection and repair. From the 39 project alternatives, 27 were selected under the Programmatic Conceptual Plan to strategically achieve system dependability. To frame the overall supply need, new sources are required in the neighborhood of 300 to 400 MGD. DEP has grouped the 27 project alternatives into phases. The first phase is a group of four projects, which include:

- Jamaica Phase 1 Groundwater (up to 55 MGD) with Flood Mitigation
- Catskill Aqueduct Capacity Optimization (up to 60 MGD)
- Delaware Rondout Aqueduct
- Demand Management (up to 20 MGD)

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