New York City
Department of Environmental Protection

Filtration Avoidance Annual Report
For the period January 1 through December 31, 2008

March 2009

Prepared in accordance with the July 2007 Filtration Avoidance Determination

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

Table of Contents

List of Figures

List of Tables

1. Introduction

In 2008, New York City continued with its aggressive and multi-faceted watershed protection program. The City first applied for a waiver from the filtration requirements of the Surface Water Treatment Rule for the Catskill/Delaware system in 1991. Since then, New York City, under the auspices of the Department of Environmental Protection (DEP), has committed more than $1.5 billion and countless staff hours to maintain the pristine quality of the source waters of the Catskill and Delaware watersheds.

DEP's comprehensive watershed protection program is based on extensive research by DEP scientists into existing and potential sources of water contamination. As part of DEP's source water monitoring program, tens of thousands of samples are collected annually 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 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, 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 a framework to continue its efforts in sustaining the high quality of New York City's Catskill/Delaware water supplies with the publication of the December 2006 Long-Term Watershed Protection Program document. This document outlined the City's programmatic commitments to continued watershed protection for the subsequent five years and served as the framework for the current Filtration Avoidance Determination, issued by EPA in July 2007. In 2008, DEP continued to comply with the substantive requirements of the 2007 FAD.

Over the past year, the world economic situation has placed pressure on resources at DEP. The agency strives to balance the need for strong watershed protection and construction and maintenance of critical infrastructure with efforts to keep water rates affordable. During 2008, DEP sought ways to improve efficiency while continuing steady implementation of critical watershed protection efforts. While New York City continues to dedicate significant funding and personnel to the watershed program, each program element will continue to be evaluated critically to ensure that resources are being deployed in the most effective and cost-effective way.

This annual report covers the period January 1, 2008, through December 31, 2008, and is compiled to satisfy the requirements of the 2007 FAD. Material in this report is organized to parallel the sections of the FAD.

While this report focuses primarily on the efforts of New York City, it is important to recognize that DEP works in partnership with many agencies, organizations and communities throughout the region to achieve its goals. The contributions of many of these groups are acknowledged throughout this report. The other private, governmental, community and non-profit entities that share a role on this complex effort are too numerous to list. However, DEP gratefully acknowledges their ongoing help and support.

2. Federal and State Objective Water Quality Compliance

During 2008, 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 2008, DEP collected a total of 44,079 samples and conducted a total of 546,158 analyses. Of these, 29,800 samples were collected and 381,300 analyses were completed within the City. Once again, the results of this monitoring effort were impressive. The City complied with the objective criteria of the Surface Water Treatment Rule (SWTR). Of the 10,056 in-City compliance samples analyzed pursuant to the Total Coliform Rule in 2008, only 0.14% were total coliform positive. All samples were negative for *E. coli*. All resamples, except one, were negative for total coliform. Since November 1994, DEP has collected more than 151,651 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 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

SWTR 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 2008, all monitoring samples complied with thresholds defined by the SWTR.

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

Both the Catskill and Delaware Aqueduct effluents from Kensico Reservoir exhibited fecal coliform concentrations in water prior to disinfection at levels less than or equal to 20 CFU 100 ml^{-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 and Delaware Systems never fell below 98.9%, and 97.8%, respectively.

As shown in Figures 2.1 and 2.2, in 2008 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.

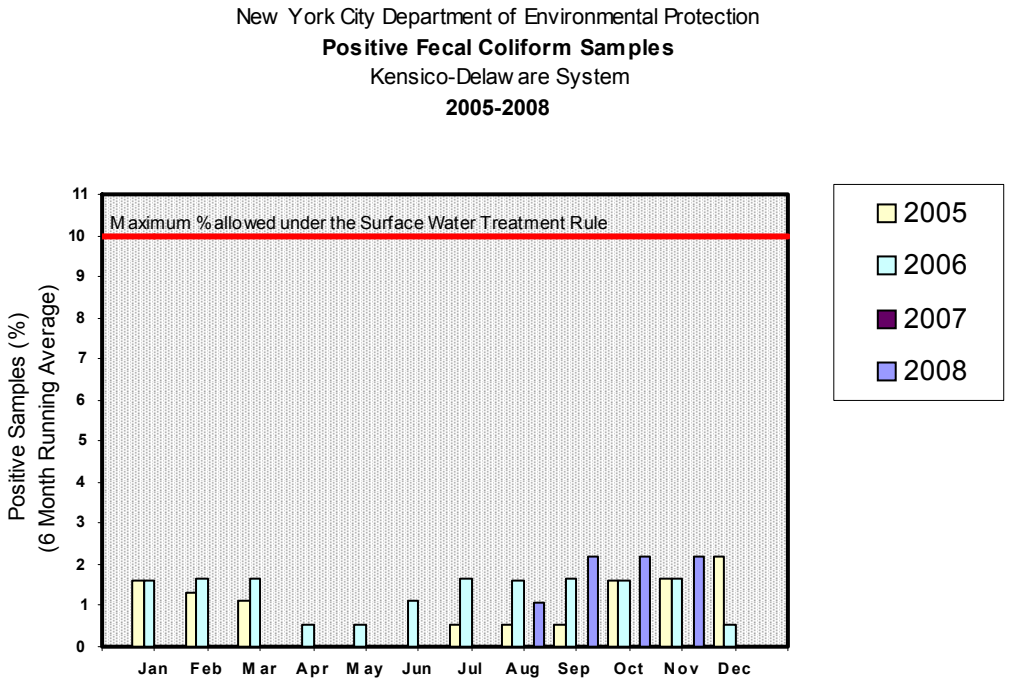

Figure 2.1. Positive fecal coliform samples, Kensico-Delaware System, 2005–2008.

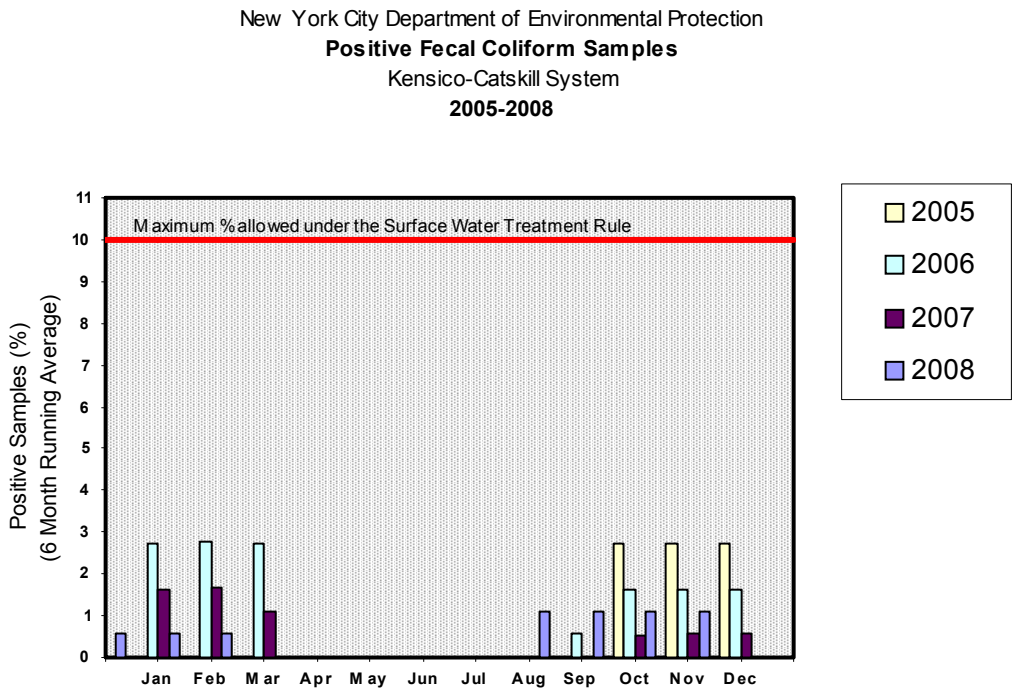

Figure 2.2. Positive fecal coliform samples, Kensico-Catskill System, 2005–2008.

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

Both the Catskill and Delaware Aqueduct effluents from Kensico Reservoir exhibited turbidity levels less than or equal to 5 NTU in water prior to disinfection for the entire 2008 calendar year (Figure 2.3). Turbidity values did not exceed 2.2 NTU for the Catskill System and 2.2 NTU for the Delaware System.

During the April 2008 reporting period, several reported grab turbidity samples at the DEL18 keypoint were not collected within +/- 5 minutes of the 4-hour time moment as specified in the SOP COMP0010S07. After some discussion, NYSDOH determined that while these irregularities contravened a supplemental section of New York State Health Code, they did not violate Federal Codes pursuant to the Safe Drinking Water Act. Therefore, DEP was not issued any monitoring or reporting violation.

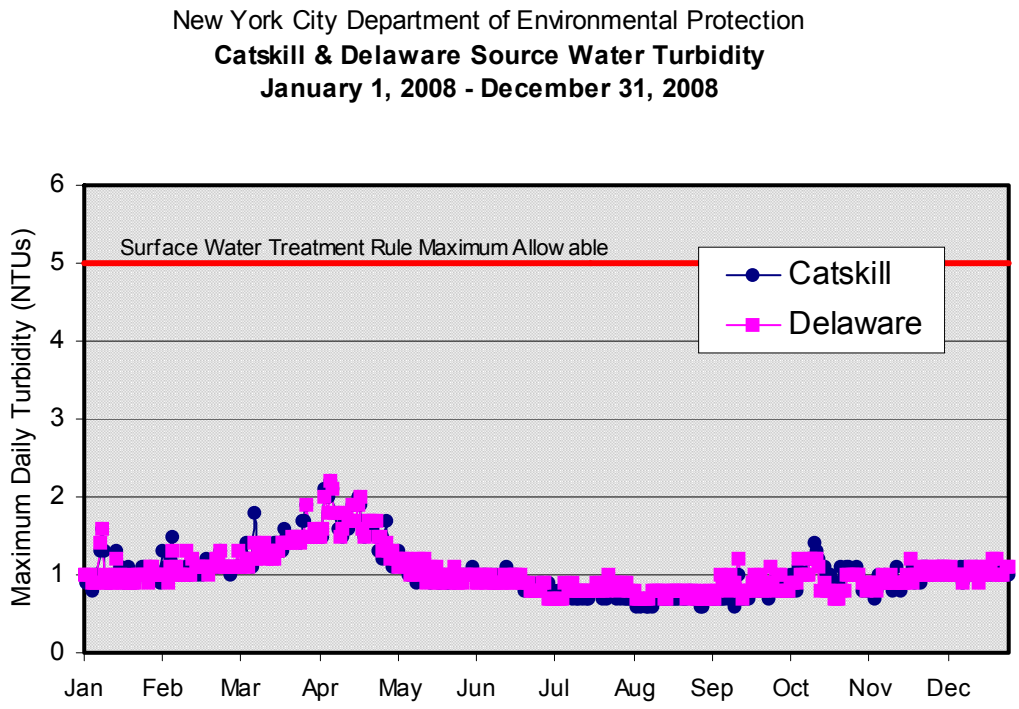

Figure 2.3. Catskill and Delaware source water turbidity, January 1, 2008 - December 31, 2008.

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

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

2.1.4 Entry Point Chlorine Residual (40 CFR Sections 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 0.25 mg L^{-1}.

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

All chlorine residuals for compliance samples measured within the distribution system during the year were measurable/detectable (the lowest being 0.01 mg L^{-1}), with the exception of two compliance samples in the Catskill/Delaware Distribution Area, each of which had a chlorine residual of 0.00 mg L^{-1}. However, these two compliance samples had a heterotrophic plate count (HPC) of 2 CFU ml^{-1} and <1 CFU ml^{-1}. Samples with an HPC less than or equal to 500 CFU ml^{-1} are deemed to have a detectable disinfectant residual for purposes of determining compliance with this requirement.

Two operational samples (formerly referred to as "non-compliance samples") also had a 0.0 mg L^{-1} free chlorine residual. Operational sites are located on mains that do not have direct service connections to consumers and are not used for compliance purposes. Operational samples supplement compliance sites and are collected to gather additional water quality data in the distribution system. Operational samples make it possible to optimize process control, assess water quality, facilitate water quality management, and determine the source and extent of physical and/or biological quality changes, such as high turbidity, color, or coliform occurrences.

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

The analysis for trihalomethanes, performed on a quarterly basis, resulted in a maximum total trihalomethane (TTHM) level of 70 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 65 µg L^{-1} in the Catskill/Delaware Distribution Area.

The highest TTHM quarterly running average during the year, recorded during the second quarter, was 39 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 fourth quarters, was 38 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

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

Within the distribution system, coliform monitoring indicated monthly levels below the 5% maximum of the Total Coliform Rule (Figure 2.4). The number of compliance samples analyzed for total coliform was 10,056. Of these compliance samples, 14 were total coliform positive. All resamples, except one, were negative for total coliform. All samples were *E. coli* negative for the year. The actual percentage of compliance samples that were total coliform positive was 0.14%.

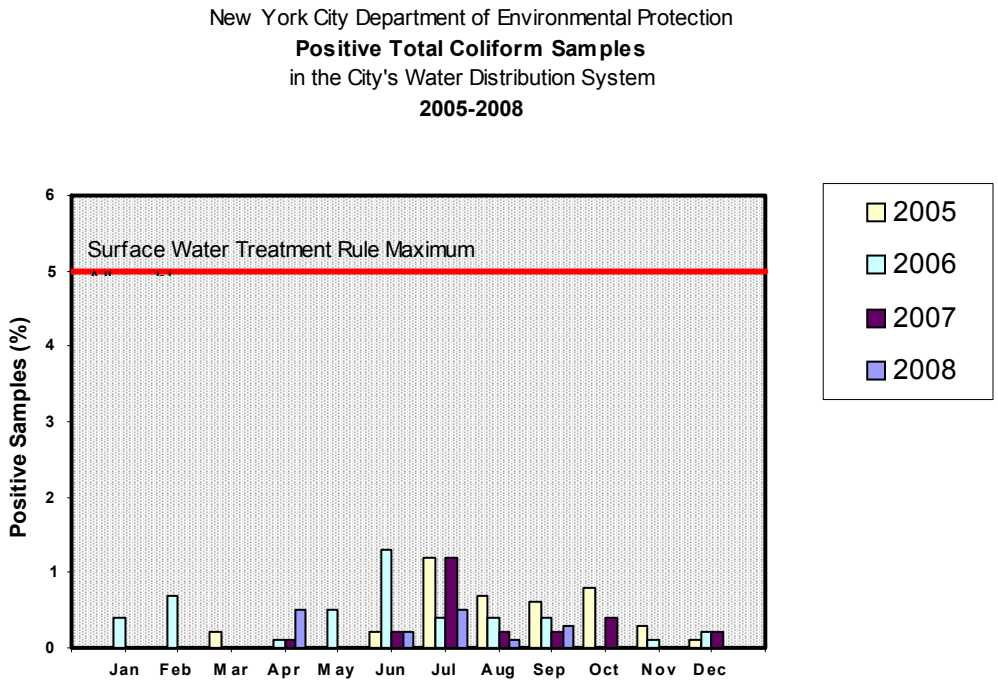

Figure 2.4. Positive total coliform samples, NYC Distribution System, 2005–2008.

2.2.2 Chlorine Residual Maintenance in the Distribution System

During the year, DEP has continued a number of programs to ensure adequate levels of chlorine throughout the distribution system. These have included: (1) maintaining chlorination levels at the distribution system's four entry points, (2) conducting spot flushing when necessary, and (3) providing local chlorination booster stations at remote locations. Three permanent local chlorination booster stations have been continuously operating to improve the chlorine residual levels at the Fort Tilden, Roxbury, and Breezy Point areas (all on 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 10,056 compliance samples analyzed pursuant to the Total Coliform Rule.

3. Environmental Infrastructure

3.1 Septic Programs

3.1.1 Septic Rehabilitation and Replacement Program

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

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

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

The Priority Area Program is an inspection and repair program implemented geographically based upon the proximity of septic systems to reservoirs and watercourses. The Priority Area Program was implemented by CWC in July 1999 in the 60-Day Travel Time Area and has since expanded sequentially to include first septic systems located within 50 feet of a watercourse and/or 300 feet of a reservoir or reservoir stem, and then septic systems located between 50 and 100 feet of a watercourse. In 2008, CWC funded the repair or replacement of 214 failing or likely to fail septic systems. A total of 956 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 2008, CWC funded the repair or replacement of seven failing septic systems under the Hardship Program. A total of 60 failing septic systems have been replaced under the Hardship Program.

The Septic Monitoring and Research Project's objective was 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 WOH Watershed. The Project was concluded in 2008. Five different septic system designs were installed under this program: aerobic treatment units (ATUs), sand filters with leach fields, peat filters with leach fields, raised systems, and conventional systems. The final report was presented to members of the Septic Monitoring Advisory Committee in June 2008. A total of 38 failing septic systems were 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, home owners who fixed failing septic systems outside of the priority areas before December 31, 2008, are eligible for reimbursement.

Under the various sub-programs discussed above, CWC funded the repair or replacement of 258 septic systems in the West of Hudson Watershed in 2008. Since program inception, a total of 2,864 failing septic systems have been repaired, replaced, or managed.

Additionally, per the 2007 FAD, the Septic Rehabilitation and Replacement Program was expanded to include $4 million in funding for commercial septic systems operated by small businesses and $2 million in funding for repairing or replacing existing cluster systems or creating new cluster systems. These components of the Septic Rehabilitation and Replacement Program are reported on below in Section 3.1.4, Other Septic Programs.

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 66 septic tank pump-outs in 2008. Since program inception a total of 361 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 the construction of septic systems, where required solely by DEP or its delegate to comply with the Watershed Regulations.

No applications were processed under the Alternate Design Septic Program in 2008.

3.1.4 Other Septic Programs

CWC adopted Small Business Septic System Rehabilitation and Replacement Program Rules in 2008. This program helps pay for the repair or replacement of failed septic systems serving small businesses (those employing 100 or fewer people) in the Catskill/Delaware Watershed. The CWC will reimburse such business owners 75% of the cost of septic repairs, up to a maximum of $40,000. To be eligible, failing commercial septic systems must be 100 feet or less from a watercourse or 500 feet or less from a reservoir, or within the 60-day travel time priority zone.

CWC is working on developing program rules for the Cluster System Septic Program. These rules are expected to be adopted in 2009.

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 project from the Hamlet of Roxbury to the Grand Gorge WWTP is complete. The Supplemental Service Area serving Hubbell Corners is under design.

The Hunter WWTP and collection system are functionally complete.

The Windham WWTP and collection system are functionally complete.

The Fleischmanns WWTP and collection system are functionally complete.

The Prattsville WWTP and collection system are functionally complete.

DEP granted the Town of Shandaken an additional 6-month time extension to January 2009 to establish the necessary sewer district in the Hamlet of Phoenicia to allow the Phoenicia WWTP and collection system project to proceed. The additional time extension was granted to allow the town time to explore the feasibility of a Vegetated Sand Bed (VSB) wastewater treatment system for the Hamlet of Phoenicia and followed a previous 14-month time extension granted to the town to establish the requisite sewer district. A Preliminary Design Report on the VSB wastewater treatment system for Phoenicia dated October 23, 2008 was received and reviewed by DEP. In December 2008, DEP informed the town that the VSB wastewater treatment system as proposed in the Preliminary Design Report was deficient in significant aspects and not approvable. A decision is expected to be made in 2009 regarding whether or not the town will go forward with the NIP project.

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 wastewater collection systems, and/or the creation of septic maintenance districts. The latter includes funding for septic system replacement/rehabilitation/upgrade and for the operation and maintenance of the district.

As a requirement of the 2007 FAD, DEP provided an additional $37.2 million in funding to complete existing CWMP projects and fund three additional CWMP projects.

To date, CWMP projects have been completed in Bovina and DeLancey, are near completion in Bloomville and Hamden, and are underway in Boiceville and Ashland. CWMP projects are slated for three additional communities—Trout Creek, South Kortright, and Lexington.

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

The Septic Maintenance District project for the Hamlet of DeLancey in the Town of Hamden is complete. The new district is responsible for scheduling regular inspections of the 59 septic systems located within the district and contracting for their repair as necessary. Approximately $630,000 out of the $2.2 million CWMP project funds were paid to set up the district, pump and inspect all of the onsite systems, and replace the 16 systems found to be substandard. The town received a check on January 8, 2008, for $1,589,558, representing the balance of the project block grant to seed a fund for the continued operation and maintenance of the district.

In Bloomville, construction of the community septic system project consisting of shallow cut-and-fill beds preceded by a sand filter was completed in 2008. Start up and lateral installations will occur in 2009.

The approved project for Boiceville is a centralized wastewater treatment system with large diameter gravity collection sewers. WWTP and Collection System Design Approvals were issued by DEP on December 16, 2008. Construction is to commence in 2009.

Construction of the community septic system project serving the Hamlet of Hamden and consisting of shallow cut-and-fill beds preceded by a sand filter was nearing completion at the end of 2008. Start-up and lateral installations will occur in 2009.

The approved project for the Hamlet of Ashland is a re-circulating sand filter WWTP with small diameter gravity sewers. Sixty-five percent collection system design drawings were received in November 2008. The Facility Plan Report and the 65% WWTP design drawings were received in December 2008. Final design approvals and the commencement of construction are expected to occur in 2009.

CWC provided program information to the communities of Trout Creek, South Kortright, and Lexington in 2008. These communities are expected to execute participating community agreements and commence study phase work in 2009.

3.4 Sewer Extension Program

DEP continued the implementation of the Sewer Extension Program, with all of the communities participating in the program during 2008. Significant accomplishments during the past year included nearing completion of the planned sewer extensions in the Town of Neversink, executing a construction contract and awarding a bid to a contractor associated with constructing an

extension near Grand Gorge in the Town of Roxbury, and setting up a strategy with Town of Middletown and Village of Margaretville local officials to procure easements needed to resume and finalize the design of the extensions planned in these communities.

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

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

Construction of the sewer extensions and associated laterals continued from the beginning of the construction season in the spring through the end of the construction season in mid-December. All of the new sewer mains, manholes, and associated laterals for each of the areas where extensions are planned have been completed. All that remains to be done prior to determining that the project is Substantially Complete is finalizing construction of two planned pump stations. This includes establishing their electrical connections, shoring up a few manholes and sewer mains, and completing all applicable tests and inspections.

It is anticipated that the project will be determined to be Substantially Complete in spring 2009 and that all work will be completed by the end of July 2009.

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

During the first half of 2008, DEP bid a contract for the construction of a sewer extension west of the Hamlet of Grand Gorge along NYS Rt. 23. The contract was awarded and a commence work date of July 24, 2008, was established.

Subsequent to the contract's registration, staff requested that the contractor comply with various pre-construction requirements, including but not limited to, preparing a Health and Safety Plan (HASP), finalizing both Stormwater Management and Traffic Control Plans, meeting Local Law 77 requirements, submitting proposals for sub-contractors and associated Vendex approvals and preparing and submitting shop drawings for all of the construction components.

It was anticipated that the contractor would be able to meet all of the pre-construction requirements in a timely manner so that construction could commence in the autumn. However, due to problems the contractor experienced in meeting these requirements, construction did not commence before the end of the year as planned.

Construction of the extension is now planned to commencing spring 2009. It is anticipated that the project will be completed by December 1, 2009.

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

Planning and design-related activities for a sewer extension next to the Pine Hill WWTP along NYS Rt. 28 continued during the past year. Six properties immediately to the west of the treatment plant were added to the project scope due to a known septic failure on one of the prop-

erties. Questionnaires were sent to these property owners to learn more about the type of on-site septic system they currently use and to learn where they would like new laterals to be placed on their properties.

Activities that need to be completed before construction can commence include finalizing the project's design plans and specifications, complying with SEQR, obtaining all applicable permits, assisting the town in preparing and adopting a new Sewer Use Law, working with the town in its effort to procure all of the easements on properties where the new sewer mains and laterals are planned, and preparing a construction contract.

It is currently anticipated that the design plans will be finalized in autumn 2009 and that bids will be let in spring 2010. DEP expects to commence construction in summer 2010.

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

Planning and design activities commenced for a new sewer extension along NYS Rt. 23C (Hill Street) and Showers Road. Activities that took place during 2008 included, but were not limited to, visiting the project area to determine the appropriate location of the planned sewer mains; meeting with affected residents to learn about concerns they have associated with constructing laterals on their properties; convening a meeting with the City's engineering consultant and the Town Supervisor to discuss issues involved with designing and constructing the planned extension; sending questionnaires to town residents who will be served by the extension to learn more about their existing on-site disposal systems and to learn where they would want laterals on their properties to be sited; and commencing work associated with completing SEQR.

Planning and design activities that need to be completed before construction can commence include finalizing the project's design plans and specifications, complying with SEQR, obtaining applicable permits, working with the town to procure easements on properties where the new sewer mains and laterals are planned, and preparing a construction contract.

It is anticipated that the design of the extension will be completed by autumn 2009 and that construction will commence in the summer of 2010.

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

Staff met with local officials from the village and town and presented a strategy for working with both municipalities to procure easements DEP needs when planned sewer mains go outside existing right-of-way areas. The strategy included realigning the planned extensions in certain areas to avoid properties whose owners have indicated an unwillingness to sign an easement that would allow a sewer main to cross their property. Under another key element of the strategy, staff would work closely with the Village and Town's Building Inspector to arrange to meet with all the affected landowners, to learn where they would like laterals to be installed on

their property. Based on this information, a map showing the location of the laterals could be prepared and attached to each landowner's easement. DEP anticipated these meetings would take place before the end of the year, but since several of the affected residents failed to respond to phone calls made by the Code Enforcement Officer to set up meeting dates, it was decided to reschedule the meetings to spring 2009.

Due to the uncertainty over the time frame for obtaining the easements, it is not possible to estimate with any degree of certainty when the design of the extensions will be completed or when construction of the extensions is likely to commence. The earliest that construction could conceivably begin is autumn 2010.

3.5 WWTP Upgrade Program

As part of the MOA, the City agreed to fund the upgrades of all existing non-City-owned WWTPs in the watershed. (As reported in previous annual reports, upgrades of City-owned WWTPs, which account for more than a third of WWTP flow in the Catskill/Delaware watershed, proceeded on a separate track and were completed in 1999.) The upgrades will provide highly advanced treatment of WWTP effluent.

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 its 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 they are separate programs, both are encompassed by the Upgrade Agreement between EFC and the WWTP owner.

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

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

The 2008 efforts focused on completing regulatory upgrades for the remaining WWTPs. By the end of 2008, 98% of the total WOH flow (32 WWTPs) had achieved Functional Completion and begun operations (compliance with the NYC Watershed Rules & Regulations (WR&R)), 1% (two WWTPs) was under construction, and, of the three WWTPs comprising the remaining 1% of the flow, two were finalizing design and one was awaiting completion of the Boiceville Community Wastewater Project so it could be connected to it.

In addition to the efforts to complete Functional Completion at all WOH WWTPs, 2008 efforts also focused on negotiating O&M Agreements and budgets, as well as processing Start Up and Performance payments and O&M payments.

In 2008 DEP added an additional $1,000,000 to the SPDES Upgrade Program.

Notable progress was also made in advancing the Croton Falls-Cross River basin projects, which involve nine-FAD related WWTPs. Two of these, comprising 83% of the Croton Falls-Cross River basin flow, have been completed; four; comprising 14% of the flow, were in the construction phase, and three were in the design phase.

3.6 Stormwater Program

3.6.1 Stormwater Cost-Sharing Programs

Costs of stormwater measures incurred as a result of complying with the WR&R 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 $2,835,645 for construction projects and $153,021 for maintenance projects, while $12,176,724 has been transferred to other eligible watershed protection programs and $19,935,086 plus interest income remains to be allocated. Table 3.1 lists all projects approved in 2008.

Table 3.1. Stormwater Controls Projects approved in 2008.

Applicant	Project	Approval Date	CWC Funding	Other Funding
Amy Jackson	New Building Construction	1/25/05	$15,000	None
	Subsurface Detention/ Infiltration	2/28/08	$9,230.52	None
Verona Oil	Verona Service Station–Windham	5/24/05	$145,000	None
	Oil/Water Separation Subsurface Infiltration			
	Maintenance	7/25/06	$40,000	
	Maintenance	8/26/08	$50,000	
Community Wastewater Management Program Fund Transfer	Administrative Costs	3/25/08	$1,000,000	None
Town of Olive	Boiceville WWTP SPPP *Stormwater Detention Pond*	9/23/08	$83,100	None
Machne Tashbar	Camp Machne Tashbar WWTP SPPP *stormwater controls*	11/4/08	$88,407.54	None

3.6.2 Stormwater Retrofit Program

The Stormwater Retrofit Program is administered jointly by CWC and DEP. The total program budget is $20,405,000. Of that, $15,236,250 is for capital expenditures, $2,688,750 is for maintenance activities, and $2,500,000 is to conduct community-wide stormwater infrastructure assessment and planning initiatives.

CWC 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 1999–2008, 68 construction grants totaling $13,383,306 were reviewed and approved for funding. Thirty-two projects have been completed utilizing $4,543,580 of program funds, focusing on street drainage, stormwater separation, stormwater treatment, and highway maintenance activities. Table 3.2 lists all projects closed in 2008.

Table 3.2. Capital Projects completed in 2008.

Applicant	Project Description	Grant Amount	Closing Date
Schoharie Watershed			
Greene County Highway Department	Street Sweeper	$180,000	9/15/08

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 2008, 15 planning and assessment projects were reviewed and approved, with a total funding allocation of $518,176.61. To date, five planning and assessment projects have been completed, for a total expenditure of $155,306.27. Three planning and assessment projects have been closed without any expenditures. Seven planning and assessment projects currently remain open.

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, 2009.

4.2 Land Acquisition

4.2.1 Annual Program Summary

The 2007 FAD required a solicitation plan for 2008–2010, which was submitted last year. The plan set 2008 benchmarks for DEP of 30,000 acres in new solicitations (land previously unsolicited) and 59,500 acres in resolicitations, and a benchmark of 5,000 acres of farmland to be solicited by the Watershed Agricultural Council (WAC). These goals were met and exceeded. Total acres solicited by DEP since 1997 now stand at 471,161 acres in the CAT/DEL System East and West of Hudson.

By the end of calendar year 2008, DEP had secured a total of 1,019 purchase contracts (fee simple and conservation easements) comprising 74,369 acres throughout the CAT/DEL System, at a cost of $246.5 million (additional "soft" costs of about $26 million). Of these, 885 projects totaling 64,835 acres have been acquired (closed), with the remaining projects under purchase contract. During 2008, 77 projects comprising 5,844 acres were closed, and 98 projects accounting for 6,860 acres were signed to purchase contract. This makes 2008 the third best year since the program began formally in 1997 for deals signed to contract in the CAT/DEL System.

As of 1996 the City owned 35,509 acres of land surrounding reservoirs in the CAT/DEL System; as of December 31, 2008 the City (including WAC farm easements) had protected an additional 91,330 acres, more than tripling land under City control to a total of 126,839 acres. In 1996 roughly 3.5% of the watershed was owned by the City; today, roughly 12.4% is controlled or owned by the City.

A total of 2,694 acres have been secured in the Croton System, which includes lands acquired with $38.5 million dedicated by the City for Croton acquisitions, lands acquired by NYSDEC (using NYS funds) and then conveyed to NYC, and lands acquired by Putnam County using Water Quality Improvement Program funds derived from the City. These figures have not changed since 2007.

4.2.2 Individual Program Summaries

During 2008, the twelfth full year of operations, DEP re-contacted individuals owning 81,719 acres and solicited, for the first time, individuals owning 30,681 acres of land. This brings the total acreage solicited to over 471,000 since signing of the MOA in 1997.

During the last dozen years, the City has increased its land holdings dramatically compared with pre-1997 ownership patterns. In Rondout, a high priority (entirely 1A or 1B) basin, the City has 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 factor of 12; in Ashokan, City-owned buffer lands have been tripled. Overall, City-controlled land has been expanded more than three-fold to 126,839 acres.

With the end of the formal MOA/FAD solicitation in 2004, the Land Acquisition Program (LAP) submitted to EPA a Re-Solicitation Plan (October 2003), which has been followed and whose goals have been met; an updated version for 2007 was submitted to EPA, NYSDOH, and NYSDEC. For 2008, the updated plan outlined a DEP goal of 89,500 acres (combined solicitation and resolicitation) and an additional 5,000 acres by WAC. DEP exceeded its goal by 23,715 (26.5%) as detailed in Table 4.1, while WAC states that it has met its 5,000-acre goal. Experience continues to show that repeated solicitations of the same properties over time yield worthwhile results.

Table 4.1. 2008 solicitation status as of December 31, 2008.

Solicitation Code	2008 Goal	Acres Solicited	Acres Remaining	Percent Complete
RESOL-DS	20,000	25,682	0	100%
RESOL-NS	15,000	31,067	0	100%
RESOL-RS	17,000	21,262	0	100%
RESOL-New Owner	7,500	4,512	2,988	60%
City	30,000	30,691	0	100%
	89,500	**113,215**		

As shown in Tables 4.2 and 4.3, 6,860 acres in 98 purchase contracts were signed by DEP, while 77 projects comprising 5,844 acres were closed by DEP during 2008 throughout the CAT/DEL System. An additional 1,654 acres were signed by WAC, yielding a total of 8,514 acres secured this year. As of the end of 2008, a total of 1,019 purchase contracts comprising 74,369 acres have been secured by DEP alone watershed-wide (signed to purchase contract or closed) in the CAT/DEL System.

Table 4.2. Contracts closed in the CAT/DEL System, by reporting period and real estate type.

R.E. Type	# of Contracts	Acres	Avg. Size of Project (Acres)	Purchase Price
Reporting Period: 1995 to 2007				
Fee	740	48,293	65	$149,484,464
CE	68	10,698	157	$18,119,256
WAC CE	73	14,024	192	$15,412,105
Reporting Period Subtotal	**881**	**73,016**	**83**	**$183,015,825**
Reporting Period: 2008				
Fee	64	4,501	70	$35,290,332
CE	13	1,343	103	$3,395,533
WAC CE	4	1,283	321	$1,840,735
Reporting Period Subtotal	**81**	**7,126**	**88**	**$40,526,601**
Program-to-date Sub-Totals				
Fee	804	52,794	66	$184,774,797
CE	81	12,041	149	$21,514,789
WAC CE	77	15,307	199	$17,252,840
Grand Totals	**962**	**80,142**	**83**	**$223,542,425**

Table 4.3. Contracts signed in the CAT/DEL System, by reporting period and real estate type.

R.E. Type	# of Contracts	Acres	Avg. Size of Project (Acres)	Purchase Price
Reporting Period: 1995 to 2007				
Fee	828	53,825	65	$175,491,174
CE	93	13,684	147	$26,608,716
WAC CE	77	15,307	199	$17,252,840
Reporting Period Subtotal	**998**	**82,816**	**83**	**$219,352,730**
Reporting Period: 2008				
Fee	85	5,023	59	$40,164,047
CE	13	1,837	141	$4,274,090
WAC CE	13	1,654	127	$4,086,335
Reporting Period Subtotal	**111**	**8,514**	**77**	**$48,524,472**
Program-to-date Sub-Totals				
Fee	913	58,848	64	$215,656,011
CE	106	15,521	146	$30,875,314
WAC CE	90	16,961	188	$21,339,175
Grand Totals	**1,109**	**91,330**	**82**	**$267,877,202**

Tables 4.4 and 4.5 and Figures 4.1 and 4.2 provide graphic and tabular presentations of LAP successes.

Table 4.4. CAT/DEL parcels closed or under contract as of December 31, 2008, sorted by status and reservoir basin.

Reservoir Basin	# of Parcels	Acres	Cost
Status: Signed, Not Closed			
Ashokan	18	470	$4,877,194
Cannonsville	24	2,266	$6,236,132
Neversink	2	144	$403,380
Pepacton	31	3,591	$10,746,209
Rondout	15	1,196	$4,332,535
Schoharie	39	3,363	$14,847,781
West Branch	18	158	$2,891,546
Sub-Total for Signed, Not Closed	**147**	**11,188**	**$44,334,777**
Status: Closed			
Ashokan	167	10,043	$26,889,849
Cannonsville	173	22,031	$28,540,812
Kensico	13	228	$31,440,468
Neversink	21	3,791	$4,078,137
Pepacton	164	15,914	$24,071,273
Rondout	106	6,276	$9,826,243
Schoharie	142	13,454	$25,526,651
West Branch	176	8,405	$73,168,993
Sub-Total for Closed	**962**	**80,142**	**$223,542,425**
Program Totals	**1,109**	**91,330**	**$267,877,202**

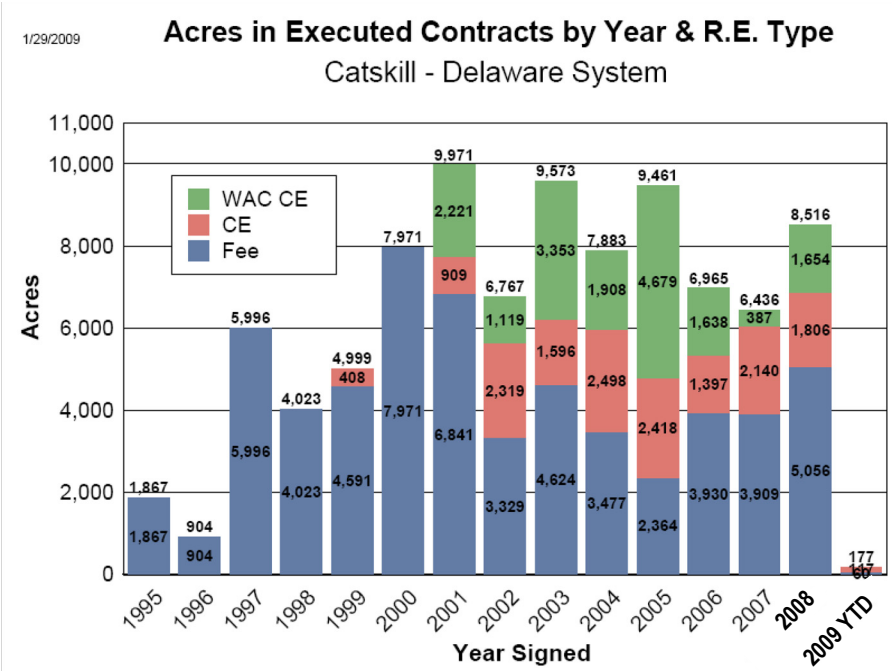

Figure 4.1 Acres in executed contracts by year and real estate type, Catskill/ Delaware System.

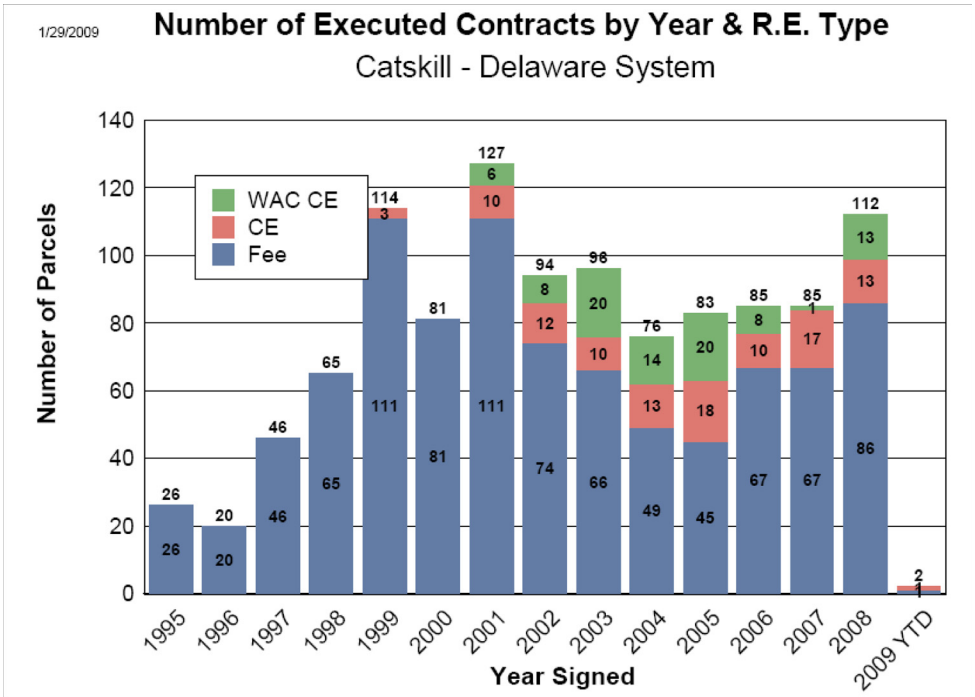

Figure 4.2 Number of executed contracts by year and real estate type, Catskill/ Delaware System.

Table 4.5. CAT/DEL parcels closed or under contract as of December 31, 2008, sorted by status and priority area.

Priority Area	# of Parcels	Acres	Cost
Status: Signed, Not Closed			
1A	6	51	$520,610
1B	32	1,361	$7,563,201
2	13	412	$4,017,464
3	31	3,239	$9,426,141
4	65	6,125	$22,807,361
Sub-Total for Signed, Not Closed	147	11,188	$44,334,777
Status: Closed			
1A	104	4,803	$31,665,420
1B	252	12,538	$89,152,881
2	139	9,229	$21,917,821
3	210	23,585	$32,162,712
4	257	29,987	$48,643,591
Sub-Total for Closed	962	80,142	$223,542,425
Program Totals	**1,109**	**91,330**	**$267,877,202**

Prior to 1997 the City controlled 1,490 acres of riparian buffers (100 feet from streams). Since 1997, the City has protected an additional 4,427 acres of buffers under fee simple acquisition and 1,339 acres under conservation easements (CEs); WAC has protected 1,413 acres through farm easements. (As reported last year, a revision to WAC's model Farm CE has expanded protection for riparian buffer strips from 15 feet to 25 feet from the stream bank, which will add on-the-ground protection to intensively farmed properties (although this is not reflected in the buffer numbers reported here).) Including lands owned by the City before 1997, the City now protects 12.0% of 100-foot stream buffers in the CAT/DEL System, roughly consistent with the percent of the watershed protected by the City. When other entities (NYSDEC, land trusts, etc.) are included, a total of 23,232 acres of stream buffers are protected, or 30.4% of the 76,322 acres of buffers calculated to exist in the CAT/DEL System (Table 4.6).

Table 4.6. Catskill/Delaware riparian buffer summary as of December 31, 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 Non-LAP Property (Pre-1997 or facility-related)	61,570.1	5.9%	1,944.0	2.5%

Table 4.6. (Continued) Catskill/Delaware riparian buffer summary as of December 31, 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
NYC-owned LAP Property (Post-1997, Fee)*	57,222.0	5.5%	4,427.2	5.8%
Land Protected by LAP NYC Conservation Easement*	15,589.2	1.5%	1,338.8	1.8%
Land Protected by LAP WAC Conservation Easement*	16,976.6	1.6%	1,412.6	1.9%
Subtotal NYC Lands and Easements	151,357.9	14.4%	9,122.7	12.0%
NY State-owned Land	206,382.3	19.7%	13,370.0	17.5%
Other Open Space (Land Trust, Municipal, etc.)	7,659.2	0.7%	739.6	1.0%
Total CAT/DEL Public Land	365,399.4	34.8%	23,232.3	30.4%
Private Watershed Lands				
Private Land	684,067.2	65.2%	53,089.9	69.6%
Total All CAT/DEL Privately-owned Land	684,067.2	65.2%	53,089.9	69.6%
Grand Total All Land in CAT/DEL	1,049,466.6	100.0%	76,322.2	100.0%

* Under contract or closed as of December 31, 2008.

**CAT/DEL includes all WOH basins plus West Branch, Boyd Corners, and Kensico.

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

Technical Program Improvements

During 2008 the City continued to improve and revise program documents and policies (subject to requirements of the MOA, FAD, WSP, and the City Code) in order to maximize program competitiveness within the marketplace.

- *Purchase Contract*: In 2008, DEP implemented a financial incentive (up to $5,000) in the model purchase contract, which is expected to appeal to landowners whose properties require subdivision before conveyance to NYC of a vacant parcel.
- *Conservation Easements (CEs)*: DEP continues to refine the model document to provide greater appeal to potential sellers while continuing to protect the City's interest in water quality. Following consultation with NYSDEC, the model CE was revised to improve integration of forestry activities on land that is both under DEP's CE and enrolled under NYS Forest Tax Law ("RPTL 480a") or similar programs. DEP expects this will further promote acceptance of the DEP CE with a certain segment of landowners.
- *Land Trusts*: the Land Trust Strategy was pursued in accordance with the 2007 FAD; in February 2008 implementation began as required by the FAD, which primarily involved consulting with land trusts about potential avenues for partnership programs. The first annual (2008) program evaluation has been submitted to USEPA and NYSDOH, and it outlines a number of challenges that must be overcome before significant progress in this area can be made.
- *Continued advances were made with regard to technical support* provided by the Land Acquisition Tracking System and the Watershed Land Information System. These systems offer tremendous productivity enhancement and efficiencies. Progress was made toward combining both systems into one, which is expected in 2009-10 and should provide further efficiencies. A number of safety and security systems for field staff were acquired, including hand-held

SPOT units (remote field-to-office communication that allows status reports) and high-band radios installed in vehicles.

DEP Conservation Easement Program

During 2008, 13 CEs totaling 1,801 acres were signed to purchase contract and 13 CEs totaling 1,343 acres were closed (Tables 4.1 and 4.2). This brings DEP's easement program in the CAT/DEL System to 106 easements closed or under contract (a total of 15,491 acres). This represents 21% of the acres protected by DEP alone.

WAC Whole Farm Easement Program

As of the end of 2008, WAC held farm easements on 77 farms totaling 15,307 acres, with executed contracts signed in 2008 on 13 farms totaling 1,654 acres. The success of the overall program to date has convinced DEP, in consultation with EPA, to add funding beyond the original $20 million for "farm" CEs (which included $10 million for "agricultural" and $10 million for "non-agricultural" land from the original $250 million Land Acquisition Program fund) allocated to date. During 2006, $7 million in new funding (from the $50 million Supplementary Fund outlined in MOA section 74) was allocated, and has since been committed by WAC to new farm easement projects. USEPA and DEP subsequently agreed that an additional $20 million from the Supplementary Fund would be directed to WAC for this program, which funds were the basis of a revised program contract that was negotiated during 2007, and approved for spending as of December 21, 2007. In a directive dated April 30, 2008, NYSDOH (as the new Primacy Agent) directed DEP to allocate the remaining $23 million from the Supplementary Fund to WAC; these funds are expected to be embodied in a revised contract by the end of 2009. The total funds committed to the Farm CE Program will at that point be $70 million. DEP is planning to extend the existing contract by at least 12 months from its termination date on March 15, 2009, and, as directed by NYSDOH, to have a revised program contract in place by the end of 2009.

WAC Forest Easement Program

The 2007 FAD mandated that DEP fund a $6 million program through which WAC was to have acquired easements on "forested portions of non-agricultural" property. The program contract was to have been executed by April 30, 2008. Negotiations began in earnest in late 2007 and continued through 2008 but unfortunately DEP and WAC could not agree on at least one fundamental element of the program—the committee voting structure (used in the Farm Easement Program since 1999)—and thus DEP is unable to proceed with this FAD deliverable. DEP has previously notified USEPA and NYSDOH and discussed with them the status of this situation. DEP's position is that while failure of the pilot program is unfortunate, its loss should not significantly hamper success of DEP's effort to protect land or acquire conservation easements through its own program.

Land Acquisition in the Croton System

With almost all of the $38.5 million allocated to this program having been spent or committed, DEP's acquisition program in the Croton System as envisioned by the original FAD and MOA is virtually complete. A total of 24 projects (1,637 acres) were acquired using these funds, with one project (269 acres) remaining under contract yet to close. In addition, the following Croton acquisitions were made—some by non-City entities—using City funding from sources external to LAP's dedicated "Croton" funds:

- 189 acres in Priority C (Middle Branch Reservoir basin, Town of Southeast) were acquired by Putnam County using Water Quality Infrastructure Program (WQIP) funds (see MOA Section 140), and protected with a farm easement donated to WAC
- 574 acres in Priority C (Amawalk, Middle Branch and East Branch Reservoir basins, Towns of Carmel, Patterson, and Southeast) were acquired by Putnam County using WQIP funds, protected by deed restrictions benefiting the City or by CE held by the Town
- An 87-acre CE acquired in 2003 by the City using "Cat-Del" funding included 25 acres in the Croton System (New Croton Reservoir basin, Priority A, Town of New Castle), with the remainder in Kensico (Priority 1B, Town of New Castle)

DEP funding sources have thus secured a total of 2,694 acres in the Croton System.

Water Supply Permit

The current permit remains active through January 20, 2012; the 2007 FAD requires DEP to apply to NYSDEC for a new 10-year permit by January 21, 2010. During 2008 DEP began preparations for SEQRA review procedures that will take place during 2009.

Transfer of Conservation Easements on Fee Acquisitions to NYS

During 2008, 25 CEs covering 300 newly-acquired DEP properties (19,577 acres) were submitted to NYSDEC. Submissions to DEC now total 45 CEs covering 546 parcels (36,041 acres).

4.3 Land Management

Background

The City's land management approach, designed to provide effective and professional management, has six major areas of concentration:

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

DEP has four goals for managing City land:

- 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.

4.3.1 WaLIS

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.

In 2008, DEP entered into an agreement with Hunter College of the City University of New York, under which the college will provide a Program Analyst/Data Manager to serve as the interface between DEP staff and PAR Government Services contractors for continued WaLIS development. This individual will assess the needs of program staff and facilitate the completion of the needed programming needed to accomplish these needs. DEP creates and acquires data in support of the City's existing watershed protection programs and future evaluation of those programs. This position will complement the next phase of the WaLIS project, in which a contract has been entered into with PAR Government Services.

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 13 easement properties totaling 1,344 acres to its growing portfolio in 2008. 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 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.

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. Since the beginning of the stewardship program, the vast majority of inspections have been either focused or full inspections. In 2008, DEP completed aerial inspections on 38 easements West of Hudson; DEP found that these inspections work very well in conjunction with a complete inspection. Many of DEP's easements are large, so the aerial perspective makes it possible to cover a greater extent of the property. Had potential violations been observed, DEP would have followed up with an immediate site visit.

Activity Approvals

Many activities, such as forestry, bluestone mining, and agriculture, which are permitted by DEP easement, require notice to and approval by DEP. The landowner must submit a proposal for the activity; DEP must then 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 past three years, DEP has begun writing easements to permit more activities "as of right" than it had in earlier 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 permit livestock, tilling and plant-

ing 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 2008 is shown in Table 4.7.

Table 4.7. Number and types of reserved rights approved on DEP easements in 2008.

Activity (exceeding thresholds)	Number pre-closing reviews/ approvals	Number post-closing reviews/ approvals
Forestry	4	5
Pond building and maintenance	4	0
Agricultural	6	0
Livestock	4	0
Utilities	2	0

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. There were no violations in 2008 and two violations from 2006 and 2007 were resolved to the full satisfaction of DEP.

Watershed Agricultural Council Farm Easements and Stewardship

DEP continues to provide an oversight and advisory role on WAC's farm easement stewardship activities. As WAC's farm easement portfolio continues to grow, its stewardship responsibilities increase as well. In 2008, WAC hired a dedicated stewardship staff member to help address the growing need for stewardship and activation of reserved rights. WAC, with assistance from DEP, developed several stewardship policies including subdivision and amendments.

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. Once lands are acquired they must be managed in a manner that ensures long-term water quality protection and proper use (including recreation).

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. 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 permitted uses. For 2008, the miles of boundary line painted and posted, as well as site visits made to properties, is shown in Table 4.8. Table 4.9 shows the number and acreage of full inspections completed in 2008 by field offices.

Table 4.8. Miles painted and posted and site visits made in 2008 by field offices.

Operations Field Office	Number of miles painted	Number of miles posted	Number of site visits
Shokan	35	25	8
Downsville	109	70	79
Grahamsville	68	9	86
Schoharie	120	73	217
EOH	86	2	0
Total	418	179	390

Table 4.9. Number and acreage of full inspections completed in 2008 by field offices.

Field Office	Number of inspections	Acres of full inspections
Shokan	234	25,702
Downsville	148	27,438
Grahamsville	116	14,232
Schoharie	146	15,769
EOH	243	19,419
Total	805	102,560

Encroachments

Discovering and then addressing encroachments on 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. 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.

Work continued in 2008 on identifying and resolving encroachments. Two in particular are worth noting. The "Catucci" encroachment involved significant trespass onto City land including buildings, trails, tree clearing, dumping, and theft of City property. The estimated damage to City property has been more than $100,000. DEP began legal action and filed a summons and complaint and subsequent default motion papers. The defendants made a proposal to settle out of court, and DEP anticipates this will occur in 2009. The "Sclafani" encroachment involves unauthorized and significant use of City property by owners of land adjacent to City property. DEP is attempting to resolve this encroachment with the landowners rather than seek a remedy through the court system. The property owners have constructed several buildings, a parking lot, and a retention pond on City property for commercial uses. While investigating the encroachments, DEP discovered ambiguity in the City's property line boundary, and this will be addressed as part of the comprehensive resolution.

Local Consultation

As part of the 1997 MOA, DEP is required to consult with the town or village in which an acquired parcel is located. The consultation ensures that the City is aware of and considers the town's or village's interests, and that the terms of the land acquisition program agreed to by the parties are complied with. DEP develops a "community review fact sheet" and a property map for each acquisition and sends a copy to the affected town or village. The fact sheet contains information important to the town, such as "natural features criteria, structures present, security/safety issues, and the proposed recreational uses". The town can then respond and DEP will consider the comments and respond as appropriate. In 2008, DEP sent 59 community review fact sheets and maps to local communities for review and comment.

Reservoir Cleanups

DEP holds reservoir cleanup events with different partners annually. In 2008, DEP held nine reservoir cleanups on seven City reservoirs. Partners included such groups as Something Good, Northern Sportsman's Club, Boy Scout Troop 9, Catskill Heritage Alliance, Girl Scouts, Village of Brewster Police and Mayor's Office, Rondout Valley School, and local residents. Over

120 bags of trash were collected by participants and then disposed of by DEP. These events are important in helping to remove garbage and debris from reservoirs while at the same time building community relationships and fostering participation. They are also used as educational forums to talk about the importance of watershed protection. Two tree-planting events were also held in 2008 in which students from local schools planted saplings along riparian areas on City land. DEP supplied the trees and staff to assist. More information about additional activities can be found in Chapter 9 (Outreach and Education).

Figure 4.3 Children participating in a cleanup event on New Croton Reservoir.

4.3.4 Recreation

The undeveloped lands that DEP owns 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 affecting the City's water supply. Thus, DEP carefully evaluates potential recreational opportunities on each parcel.

Figure 4.4 New PAA sign on a City-owned property in the Town of Middletown.

In 2008, a new recreation designation called Public Access Areas (PAAs) was initiated that permits recreational users to utilize City lands without a DEP Access Permit, Hunting Tag, or Vehicle Mirror Hanger, for fishing, hiking, hunting, and trapping on City land west of the Hudson River. To allow for these designations, DEP had to amend its "Rules for the Recreational use of Water Supply Lands and Waters", which included holding public hearings and receiving comments following a comment period. In addition to PAAs, other modifications included allowing year-round boating on many East of Hudson reservoirs (during ice-free periods), hunting of all species allowed by NYSDEC, lowering the allowed hunting age from 14 to 12 (to be consistent with NYSDEC hunting regulations), and establishing trapping as an allowed use. Another new recreation designation is the Designated Use Area. These are areas that DEP will open for specific recreational uses (e.g., walking, bicycle riding, roller-blading) on a site-by-site basis and where no DEP Access Permits will be required. Designated Use Areas will include DEP lands that have been traditionally open for public use such as the Ashokan Walkway.

Sixty new PAAs were opened in five counties, totaling over 13,000 acres. The majority of the PAAs were properties adjacent to NYSDEC lands, but DEP also opened lands that were not. Properties that were acquired towards the end of 2008 were also opened as PAAs. The response from stakeholders has thus far been very positive. NYSDEC provided DEP with 10,000 PAA signs and provided some assistance in installing them (Figures 4.4 and 4.5).

Figure 4.5 NYSDEC and NYCDEP staff posting new PAA signs.

Cannonsville Boating Pilot Project

In 2008 DEP began planning for a pilot program to expand recreational boating opportunities on the Cannonsville Reservoir. A committee was formed and a kick-off meeting was held to initiate development of the program. The committee consisted of various DEP staff, the Delaware County Chairman of the Board of Supervisors, the Town Supervisors of the Towns of Tompkins and Deposit, the Delaware County Watershed Affairs Commissioner, representatives from the USEPA, NYSDEC, and NYSDOH,

and the Catskill Center for Conservation and Development. The committee used a collaborative, consensus building approach as it studied the issues and constructed the program. It analyzed the mission, researched facts, conducted site visits, developed and analyzed alternatives, and formulated recommendations, while seeking and obtaining input from numerous stakeholders at invitational meetings and throughout the process. The committee considered all input from all sources to better refine the proposed program. Ultimately, it decided to allow several different types of watercraft to be launched from several specified sites around the reservoir, including one site from which the launching of small sailboats would be allowed. Launch sites were coordinated with the NYSDEC to prevent conflict with nesting eagles and with the NYSDOT to allow safe access along NYS Route 10. Under the proposed plan, individuals age 16 and older would be required to obtain individual DEP Access Permits and boat tags would be issued to boaters after they had steam cleaned their vessels and appurtenant devices (oars, paddles, sails). Boaters would be able to secure temporary (7 days or less) or seasonal (the entire summer season) boat tags. Steam cleaning services would be provided by several local vendors, who would be trained and certified by DEP before performing the service. The program would run from Memorial Day through Columbus Day each year for three successive years starting in 2009, and would be evaluated for improvements along the way. The Watershed Recreation Rules are being amended to include the program.

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 by 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, which was conducted in 2003 to assess the overall condition of DEP forests, indicated that the majority of the forests are 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. During 2008, 12 forest management projects were planned, implemented, or completed in five of the 19 basins in the watershed. The objectives of these projects included improving ecosystem functions, promoting forest regeneration, tending the forests through selective thinnings, and salvage from weather-related events. Treatments to a

total of 205 acres were completed in 2008, while treatments to an additional 385 acres were in operation in 2008 and will continue into 2009. Between projects completed in 2008 and those continuing into 2009, approximately 1,392,200 board feet of timber are being harvested .

Table 4.10 provides a breakdown of forestry projects in 2008.

Table 4.10. Forestry projects completed in 2008, in progress in 2008 and continuing in 2009, and in the planning stage for 2009.

Project Name	Basin	Project Area	Estimated Board Feet
Projects Completed			
Rondout Borrow Pit	Rondout	40	77,400
Pickerel Point	Ashokan	165	535,400
TOTALS		205	612,800
Projects In Progress			
Neversink Borrow Pit	Neversink	75	203,000
VanSteenburg Cove	Ashokan	90	245,500
Murphy Hill #2	Pepacton	70	229,800
Burns Cove	Ashokan	65	101,100
TOTALS		300	779,400
Projects In Planning Phase			
Davis Bend	Ashokan	45	111,500
South Rondout	Rondout	60	128,800
Hogsback	Neversink	75	NA
Acorn Hill	Ashokan	90	NA
Ashalter Fields	Neversink	40	NA
Ol' McCume	Pepacton	75	NA
TOTALS		385	240,300

Forest Management Plan

The 2007 FAD required DEP to "develop and submit a forest management plan" by November 30, 2011. Significant progress was made towards this deliverable in 2008. DEP Forestry staff and others developed the parameters needed for a comprehensive forest inventory and forest management plan of all City-owned lands. Unlike most other large forested water suppliers,

DEP has not conducted a comprehensive inventory and associated forest management plan. DEP is close to finalizing an agreement with the United States Forest Service (USFS) to conduct the inventory and develop the associated forest management plan.

Carefully planned forest management can help the City improve the watershed forest's resistance to and recovery from catastrophic events, enhance erosion control, create and maintain recreational opportunities, reduce liability exposure from forest safety hazards, and provide economic benefit to watershed communities. Forest management also allows the City to create value from its sizable investment in land while mitigating asset value deterioration that naturally occurs as forests age. Comprehensive forest management planning enhances the protection of the ecological systems that provide the City's drinking water by facilitating landscape-level decision making.

The goal of the data analysis and plan development is to provide comprehensive planning for forest management, which will guide the work of DEP watershed foresters and other staff in securing long-term source water protection through responsible, sustainable management of New York City's vast forested watershed lands. Implementation of this plan helps to ensure that forest management will be consistent with the City's water quality goals, and will be based on current and accurate knowledge of existing forest conditions.

Watershed forest management planning is necessary to support DEP's management of over 94,000 acres of City-owned terrestrial water supply lands. The initial part of the planning process is a comprehensive inventory of forest resources. The Watershed Forest Management Plan will include analysis, summary, and presentation of the forest inventory data, as well as related land and natural resource information. The Plan will provide directives for practical, sustainable, science-based management of City-owned forested watershed lands, with the overall goals of protecting public health through source water protection, maintaining or enhancing ecological integrity, and providing economic benefits to watershed communities. On-the-ground inventory work, covering approximately 9,400 inventory plots, should begin in April 2009 and be completed in the fall of 2010.

4.3.6 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. Farmers can now submit a proposal on how they would farm City-owned land while protecting water resources. Candidates for this expansion of agricultural activity are typically existing properties that were farmed up until the time 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 manage-

ment plan. Most of the farmers using City-owned land are enrolled in the Watershed Agricultural Council's Farm 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 16 crop and maple tapping projects in 10 different towns totaling over 500 acres. New agricultural projects for 2008 are shown in Table 4.11.

Table 4.11. Projects initiated in 2008 for the agricultural use of City land.

Project #	Type	Town	Acres
1822	Livestock	Bovina	25
1823	Corn/hay	Bovina	14
1825	Vegetables	Yorktown	5
1827	Hay/corn	Stamford	35
1828	Hay	Stamford	50

4.3.7 Invasive Species Control

DEP established an Invasive Species Working Group in December 2008. The working group's primary goal is to develop and implement an agency-wide, science-based, comprehensive plan to identify, prioritize, and address invasive species threats. Specifically, the plan will be 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 ways that anticipate future threats, and (6) build a framework for invasive species outreach and education. The working group is also charged with staying abreast of emerging issues, and serving as a forum for information exchange, rapid response needs, and budget prioritization.

In March 2008, the NYSDEC Office of Invasive Species awarded $50,000 in matching funds to the Eastern New York Chapter of The Nature Conservancy, in partnership with DEP and the Catskill Regional Invasive Species Partnership (CRISP), for a proposal entitled "Detecting and Eradicating High Threat Invasive Plant Species in the Catskill Region". The proposal was co-authored by DEP and the Eastern New York Chapter of The Nature Conservancy. CRISP is one of eight voluntary regional partnerships that are forming across the state in response to the recommendations of the New York State Invasive Species Task Force.

The primary goal of the project is to establish a framework in the WOH watersheds and Catskill Region for reducing the threat of invasive plant species, in order to sustain ecosystem services including high quality drinking water, timber products, and recreational opportunities. The project has two eradication objectives and two early detection/rapid response objectives: 1) eradi-

cation of swallow-wort (*Cynanchum rossicum*) on DEP land in the Pepacton Reservoir basin near Margaretville, NY, by 2010, 2) eradication of bush honeysuckle (*Lonicera morrowii* and *L. tatarica*) from a wetland at The Nature Conservancy's Lordsland Conservancy in Otsego County that supports a globally rare, NYS S2-listed wetland plant population (Jacob's-ladder, *Polemonium vanbruntiae*), 3) establishment of a regional early detection/rapid response program, through invasive plant surveys, followed by eradication efforts, for a set of priority invasive plant species with a limited distribution, and 4) delineation of two large, unfragmented, forested "Weed Prevention Areas" in the Catskill Region.

In 2008, the first year of the grant project, two Student Conservation Association interns were hired for three months to carry out priority invasive plant surveys and outreach in addition to manual control of swallow-wort and bush honeysuckle. The Catskill Center for Conservation and Development provided office space and logistical support for the interns. Over the course of 2008, five previously unknown occurrences of pale swallow-wort in the West of Hudson watershed were discovered. These occurrences were mapped and reported to CRISP.

Invasive Species Management

In April 2008, the DEP Invasive Species Coordinator worked with NYSDEC Forest Health foresters to investigate a report of Asian Longhorned Beetle in Tivoli, N.Y. (approximately 25 miles from the WOH watershed boundary). The ground survey was conducted prior to tree leaf emergence using spotting scopes. No evidence of Asian Longhorned beetle was found.

With funding from the NYSDEC Terrestrial Invasive Grant Program, the second year of a multi-year swallow-wort control effort was completed on City-owned land in the Pepacton Reservoir basin. Herbicide treatment of the Pepacton site was completed by a pesticide applicator contractor under DEP supervision. Garlon 4 (triclopyr) was applied as a foliar spray to swallow-wort in the forested upland area, and a foliar spray of Roundup Pro (glyphosate) was applied to plants in the riparian zone. Funding enabled DeP to treat the site twice during the growing season, as recommended.

DEP also began the first year of treatment of three high priority invasive plants on City land, initiating control of Giant Hogweed (*Heracleum mantegazzianum*) in the Croton Falls basin, Mile-a-Minute Weed (*Persicaria perfoliata* L) in the Cross River basin, and Japanese barberry (*Berberis thunbergii* L.) at a forest improvement project in the Ashokan basin. Door-to-door outreach to residents was conducted near the Giant Hogweed and Mile-a-Minute sites in an effort to increase public awareness and understanding of invasive species issues and DEP concerns.

The DEP Invasive Species Coordinator continued to work with CRISP and began attending meetings of the Lower Hudson Partnership for Regional Invasive Species Management (PRISM) . In December 2008, CRISP partners organized winter training in Asian Longhorned

beetle identification for its members, spurred by concern about the potential transport in 2008 and earlier of Asian Longhorned Beetle to New York State campgrounds from Worcester, MA, via infested firewood.

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 non-point sources of agricultural pollution without compromising the farm's economic viability.

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

The WAP is administered locally by the Watershed Agricultural Council (WAC) using funding provided in large part by New York City. Over time, WAC and DEP have leveraged generous financial support from non-City sources to complement and enhance the WAP, particularly from the United States Department of Agriculture (USDA), Environmental Protection Agency (EPA), and Army Corps of Engineers. Local, state, and federal agricultural agencies provide planning and engineering services, technical assistance, educational programs, and scientific and administrative support through WAC sub-contracts, 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 (EOH) programs (including new WFPs and the implementation of existing WFPs); status and summary of annual status reviews (ASRs) for all participating farms; WAC farm recruitment activities; progress in soliciting new acres in the Conservation Reserve Enhancement Program (CREP); implementation plans for the subsequent year (including the number 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 the WAP based on certain criteria.

4.4.1 FAD Program Goals

Table 4.12 summarizes the accomplishments of the WAP through 2008 (see also Figures 4.6 and 4.7, which document the extent of WFPs with commenced implementation, large farms that are substantially implemented, and farms that completed Annual Status Reviews in 2008).

Table 4.12. Summary of WAP accomplishments as of December 31, 2008.

Task	Farms	Sub-Farms	Total Farms
Current number of known watershed large farms	266	41	308
Current number of eligible large farm sign-ups	254	41	295
Current number of WFP implementation agreements	248	41	289
Total WFPs substantially implemented	223	29	252
Active	163	27	190
Inactive	60	2	62
Number of WFP annual follow-ups (2008 only)	216	30	246
Total WFP implementation agreements on small farms	65	0	65
WFPs approved during 2008	10	0	10
Total WFP implementation agreements on EOH farms	44	0	44
WFPs approved during 2008	6	0	6

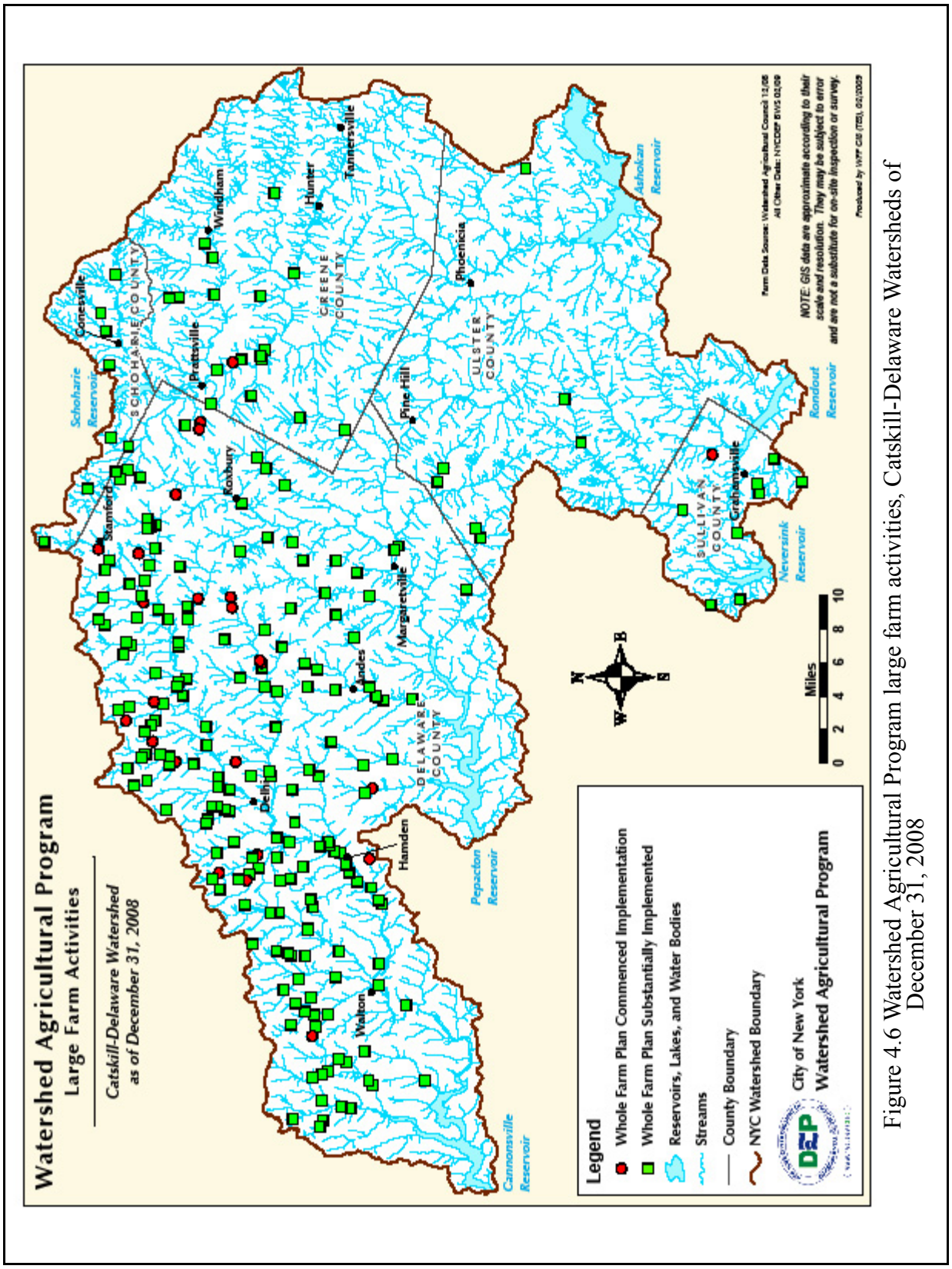

Figure 4.6 Watershed Agricultural Program large farm activities, Catskill-Delaware Watersheds of December 31, 2008

4.4.2 Large Farm Program

There are 289 large farms (including 41 sub-farms) with WFP implementation agreements, representing 94% of all known commercial farms in the watershed and 98% of the large farms participating in the WAP. These figures include two new large farms that signed up for the WAP during 2008 and are expected to have WFPs developed and approved within the next few years.

Farms Substantially Implemented (SI). Through 2008, 252 farms have reached the SI milestone at least once, which represents 81.8% of the 308 known large farms in the watershed. The 2007 FAD requires that 90% of all active large farms in the West of Hudson Watershed have SI WFPs beginning September 30, 2010. There are 15 high priority WFP revisions scheduled for 2009, of which DEP anticipates at least half will become SI as a result.

It is important to recognize that farms are dynamic enterprises and a farm that meets the SI definition one year may not meet the definition the following year. This can be due to several reasons: a delay in implementation; a planner identifying new environmental issues on the farm; the farm expands; the farmer changes his or her enterprise; the farmer is reluctant to proceed with implementation. In response to last year's annual report, DEP and WAC have begun tracking those farms that no longer meet the SI definition. Of the 252 farms that reached the SI milestone at least once, approximately 78 farms (including 19 sub-farms) no longer meet the definition. These 78 farms include:

- 21 farms that experienced a delay in implementation
- 50 farms with newly identified BMPs
- 3 farms for which (a) and (b) are true
- 4 farms with unfunded streambank projects only

During 2008, 21 WFP revisions were approved and 247 BMPs were installed at a cost of $ 1,914,754 (Table 4.13) on large farms in the West of Hudson Watershed.

Table 4.13. Implementation of BMPs on West of Hudson large farms during 2008.

BMP Code	Best Management Practice	No. of BMPs
313	Waste Storage Facility (includes repair)	3
314	Brush Management	2
328	Conservation Crop Rotation	2
362	Diversion	1
382	Fencing	17
391	Riparian Forest Buffer	15
393	Filter Strip	4
395	Stream Restoration	1
412	Grassed Waterway	2

Table 4.13. (Continued) Implementation of BMPs on West of Hudson large farms during 2008.

BMP Code	Best Management Practice	No. of BMPs
468	Stonelined Waterway	1
512	Pasture & Hayland Planting	3
516/614	Pipeline & Trough/Watering Facility	12
528	Prescribed Grazing	6
558	Roof Runoff Management System	2
560	Access Road	9
561	Heavy Use Area Protection	7
574	Spring Development	14
575	Animal Trails & Walkway	11
580	Streambank Protection	1
587	Structure for Water Control	1
590	Nutrient Management Plan	55
606	Subsurface Drain	3
612	Tree & Shrub Planting & Natural Regeneration	17
620	Underground Outlet	3
633	Waste Utilization	46
634	Waste Transfer System	2
707	Barnyard Water Management	1
3010	Roofed Barnyard - Feeding Pad	1
3110	Calf Greenhouse	1
3175	Enhanced Nutrient Management Credit	4
Total Large Farm BMPs Implemented		247
Total Large Farm BMP Cost		$1,914,753

Annual Status Reviews (ASRs). The 2007 FAD requires that ASRs be completed on all farms with substantially implemented WFPs. Two hundred forty-three large farms met the substantially implemented definition at least once in 2007 and therefore required an ASR in 2008. The WAP completed 232 ASRs on large farms, which included 223 of the required farms (Figure 4.7). DEP has requested that WAC submit a report that explains why this FAD milestone was not met and established a new deadline of February 28, 2009 to complete all the required status reviews. All status reviews were complete by the revised deadline. DEP plans to work with WAC in 2009 to establish a plan to ensure that this milestone is met in the future.

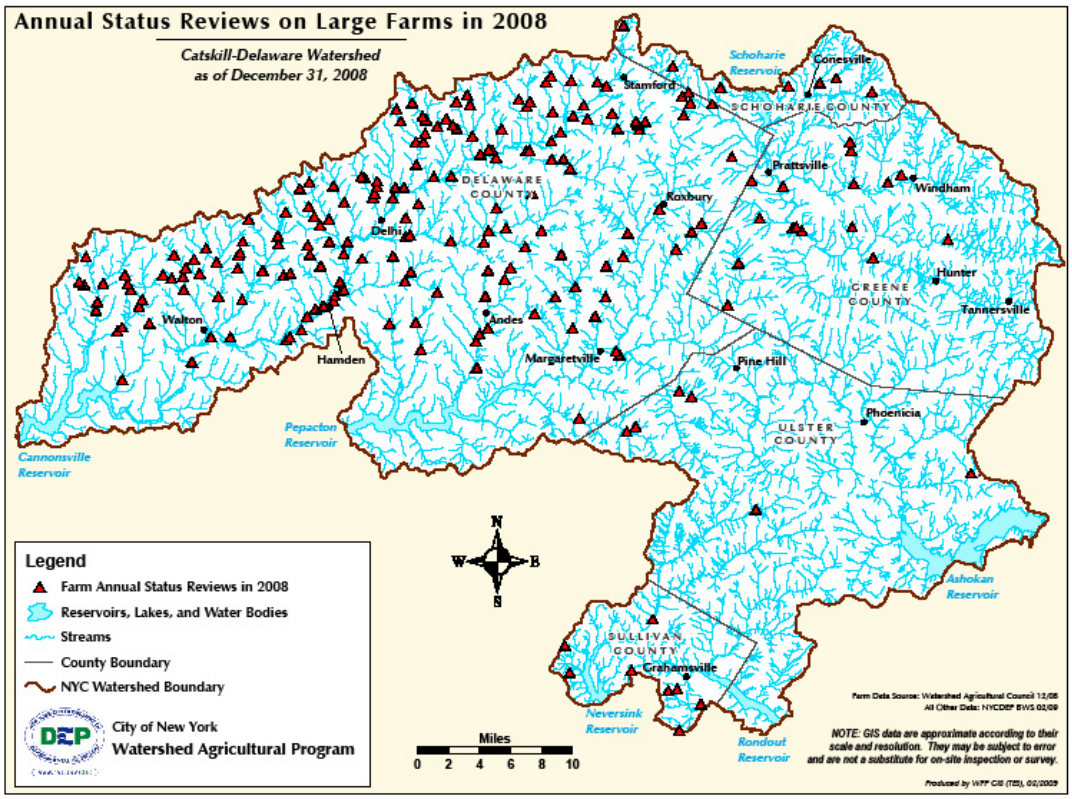

Figure 4.7 Annual status reviews on large farms, Catskill-Delaware Watershed as of December 31, 2008.

4.4.3 WAC Farm Recruitment Efforts

Two new large farms signed up to participate in the WAP during 2008 and WAC approved one new large farm WFP. WAC also sponsored an annual program participant recognition event which serves the important purpose of recruiting new farmers into the program. WAC has signed up 95.7% (295 farms) of all the known commercial farms (308) in the watershed.

4.4.4 Farmer Education Program

The WAP provides educational opportunities for watershed farmers through the Farmer Education Program implemented by WAC and Cornell Cooperative Extension (CCE). In 2008, 18 classrooms and on-farm educational programs were sponsored, which included classes on nutrient management, no-till crop production, rotational grazing, pasture management, estate planning and other topics. The classes were attended by nearly 500 total participants, including 232 watershed farmers and 105 farmers from outside the watershed.

4.4.5 Small Farm Program (West of Hudson)

In 2008, WAC approved 10 new small farm WFPs, which meets the annual FAD goal. A total of 65 small farm WFPs have been approved to date (Figure 4.8), of which 49 have commenced BMP implementation and 14 have had all identified pollutant issues addressed. During 2008, 60 BMPs were implemented on small farms at a cost of $225,757 (Table 4.14) and 27 ASRs were completed. A total of 655 BMPs have been implemented on small farms at a cost of over $2.2 million.

Table 4.14. Implementation of BMPs on West of Hudson small farms during 2008.

BMP Code	Best Management Practice	No. of BMPs
362	Diversion	1
382	Fencing	7
391	Riparian Forest Buffer	4
516/614	Pipeline & Trough/Watering Facility	4
560	Access Road Improvement	2
561	Heavy Use Area Protection	2
574	Spring Development	5
578	Stream Crossing	1
580	Streambank Protection	1
587	Structure for Water Control	1
590	Nutrient Management Plan	12
612	Tree & Shrub Planting & Nat. Regeneration	5
620	Underground Outlet	1
633	Waste Utilization	12
NA	Dump Wagon	1
NA	Portable Run-In Shed	1
Total Small Farm BMPs Implemented		60
Total Small Farm Implementation Cost		$225,757

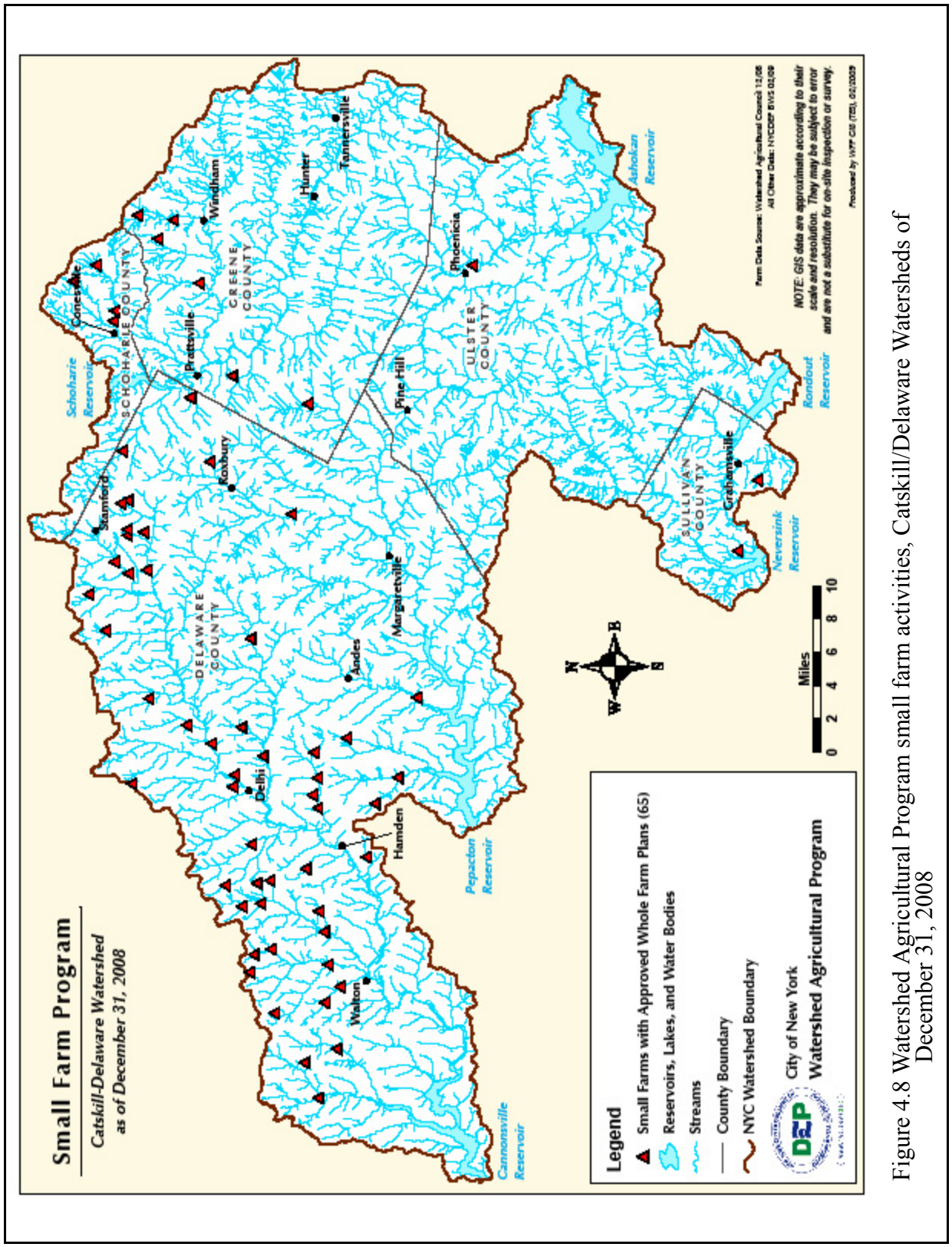

Figure 4.8 Watershed Agricultural Program small farm activities, Catskill/Delaware Watersheds of December 31, 2008

4.4.6 East of Hudson (EOH) Agricultural Program

In 2008, WAC approved 6 new WFPs for EOH farms, which meets the annual FAD goal. A total of 44 WFPs have been approved to date (Figure 4.9), of which 35 have commenced BMP implementation. During 2008, 64 BMPs were implemented on EOH farms at a cost of $563,552 (Table 4.15) and 33 ASRs were completed. A total of 341 BMPs have been implemented on EOH farms to date at a cost of over $2.11 million.

Table 4.15. Implementation of BMPs on East of Hudson farms during 2008.

BMP Code	Best Management Practice	No. of BMPs
317	Manure Composting Facility	2
340	Cover Crop	1
342	Critical Area Planting	3
382	Fencing	3
390	Riparian Herbaceous Cover	1
412	Grassed Waterway	2
468	Stonelined Waterway	1
516/614	Pipeline & Trough/Watering Facility	8
528	Prescribed Grazing	3
558	Roof Runoff Management System	8
560	Access Road	4
561	Heavy Use Area Protection	6
578	Stream Crossing	1
587	Structure for Water Control	3
590	Nutrient Management Plan	1
620	Underground Outlet	5
633	Waste Utilization	1
635	Wastewater Treatment Strip	5
707	Barnyard Water Management System	1
719	Waste Infiltration Area	1
3310	Farm Fueling Facility	4
Total East of Hudson BMPs Implemented		64
Total East of Hudson BMP Cost		$563,552

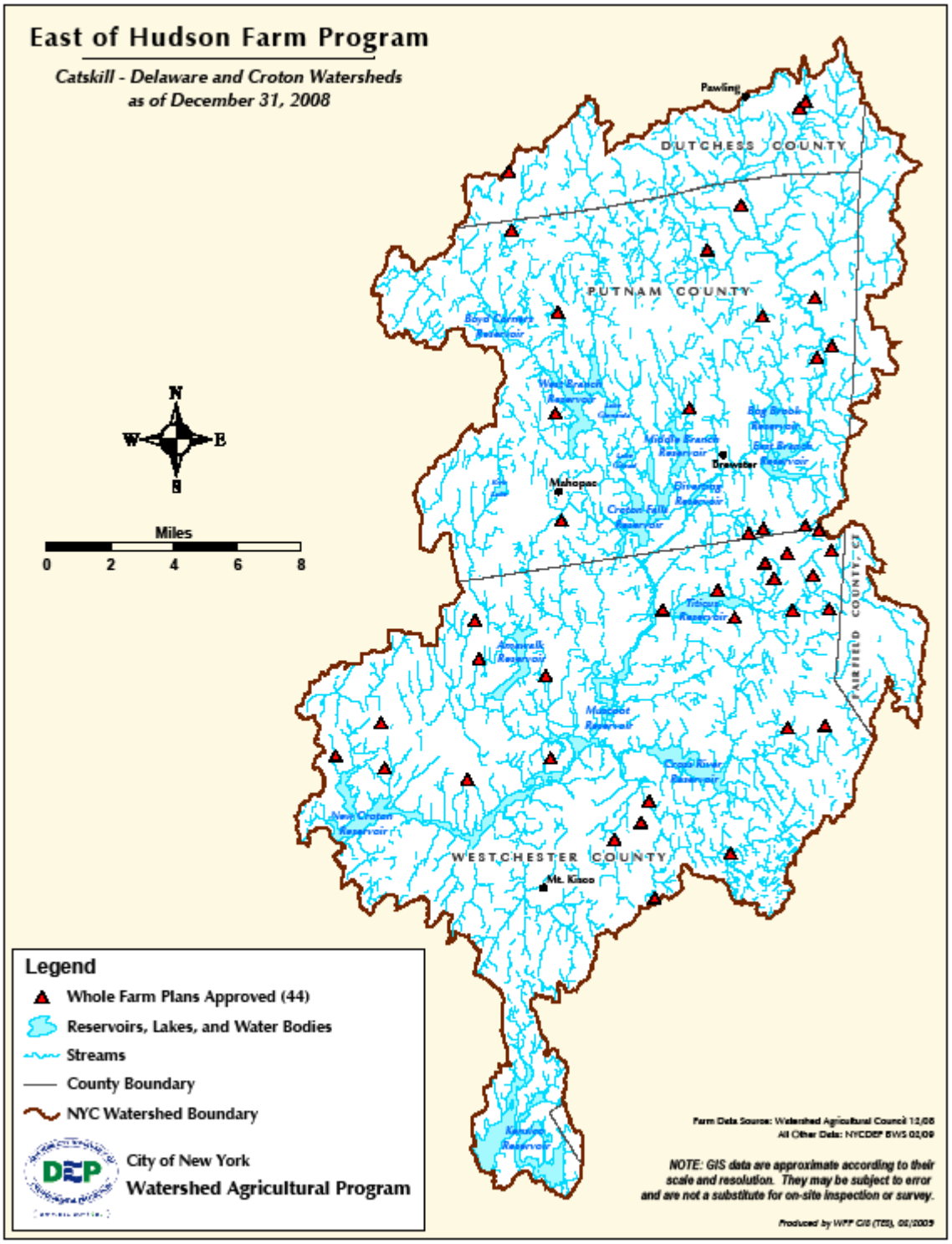

Figure 4.9 East of Hudson Farm Program, Catskill-Delaware and Croton Watersheds as of December 31, 2009

4.4.7 Implementation Plan for 2009

The 2007 FAD requires DEP to annually report on the WAP implementation plan for the subsequent year, including the numbers and types of BMPs to be implemented, estimated cost of these BMPs, nutrient management plans to be created or revised, and WFP revisions to be completed. During 2009, the WAP has the following goals:

- Implement 225 BMPs on large farms at a total estimated cost of $2,059,513
- Implement 115 BMPs on small farms at a total estimated cost of $483,000
- Implement 89 BMPs on EOH farms at a total estimated cost of $860,433;
- Complete 63 new or updated nutrient management plans
- Revise 15 high priority large farm WFPs and 11 small farm WFPs

4.4.8 Nutrient Management Planning (NMP)

The WAP Nutrient Management Team (NMT) completed 55 new and updated nutrient management plans on large farms and 14 for small farms in 2008. In the WOH watershed there are 168 active large farms following an NMP. Of these, 156 (93%) with 13,763 animal units have NMPs that were developed within the last three years.

The Nutrient Management Credit Program had a very successful year. Eighty-two participants (one farm chose to withdraw from the program) submitted their manure spreading records, which indicates a nearly 99% compliance with the recommendations in their NMPs. The nutrient management plans for these 82 farms include 25,183 acres of cropland, hayland, and pasture. Additional farmers will be invited to participate in the coming year to ensure that the program is offered to at least 80 Cannonsville basin farmers.

4.4.9 Conservation Reserve Enhancement Program (CREP)

A total of 1,928.8 acres of riparian forest buffers are currently under a CREP contract, which includes 43.6 new acres that were enrolled in 2008 (Figure 4.10). In addition, more than 200 acres of riparian buffers have been approved by WAC and are currently in the CREP contract development pipeline. Out of the 184 CREP contracts, 172 are complete with all associated BMPs implemented. The Delaware County Soil and Water Conservation District estimates that CREP has excluded more than 10,000 head of livestock (mainly dairy and beef cows) from watershed streams and protected approximately 185 stream miles.

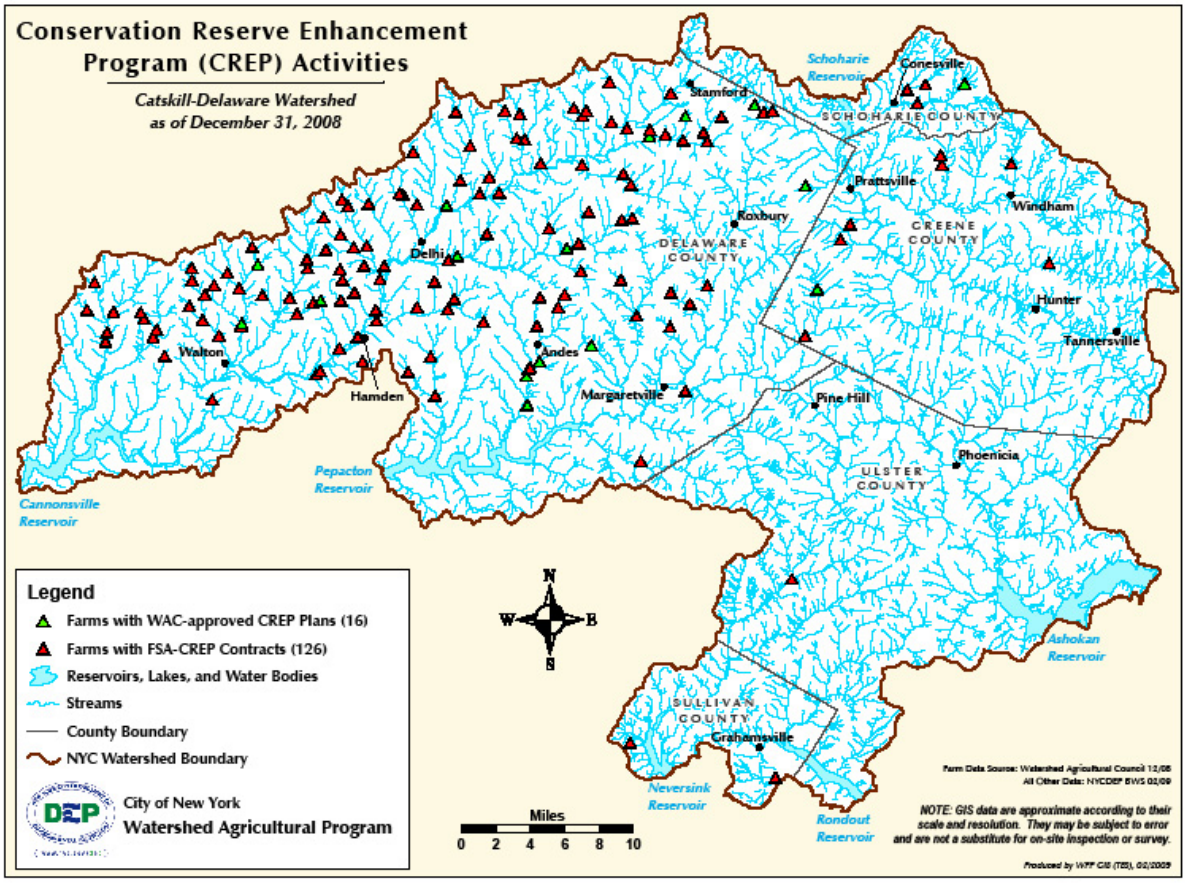

Figure 4.10 Conservation Reservoir Enhancement Program (CREP) activities, Catskill-Delaware Watershed, as of December 31, 2008.

In 2008, the New York City CREP Memorandum of Agreement between the City, New York State, and USDA was extended through 2012 to coincide with the term of the 2008 Farm Bill.

It is worth noting that in 2008, the first New York State CREP contract was approved for a 3.3-acre buffer on an EOH horse farm in the Town of Pawling.

4.4.10 WAC Agricultural Easement Program

Please refer to the Land Acquisition Program section of the report (Section 4.2).

4.4.11 WAP Evaluation

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 methodol-

ogies, 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 the WAP in a report due December 31, 2010.

In the interim, the WAP continues to be an effective and successful pollution prevention partnership as measured by the current numeric FAD metrics described in this report, and especially by the continued high level of participation and support within the watershed farming community. In 2008, DEP and WAC completed negotiations on a new 46-month contract that extends the Watershed Agricultural Program into 2012.

4.4.12 Related Research Activities (City and non-City funds)

In July 2008, WAC entered into a 19-month contract with PAR Government Systems Corporation to develop and implement a comprehensive database management system (CDBMS) that will provide WAC with a centralized approach to storing, managing, searching, and accessing data. The CDBMS will store all of WAC's programmatic and departmental data in order to better serve the needs of researchers in support of the Watershed Agricultural & Forestry Program, as well as its own needs for program evaluation and assessment. The current phase of this database project is scheduled to be completed by June 2009 and includes the purchase of hardware and software. The final phase is scheduled to be completed by February 2010.

Since the WAP strives to make effective on-farm planning and BMP implementation decisions based on sound science, WAC also supports 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. The following are abstracts of research papers that were released in 2008 related to agricultural research conducted in the watershed.

Abstract

The Cannonsville Reservoir watershed is a major component of the unfiltered New York City water supply system. The voluntary, incentive-based Watershed Agricultural Program is a collaborative effort among producers, and federal, state, and local organizations to address the problem of phosphorus loading effects on water quality through implementation of whole farm plans. The effectiveness of selected conservation practices, including streambank fencing, precision feeding, and the use of cover crops with silage corn (*Zea mays* L.) are being evaluated. Simulation models have been developed and improved to evaluate the effectiveness of individual conservation practices and better assess animal agriculture and manure management practices. Conservation practices implemented through the Watershed Agricultural Program are resulting in

lower phosphorus loading from nonpoint sources in the watershed. Future efforts need to identify the most cost-effective conservation practices and extend our knowledge of watershed quality protection beyond the boundaries of the Cannonsville Reservoir watershed.

Abstract

Although water quality problems associated with agricultural non-point source (NPS) pollution have prompted the rapid and widespread adoption of a variety of so called "best management practices" (BMPs), it has proven difficult to assess their cumulative impacts and individual effectiveness in reducing NPS pollution at the watershed scale. In this project we combined long-term monitoring, paired-watershed analyses, and process-based watershed modeling to assess changes in dissolved phosphorus (DP) for a 160 ha catchment in the New York City Catskill water supply watersheds. The land use was a combination of forests and dairy farmland. A suite of BMPs were implemented in the mid-1990s aimed at reducing P loads. Using a nearby 86 ha forested watershed as a control site for a paired-watershed study, we found that the DP loads were reduced by 43% (+/-6%) and particulate P loads dropped by 29%. To assess the roles of individual BMPs in this reduction we used the Variable Source Loading Function (VSLF) model, a distributed watershed model and empirical relationships for DP concentrations in runoff based on on-site rain simulator experiments. The model analysis predicted a total reduction that was within 5% of the paired-watershed analysis and showed that the most effective BMPs were those that disassociated manure spreading and other P sources from areas prone to generating runoff, i.e., hydrologically sensitive areas. Interestingly, barnyard BMPs, which were generally the most expensive, appeared to have little impact on stream water quality. Unfortunately, because we cannot mechanistically model the processes that control particulate P across a whole watershed, the model was unable to make similar assessments of BMP impacts on particulate P. This body of work demonstrates that combining both long-term monitoring and process-based modeling allows us to evaluate BMP effectiveness in the "living landscape" without necessarily establishing special research watersheds.

Abstract

This study extrapolated benefits of farm-level precision feed management (PFM) strategies to a watershed scale by evaluating effects of several PFM variations in controlling phosphorus (P) losses and reducing soil-P build-up at field and watershed scales. The PFM strategies more precisely balance dairy cattle dietary P and improve on-farm forage production and utilization in the animal diet in an effort to reduce manure P concentration, importation of feed nutrients, P imbalance problems, and soil-P build-up while maintaining farm profitability. The Soil and Water Assessment Tool (SWAT) was used for this study. SWAT simulation of manure application to cropland with reduced P concentration integrated with increased productivity of grass-forage resulted in particulate phosphorus (PP) and soluble phosphorus (SolP) losses reductions of 22% and 12%, respectively. Predicted average PP and SolP losses reductions at the watershed outlet were 16% and 13%, respectively, compared to the baseline. Model results also demonstrated an appreciable decrease in field-level soil-P during the growing season, indicating increased soil-P

removal by the improved grass-forage. For the growing season, reductions for predicted active and labile P pools compared to the baseline were 11 mg/kg and 5 mg/kg, respectively. Compared to the baseline condition, the reduction in field-level soil P was equivalent to 8% and 7%, for labile and active P pools, respectively. Overall, the PFM strategies, in addition to their primary objectives of economic benefits and reducing P imbalance problems, were found to have potential for reducing soil-P build-up and P losses both at field and watershed levels. Performing model-based environmental evaluation of farm management strategies done at watershed level helps to integrate farm management plans (the smallest management unit) into watershed level planning. Also, evaluating farm management strategies at a watershed scale provides valuable and comprehensive information for assessing the potential for long-term, cost-effective, and permanent reduction of P loss from dairy agriculture to the Cannonsville Reservoir.

Abstract

New York dairy farms use their most fertile land to produce corn silage, an important component of their production system. Increasing demand for corn by ethanol producers is driving up corn grain prices. This is introducing a major shift into the NY dairy farm system by prompting farmers to place more land into corn production. Increasing corn grain production may allow farmers to produce their feed grain needs on-farm and, thus, avoid tight marginal profits caused by purchasing higher-priced grain. However, erosion and associated phosphorus (P) loadings of corn land is of particular environmental concern. P loss from agricultural lands continues to be a major pollutant for NY City water supply reservoirs. To reconcile the farmers' economic needs for increasing on-farm corn grain production with the risk of increased erosion and P loss threats from expanded corn fields, farm planners and other agencies are initiating a no-till management option to the corn production system. This study quantitatively assesses the potential environmental and economical effects of implementing no-till management in conjunction with the increased need to grow corn grain. This study applies a whole-farm model to a large and small farm in the Cannonsville Reservoir watershed to evaluate different management scenarios. Farm factors evaluated include farm profits, feed imports, farm P balance, and P losses. Study findings will enable relative comparisons between the risks of increasing downstream water quality pollution with that of decreasing on-farm economic viability.

4.5 Watershed Forestry Program

The Watershed Forestry Program is a collaborative partnership between DEP, the not-for-profit Watershed Agricultural Council (WAC), and the United States Forest Service (USFS) that promotes and supports the economic viability of well-managed working forests as a beneficial land use for watershed protection. Since 1997, WAC has utilized core DEP contract funds to secure multi-year matching grants from the USFS to support the following core programs: (1) forest management planning and stewardship; (2) best management practice (BMP) implementation; (3) logger and forester training; (4) model forest program; (5) watershed forestry education program; and (6) forest products marketing and utilization.

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 to report annually on the program's accomplishments. During 2008, DEP and WAC completed negotiations on a 46-month contract that enables WAC to continue administering and implementing the Watershed Forestry Program through 2012. This new WAC contract was registered in December and takes effect January 1, 2009. It is worth noting that in developing this contract, DEP and WAC worked closely with the USFS to develop a long-term program budget plan that not only combines City and federal funding sources, but also targets these respective funding streams to specific core program tasks. The result is a well-rounded, comprehensive program that is jointly and diversely funded to protect water quality while actively supporting the economic viability of forestry as a watershed land use.

4.5.1 Forest Management Planning and Stewardship

Encouraging forest landowners to become long-term forest stewards remains one of the cornerstone goals of the Watershed Forestry Program. Towards this end, WAC provides training, technical assistance, and financial incentives to landowners and foresters to develop written long-term forest management plans and then implement key stewardship practices from these plans, primarily through the pilot Management Assistance Program (MAP).

During 2008, 58 WAC forest management plans were completed covering approximately 10,740 total acres, of which an estimated 8,850 acres are forested. Six landowners updated their five-year old WAC plans during 2008 and 54 total riparian plans were completed covering 2,050 riparian acres. To date, more than 740 WAC plans have been completed covering 132,500 total acres, of which an estimated 103,800 acres are forested and 7,128 acres are delineated as unique riparian management areas. This report marks the first time ever that cumulative enrolled forest land exceeded 100,000 acres in the program's 10-year history.

Also during 2008, DEP and WAC completed the sixth annual evaluation of five-year-old WAC forest management plans (FAD report submitted January 2009) as well as the one-time evaluation of the three-year MAP pilot project (FAD report submitted December 2008). In terms of the MAP pilot, two funding rounds were held during 2008 which resulted in 35 landowners being approved for 47 projects. During 2008, 48 MAP projects were completed by 42 different landowners. To date, 146 landowners have been approved for 174 projects, 28 of which have been subsequently cancelled by the landowner and 121 of which have been completed by 85 different landowners. Pursuant to the 2007 FAD requirements and the results of the 2008 MAP pilot evaluation, the Watershed Forestry Program is currently in the process of expanding and implementing MAP on a watershed-wide basis.

4.5.2 Best Management Practice (BMP) Implementation

Encouraging loggers, foresters, and landowners to voluntarily adopt and implement forestry BMPs during and after timber harvesting operations is another priority goal of the Watershed Forestry Program. Towards this end, WAC provides training, technical assistance, and financial incentives to loggers, foresters, and landowners to properly install erosion control BMPs on forest roads and minimize the water quality impacts of logging equipment through the use of temporary portable bridges and other available WAC stream crossing BMPs.

During 2008, 45 timber harvest road projects and seven road remediation projects were completed. These 52 projects represent 70 miles of properly constructed or relocated roads, 2,503 water bars, 156 broad-based dips, 1,395 linear feet of geotextile road fabric or silt fencing, 1,767 cubic yards of stone, 310 linear feet of culverts, 105 hay bales, and the post-harvest stabilization of 27 acres. To date, a total of 150 timber harvest road projects and 59 road remediation projects have been completed. These 209 projects represent 283 miles of properly constructed or relocated roads, 9,736 water bars, 532 broad-based dips, 7,438 linear feet of geotextile road fabric or silt fencing (1.4 miles), 9,276 cubic yards of stone, 3,291 linear feet of culverts, 1,299 hay bales, and the post-harvest stabilization of 135 acres.

In addition, WAC owns the following stream crossing BMPs that are available for temporary loan to interested applicants: seven 20-foot bridges, one 50-foot bridge, one 30-foot bridge, five plastic arch culverts, and 12 sets of rubber tire land mats (used to reduce erosion on stream approaches). During 2008, WAC loaned out one 20-foot bridge, one 30-foot bridge, one arch culvert, and one set of rubber tire land mats. The bridges were used at three separate active logging operations for a combined total of 10 months. Also during 2008, WAC approved six stream crossing projects, three of which were completed.

Finally, during 2008 WAC offered free samples of specific erosion control technology, of which 50 total samples were distributed to 16 participants representing the following BMPs: straw wattles (19 samples), geotextile road fabric and pipe culverts (seven samples each), grass seed (six samples), hay bales (five samples, 100 hay bales total), non-petroleum chainsaw oil (three samples), erosion control blankets (two samples), and silt fencing (one sample). WAC continues to utilize a flatbed trailer to facilitate the transport of forestry BMPs throughout the watershed.

4.5.3 Logger and Forester Training

The Watershed Forestry Program promotes and supports voluntary logger training and regular participation in the New York State Trained Logger Certification (TLC) Program. Towards this end, WAC partners with Cornell Cooperative Extension (CCE) of Greene County and New York Logger Training, Inc. (NYLT) to schedule, promote, and conduct core TLC workshops and other continuing education courses throughout the watershed each year. For example, WAC produces an annual logger training calendar that is distributed to hundreds of loggers and

sawmills, in addition to producing and distributing dozens of TLC promotional hats, T-shirts, key chains, first aid kits, and roadside signs. WAC also sponsors and/or participates in several area logger festivals as well as the annual New York State Woodsman's Day in Boonville, NY.

During 2008, WAC and CCE sponsored 12 logger training workshops attended by 87 total participants. These workshops covered the following topics: Game of Logging (four workshops, 33 participants), Forest Ecology & Silviculture (two workshops, 19 participants), First Aid & CPR (two workshops, 14 participants), Forest Pests (one workshop, 11 participants), and Critical Injury Response (one workshop, 10 participants). A total of 68 individuals working in the Catskill/Lower Hudson region are fully certified through December 31, 2008, representing a 17% increase from 2007. It is also worth noting that in 2008 WAC made 16 TLC incentive payments totaling $19,437 to seven individual loggers who completed road BMP projects as part of WAC's ongoing efforts to offer higher BMP cost-sharing rates to TLC loggers.

In addition to training loggers, WAC sponsored four forester training workshops during 2008 that attracted 80 total participants. Forty-six foresters are currently trained to write WAC forestry plans. At least half of these foresters provide services to East of Hudson landowners.

4.5.4 Model Forest Program

The Watershed Forestry Program collaborates with SUNY College of Environmental Science and Forestry (ESF), CCE of Delaware and Greene Counties, Frost Valley YMCA, and other local and state partners to coordinate and support the following three watershed model forests: Lennox (Delaware County), Frost Valley (Ulster County), and Siuslaw (Greene County). Each model forest is designed to integrate forestry and water quality research with interpretive watershed education opportunities and various BMP and silvicultural demonstrations, so that visitors may experience and learn first-hand about working forest landscapes.

During 2008, a demonstration deer fence was installed at the Frost Valley Model Forest where timber harvesting activities continued at several experimental treatment blocks. At the Lennox Model Forest, WAC, SUNY-ESF, and CCE conducted a field reconnaissance of the forest tent caterpillar situation following last year's heavy defoliation and subsequent treatment with aerial insecticides. Given the minimal presence of caterpillar egg masses, there was no need for spraying in 2008. At the Siuslaw Model Forest, efforts are underway to develop an overall forest management plan while establishing certain educational signs and specific demonstration projects, such as the plastic arch culvert that was installed during 2008.

4.5.5 Watershed Forestry Education Program

The Watershed Forestry Program collaborates with many local partners to implement watershed stewardship education programs for specific urban/rural audiences with targeted messages about the benefits of well-managed working forests. In 2008, DEP and WAC agreed to streamline the delivery of certain school-based educational programs by integrating the Catskill

Stream and Watershed Education Program (CSWEP), Watershed Forestry Institute for Teachers (WFIT), and the Green Connections Partnership Program into a single competitive bid package that was ultimately awarded to the Catskill Center for Conservation and Development.

During the first half of 2008, the Catskill Center completed the 2007-2008 Green Connections Program that involved 400 students from five New York City and five watershed partner schools. The culminating activity for all participants was a series of spring upstate watershed field trips. In July, the Catskill Center conducted the 10th annual Watershed Forestry Institute for 20 upstate and downstate teachers, including a separate 10-year reunion event that was attended by 35 participants (including 26 teachers). The Institute boasts nearly 180 alumni since 1999. In September, the Catskill Center launched the next Green Connections Program cycle, covering 2008-2009. This program cycle involves 500 students from six New York City and six watershed partner schools. All participants received a classroom visit and completed their fall downstate field trips. It is worth noting that 2008 marked the first year that DEP actively collaborated in the Green Connections Program by conducting all downstate classroom visits, assisting with the downstate field trips, and generally providing in-City educational support.

In 2008, WAC continued to support the Watershed Forestry Bus Tour Grants Program which is funded jointly by DEP and the USFS. Two funding rounds were held during 2008, with 21 bus tour grants awarded and 21 bus tours completed for approximately 1,050 participants. To date, the Bus Tour Program has awarded more than 100 grants during 13 funding rounds, which has allowed nearly 5,000 downstate participants to visit the upstate watershed. In tandem with the bus tour program, WAC also worked with the USFS to develop a watershed forestry companion website to the interactive online New York City Open Accessible Space Information System (OASIS). The original OASIS website can be viewed at www.oasisnyc.net, whereas the new watershed version can be viewed at www.nycwatershed.org/oasismap/index.html.

In terms of invasive species education, the Watershed Forestry Program continued to participate in the Catskills Regional Invasive Species Partnership (CRISP) and the Lower Hudson Partnership for Regional Invasive Species Management (PRISM) during 2008.

Finally, in terms of educating forest landowners and local municipal officials, the Watershed Forestry Program continued many of its previous year's efforts, including sponsoring and attending New York State Forestry Awareness Day 2008 in Albany. In the East of Hudson watershed, WAC partnered with Clearpool Education Camp to conduct two landowner workshops for 25 participants. In the West of Hudson Watershed, WAC partnered with Delaware County CCE to conduct two landowner workshops for 30 participants. WAC and DEP also supported the annual Region 3 ReLeaf Conference in Westchester County (150+ participants) in addition to presenting at a Pace University workshop that attracted approximately 70 local officials and area residents. The Pace event resulted in WAC being asked to lead a group of 14 Westchester County Parks Department employees on a personalized local tour of active forestry projects.

4.5.6 Forest Products Marketing and Utilization

The Watershed Forestry Program supports and facilitates specific economic development projects that focus on strengthening the viability of the forest products industry and promoting the marketing and utilization of locally harvested wood products. During 2008, WAC continued to close out its USFS Economic Action Program (83 grants were awarded to 50+ regional businesses totaling $2.4 million during 2000-2008), while expanding the "Pure Catskills" marketing campaign to include forestry products along with traditional farm products. WAC published the fourth annual "Pure Catskills Wood Manufacturing Directory" in addition to recruiting new members to the Catskill WoodNet website (www.catskillwoodnet.org), which currently boasts 71 business listings. Throughout 2008, WAC also collaborated with the USFS and NYSDEC to support and conduct forest product marketing and utilization programs for industry professionals. In January, WAC sponsored the attendance of three local business representatives at an annual "Drying Quality Lumber for Profit" workshop held at SUNY-ESF, in addition to presenting with NYSDEC at a Construction Specifications Institute in Albany. In February, WAC sponsored a series of three local workshops ("Using Locally Produced Framing Lumber") that were attended by more than 200 participants. During May and August, WAC attended the New England Woodworking Expo in Connecticut, the Smallwood 2008 Conference in Wisconsin, and the IWF Trade Show in Atlanta, where the "Pure Catskills Wood Manufacturing Directory" was distributed and Catskill WoodNet was promoted.

Finally, during 2008 WAC initiated a woody biomass energy exploration project using grant funding provided by the USFS. In October, WAC issued a Request for Proposals to conduct woody biomass pre-feasibility studies at selected sites in the watershed region. Eleven applications were received and three sites were chosen: Cairo-Durham Middle/High School, Onteora Middle/High School, and South Kortright Central School. WAC is currently working with a consulting firm, Richmond Energy Associates, to visit each facility and conduct the necessary pre-feasibility studies as the woody biomass project moves forward.

4.5.7 Summary

The Watershed Forestry Program continued to implement all its major core program tasks while meeting all related FAD deliverables during 2008. In particular, completing and evaluating the three-year MAP pilot project represents an important next step in the program's progression from a forest management planning focus to increased emphasis on plan implementation and promoting long-term forest stewardship practices. This ongoing transition will enable the Watershed Forestry Program to continue addressing two priority issues of increasing regional importance: invasive species control and riparian buffer protection. DEP also acknowledges the invaluable partnership role of the USFS in terms of leveraging City funding commitments with federal matching grants and enabling the Watershed Forestry Program to successfully pursue its dual mission of protecting water quality and supporting forestry economic viability.

4.6 Stream Management Program

Significant progress was made by the Stream Management Program (SMP) in 2008 toward achieving its mission of protecting and/or restoring achievable levels of stream system stability and ecological integrity by providing for the long-term stewardship of streams and floodplains. With the 1997 FAD, SMP initiated a partnering and planning effort with County Soil and Water Conservation Districts (SWCDs) for each of the main stem rivers in the West of Hudson Watershed. Eleven years later, stream management plans have been completed for all of the Catskill and Delaware watershed main stem rivers with the exception of the Neversink River and Rondout Creek. With the 2007 FAD, the SMP has begun to transition from a program planning phase to a program implementation phase. Successful implementation of the strategies, policies, and projects within stream management plans can help Catskill communities live more harmoniously with their mountain rivers, and both improve and protect the quality of stream water that feeds the Catskill and Delaware watershed reservoirs.

The primary focus of the SMP in 2008 has been the successful establishment of a new set of contracts, each five years in length, with its partnering SWCDs and Cornell Cooperative Extension of Ulster County to advance this transition in most of the West of Hudson Watershed. At the close of the reporting period, all but one implementation contract was successfully registered, enabling an additional investment of $27.1 million in stream management in the region.

The 2007 FAD emphasized a need to ensure that implementation of stream management plan recommendations was locally driven where possible and reasonable. In fulfillment of this goal, DEP's partnering SWCDs have successfully established new watershed advisory councils to facilitate this implementation in the Cannonsville, Pepacton, and Schoharie watersheds. DEP was pleased to secure agreement in 2008 with its SWCD partners that municipal adoption of plans was necessary for implementation funding to flow. At the close of the reporting period, most towns in the Schoharie watershed had adopted their respective stream management plan, and the Delaware County SWCD had begun making significant progress in this endeavor as well. In Ulster County, SWCD and CCE-Ulster County are working swiftly to accomplish the same result.

Another significant SMP accomplishment of 2008 was the completion of the development of the Streamside Assistance Program (SAP), following issuance of guidelines in December 2008. The SAP will provide technical assistance and implementation funding to landowners through four coordinators who will be supported by the existing SMP partnership framework. DEP has committed $3.86 million to this effort.

An expanded set of SMP project maps with this 2008 report attempts to better illustrate, basin by basin, the numerous projects that are at various stages of development. In 2008 the SMP and its partners completed the Schoharie Avenue Streambank Stabilization Project in the Village of Hunter, and advanced 23 additional projects in the Schoharie and Delaware watersheds.

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. Table 4.16 identifies the name of each SMP project depicted in the maps (Figures 4.11 through 4.13) that illustrate the status of stream management plans and restoration projects throughout the WOH Watershed.

Ashokan Basin

Since completion of the Upper Esopus Creek Management Plan in early 2007, DEP and Cornell Cooperative Extension – Ulster County (CCE Ulster) have begun to extend the stream management planning process from the mainstem Esopus Creek to the entire Ashokan Reservoir watershed. This involves (1) contracting with CCE Ulster and the Ulster County Soil and Water Conservation District (UCSWCD) to form the Ashokan Watershed Stream Management Program Team; (2) reforming a project advisory council with adequate representation for the entire Ashokan Reservoir watershed; (3) extending assessment to other streams; and (4) implementing Plan recommendations. A significant change in staffing (CCE Ulster's project coordinator left the position in May 2008 and a replacement coordinator did not start until October 2008) and delays in contracting with UCSWCD limited some of the planned progress for SMP implementation in the Ashokan basin during 2008.

Table 4.16. DEP Stream Management Program project name and identification by basin.

Basin	Project ID	Type of Project	Name of Project
Schoharie Basin			
	S-01	Restoration	Schoharie Creek, Lexington Project 1
	S-02	Demonstration	Batavia Kill, Maier Farm
	S-03	Restoration	Batavia Kill, Brandy Wine
	S-04	Demonstration	East Kill, Farber Farm
	S-05	Restoration	Batavia Kill, Big Hollow, Reach 1
	S-06	Restoration	Batavia Kill, Big Hollow, Reach 2
	S-07	Restoration	Batavia Kill, Ashland Connector
	S-08	Restoration	Prattsville Floodplain Restoration Project
	S-09	Restoration	West Kill, Shoemaker Property
	S-10	Demonstration	West Kill, RAH Stables
	S-11	Stormwater	Schoharie Creek, Hunter Highway
	S-12	Restoration	Batavia Kill, Conine
	S-13	Bank Stabilization	Schoharie Creek, Schoharie Avenue

Table 4.16. (Continued) DEP Stream Management Program project name and identification by

Basin	Project ID	Type of Project	Name of Project
	S-14	Demonstration	Schoharie Creek, Lexington Culvert
	S-15	Restoration	Gooseberry Creek at Tannersville
	S-16	Bank Stabilization	Batavia Kill, Holden Project
	S-17	Riparian Buffer	East Kill, Shadow Mtn
	S-18	Riparian Buffer	East Kill, Curtain Riparian Project
	S-19	Riparian Buffer	Schoharie Creek, Carr Road
	S-20	Riparian Buffer	Schoharie Creek, Falke Road
	S-21	Riparian Buffer	West Kill, Cty Rte 6 Planting
	S-22	Restoration	West Kill, Long Road
	S-23	Stormwater	Gooseberry Creek, Project Office
	S-24	Riparian Buffer	Schoharie Creek, Prattsville Project
	S-25	Stormwater	Batavia Kill, Windham Mtn
	S-26	Stormwater	Batavia Kill, Sugar Maples 1
	S-27	Restoration	Batavia Kill, Sugar Maples 2
	S-28	Riparian Buffer	Manor Kill, Town Hall Planting
Delaware Basin			
	D-01	Demonstration	Delaware WB, Town Brook, Post Farm
	D-02	Restoration	Delaware WB, Wright Brook, Rama Farm
	D-03	Restoration	Delaware WB, Town Brook, Palmatier Farm
	D-04	Demonstration	Delaware EB, Margaretville Fairgrounds
	D-05	Bank Stabilization	Delaware EB, Tremper Kill, Tuttle Farm
	D-06	Restoration	West Branch Delaware at Terrace Ave.
	D-07	Restoration	West Branch Delaware at South St.
	D-08	Bank Stabilization	Delaware EB, Tremper Kill, Liddle Farm
	D-09	Restoration	Delaware WB, Trout Creek, Loewentheil Farm
	D-10	Riparian Buffer	Beers Brook EWP Planting, D-W-902A
	D-11	Riparian Buffer	Beers Brook EWP Planting, D-W-060
	D-12	Riparian Buffer	Beers Brook EWP Planting, D-W-103
	D-13	Riparian Buffer	Pines Brook EWP Planting, D-W-901C Reach A
	D-14	Riparian Buffer	Pines Brook EWP Planting, D-W-901C Reach B
	D-15	Riparian Buffer	Pines Brook EWP Planting, D-W-901D
	D-16	Riparian Buffer	Lower Third Brook EWP Planting, D-W-601
	D-17	Riparian Buffer	Lower Third Brook EWP Planting, D-W-401
	D-18	Riparian Buffer	Upper East Brook EWP Planting, D-W-004 Reach A

Table 4.16. (Continued) DEP Stream Management Program project name and identification by

Basin	Project ID	Type of Project	Name of Project
	D-19	Riparian Buffer	Upper East Brook EWP Planting, D-W-004 Reach B
	D-20	Riparian Buffer	Herzog Farm EWP Planting, D-WAC-501
	D-21	Riparian Buffer	Phoenix Farm EWP Planting, D-WAC-502
	D-22	Riparian Buffer	Oxbow Hollow EWP Planting, D-W-002A
Ashokan Basin			
	A-01	Demonstration	Broadstreet Hollow
	A-02	Demonstration	Stony Clove, Lanesville
	A-03	Demonstration	Esopus Creek, Woodland Valley
Rondout Basin			
	R-01	Demonstration	Chestnut Creek, Grahamsville, Town Hall
	R-02	Infrastructure	Pepacton Hollow
	R-03	Demonstration	Rondout Creek Demo Project
Neversink Basin			
	N-01	Demonstration	Neversink River Demo Project

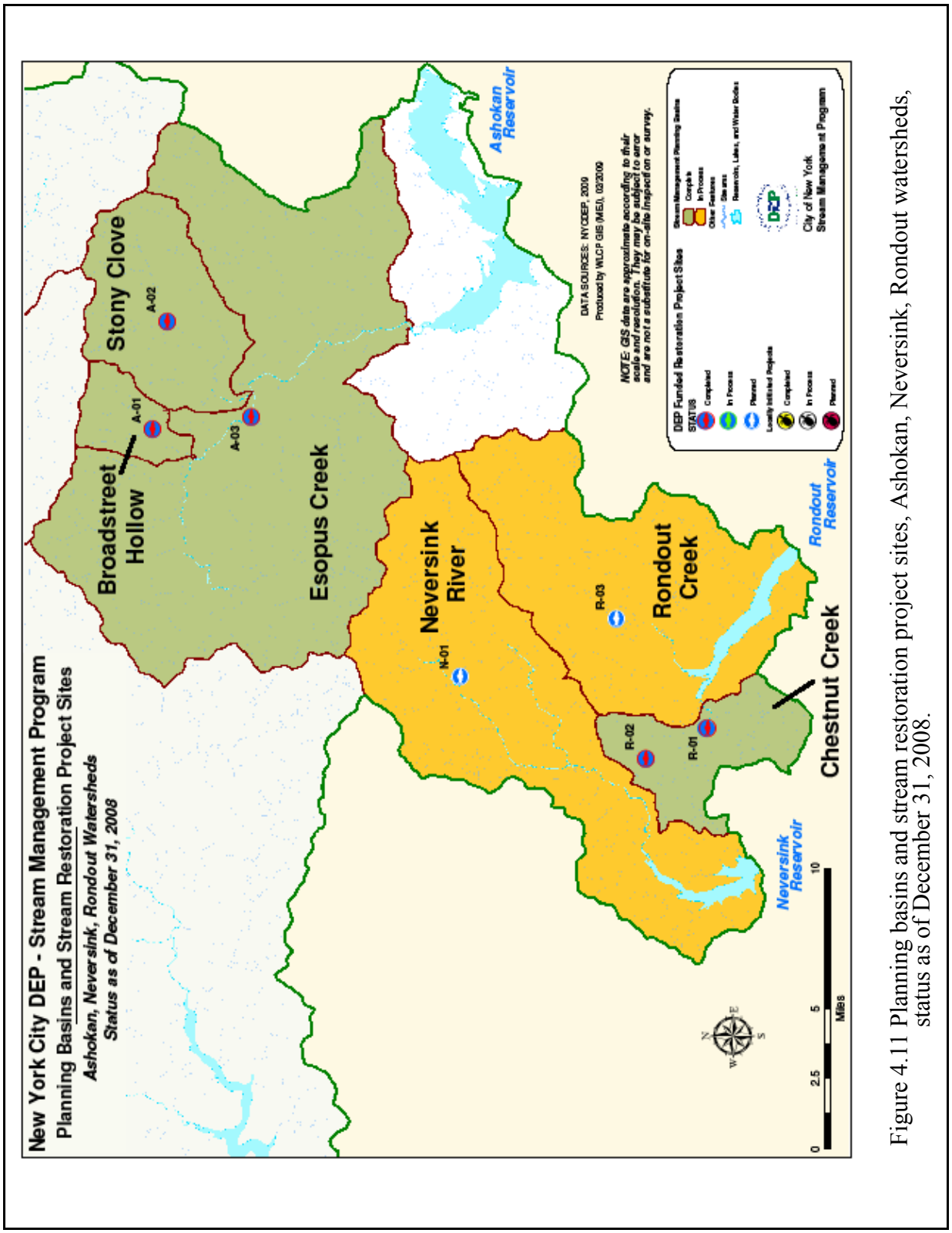

Figure 4.11 Planning basins and stream restoration project sites, Ashokan, Neversink, Rondout watersheds, status as of December 31, 2008.

Major milestones in the Ashokan Basin in 2008 included the following:

- Negotiation of two contracts to develop the Ashokan Watershed Stream Management Program to meet the requirements of the 2007 FAD:
    - o A five-year contract with CCE Ulster 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. This contract was registered in summer 2008.
    - o A five-year contract with UCSWCD for (1) technical staffing, and (2) a $2.5 million fund for implementing at least one restoration project, the streamside assistance program, and stream BMPs recommended in the Management Plan and/or annual Action Plans. This contract is expected to be registered in spring 2009.
- Completed a geomorphic and riparian vegetation assessment of Woodland Creek, a major tributary to Upper Esopus Creek.
- CCE Ulster continued to develop and implement education and outreach programming (discussed in more detail in Section 4.6.2, Education and Outreach).
- CCE Ulster added another "Trees for Tribs" site to the expanding network of riparian enhancement sites sponsored by the NYSDEC Hudson River Estuary Program. There are now two such sites along Esopus Creek. Both sites were planted by volunteers (including the Esopus Stream Stewards).
- Additional bank stabilization and/or maintenance "repairs" were completed at the Esopus Creek at Woodland Valley, Broadstreet Hollow, and Stony Clove at Lanesville stream restoration demonstration projects. See Section 4.6.5 for a detailed description.
- In Stony Clove, Streamside Planting Program sites were monitored for the third and final year, and staff met with NYSDOT, NYSDEC, and Ulster SWCD staff to discuss preferred solutions for a failing road embankment along the creek near Chichester.

Schoharie Basin

Prior to 2008, DEP and the Greene County Soil and Water Conservation District (GCSWCD) had completed stream management plans for all major Schoharie Reservoir tributaries, including the Batavia Kill (2003), West Kill (2005), East Kill (2007), and Schoharie Creek (2007). Importantly in 2008, GCSWCD completed the plan for the Manor Kill, effectively completing the planning for the major tributaries to the Schoharie Reservoir.

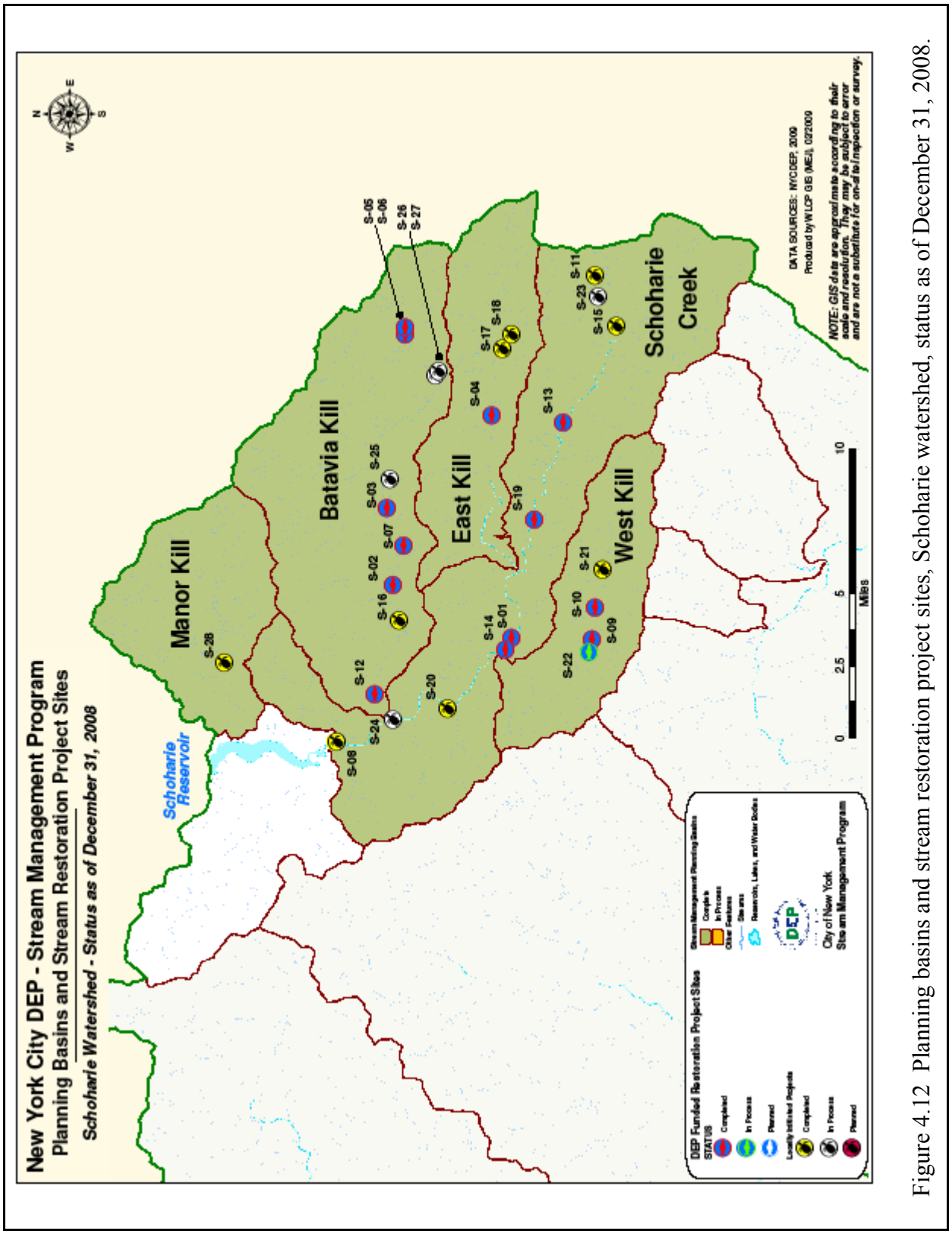

Figure 4.12 Planning basins and stream restoration project sites, Schoharie watershed, status as of December 31, 2008.

The new Schoharie Watershed Advisory Committee (SWAC) was formalized in 2008, designed to represent the collective interests of local government, property owners, watershed agencies, and non-profit organizations in implementing the stream management plan recommendations. All 11 municipalities are represented on the SWAC and three subcommittees have formed and been very active this year: Highway Superintendents, Education and Outreach, and Recreation and Habitat. At the close of 2008, 8 of the 11 municipalities, all in Greene County, have completed the SEQRA process, have adopted their relevant stream management plan, and signed an MOU with the GCSWCD to guide implementation in their town. In 2008, GCSWCD and DEP developed a new relationship with the Schoharie County SWCD and Planning Department, and are in the process of working with Conesville to seek its adoption of the recently completed Manor Kill stream management plan.

The SWAC's first priority in 2008 was deciding on an implementation framework. At the recommendation of GCSWCD and DEP, the SWAC chose a competitive application process overseen by the GCSWCD. Funding categories and allocations were decided, and the materials for the application process were drafted, with a goal to launch the stream management implementation program in 2009.

Importantly, in 2008 DEP successfully negotiated and registered a new five-year contract with the GCSWCD to implement stream management plan recommendations, and hired a Greene County Streamside Assistance Program Coordinator. The agreement focuses specific attention on the SWAC, SAP (riparian restoration), and technical assistance to municipalities and others regarding restoration and stormwater issues. Funding is also provided for a full-time educator and a full- time stormwater project specialist.

Additionally, DEP and GCSWCD accomplished the following tasks, many of which fulfill stream management plan recommendations:

- Completed the 2009 update to the 2007 Action Plan for the Schoharie Watershed. This Plan provides the road map for implementing stream management plan recommendations.
- Worked with the GCSWCD towards meeting the relevant requirements set forth by the Shandaken Tunnel SPDES permit. These include funding $2 million in stream management plan recommendations and repair of 5,000 linear feet of stream.
- Provided support and sponsorship for the second annual Schoharie Watershed Summit, led by the GCSWCD Watershed Assistance Program.
- Completed four major stream projects, including the Conine stream restoration demonstration project, Schoharie Avenue streambank 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).
- Applied to NYSDEC Region 4 for a general permit to facilitate SAP projects where stream work or plantings of 300 feet or less is needed.

- Sponsored the second annual summer bus tour/workshop and second annual Batavia Kill festival.
- Sponsored two construction erosion and sediment control trainings for over 150 watershed developers, planners, code enforcement officers, regulators, and contractors.
- Conducted restoration project performance monitoring at five sites.
- Conducted a study with the NYS Natural Heritage Program to define the "target" riparian ecological communities for future floodplain restoration planting projects in the basin.
- Advanced stream habitat assessment by assisting completion of a SUNY ESF graduate student research project studying the effects of selected stream restoration practices on stream temperature and hyporheic flow.
- Maintained stormwater controls at the Hunter Highway Garage. In 2008, controls overseen by GCSWCD prevented 6.3 tons of sand and salt from entering Schoharie Creek.
- Provided technical assistance including hydrology and hydraulic assessment to better size culverts for the Greene County Highway Department.
- Provided technical assistance to the Town of Windham, including specification and permitting for the construction of a proposed Creamery Pond Recreation Park along the Batavia Kill.

GCSWCD and DEP also continued implementing recommended projects in 2008. DEP and GCSWCD completed the 2,300-foot riparian restoration in Jewett (the "Carr Road Project"); the bank stabilization project in the Village of Hunter (the "Schoharie Street Project"); a few smaller riparian restoration projects; repairs to the Farber Farm Project (originally completed in 2001 on the East Kill), including a volunteer planting; and an assessment and repairs to the Broadstreet Hollow stream restoration project.

Delaware Basin

Following the completion of the East Branch Delaware Stream Corridor Management Plan (EBDR SCMP) in 2007, DCSWCD prepared the initial EBDR SCMP Action Plan in spring of 2008 and negotiated a five-year contract funding implementation of both the East and West Branch plans through 2013. DCSWCD merged the Project Advisory Committees (PACs) of the East and West Branch of the Delaware and prioritized recommendations from both basin plans. DCSWCD launched the process of community adoption of the EBDR SCMP, including SEQRA review and plan adoption by the Delaware County Board of Supervisors. To extend adoption of the West Branch SCMP to the Town of Tompkins, DCSWCD performed an assessment of stream conditions in the Trout Creek sub-basin. The assessment will be appended to the WBDR SCMP for community review prior to plan adoption.

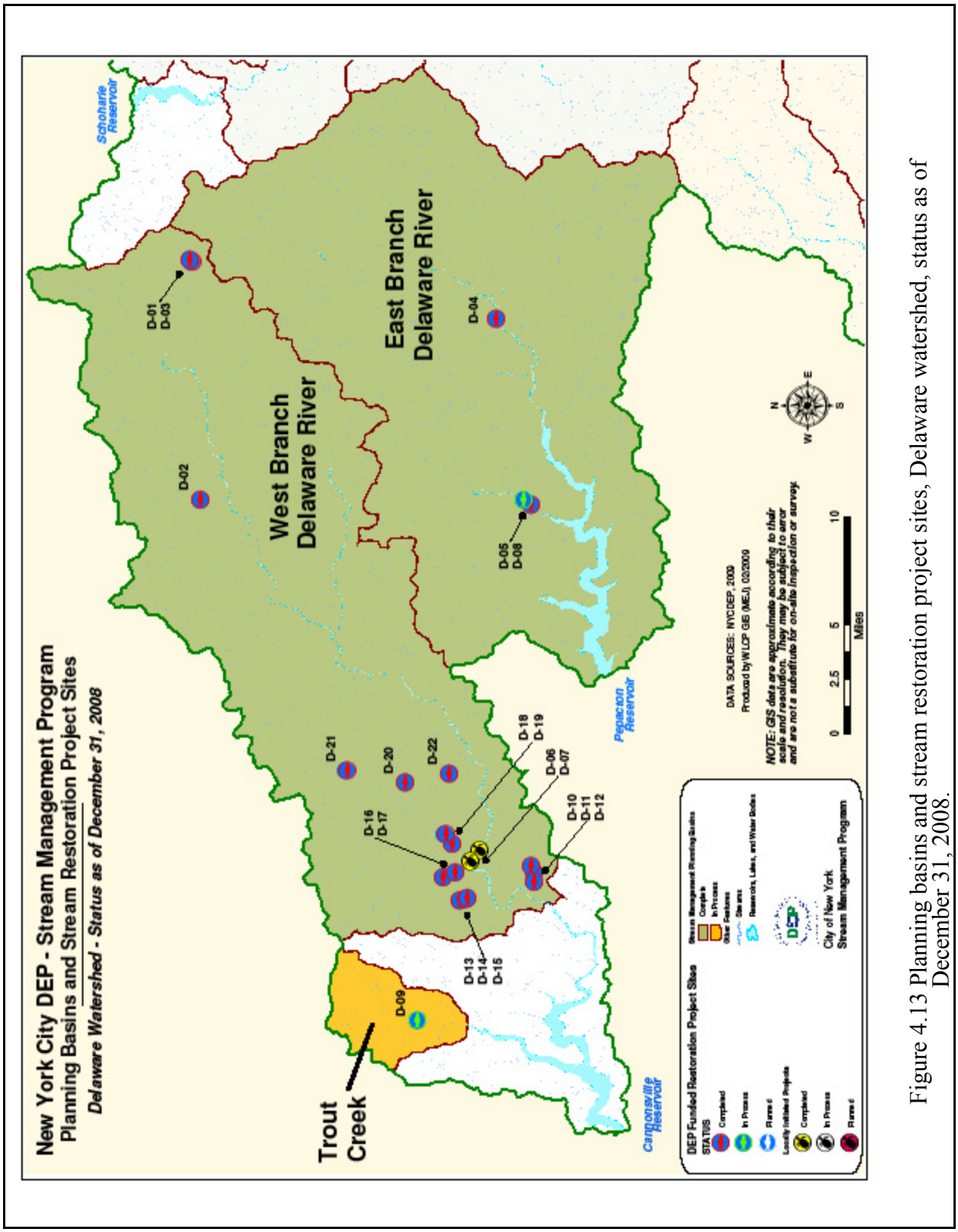

Figure 4.13 Planning basins and stream restoration project sites, Delaware watershed, status as of December 31, 2008.

DCSWCD and its partnering agency, Delaware County Planning Department, recruited and filled two staff positions—Streamside Assistance Coordinator and Environmental Planner—to support implementation of the SAP and plan related activities, respectively. Initial implementation of both the EBDR and WBDR SCMPs in 2008 focused on organizing for flood response and continuing flood recovery efforts. DCSWCD continued to support Emergency Watershed Protection efforts related to flood events in 2006 and 2007, responded to a flash flood event in 2008 in the Pepacton basin, provided training to highway departments on culvert replacement practices, and prepared a field- based training program for contractors and highway departments involved in post-flood stream remediation efforts.

Major milestones in the Pepacton basin included:

- Completion of the riparian buffer planting at the Margaretville Pavilion Stream Restoration Demonstration Project;
- Meetings with streamside landowners along the Bull Run in Margaretville as part of an effort to assess the need for stream restoration/flood hazard mitigation measures along this high gradient, flash-flood-prone stream course;
- Adoption of the EBDR SCMP by the Village of Margaretville, Town of Middletown, and Town of Andes;
- Assistance to the Towns of Andes and Colchester with flood damage assessments from the June 2008 flood event in the Holliday Brook, Beech Hill, and Barkaboom sub-basins;
- Project design and permit package preparation for the Liddle Farm CREP streambank stabilization project in the Tremper Kill sub-basin. Construction is anticipated in 2009;
- Formation of a PAC sub-committee to address fisheries and recreation issues along the East Branch Delaware River;
- Japanese knotweed control project on Vly Creek led by the residents of the Town of Halcott.

Major milestones for the Cannonsville basin included:

- The design, bidding, and completion of 13 planting plans for Emergency Watershed Protection (EWP) sites from the 2006 flood;
- Completion of designs for the Shelton Farm Conservation Reserve Enhancement Program (CREP) streambank stabilization project . A change in property owners occurred in 2008 and the new property owner (Loewenthiel) continues to support the project;
- The organization of a culvert management workshop for 95 contractors, highway superintendents, and state and local agency staff sponsored by DEP, Trout Unlimited, and the Upper Susquehanna Coalition;
- Establishment of a working group of state and local officials and the presentation of conceptual designs to address flooding issues in lower Third Brook in the Village of Walton;
- Presentations to the Village of Walton opposing the development of a housing project within the 100-year flood zone and supporting the restoration of the floodplain on the previously filled property.

Neversink and Rondout Basins

Contracting challenges in 2008 have slowed DEP's efforts to commence stream management planning in the Rondout and Neversink basins, due in 2010 and 2011, respectively. After negotiating a tripartite agreement with the Towns of Neversink and Denning for nearly a year, DEP decided that in order to meet FAD deliverable timetables, it was necessary to contract with Sullivan County SWCD. At this writing, DEP is in negotiations with SCSWCD and anticipates that a contract will be in place in summer 2009.

DEP has proceeded with data collection to inform the Rondout Creek plan. A stream feature inventory was completed for approximately 40 percent of the mainstem, and morphological characterization was completed at selected priority locations. Additionally, DEP acquired the services of a planner to identify the key stakeholders in the Rondout basin and plan a stakeholder's "roundtable" meeting in spring 2009 to focus concerns related to Rondout Creek.

4.6.2 Education and Outreach

Education and outreach (E &O) are core components of the SMP's mission. The emphasis in 2008 has been to improve internal and external coordination. Two interbasin E&O Working Group meetings were held, first in March to enable our partners to present the E&O activities in their 2008 Action Plans and in May to refine and update the SMP's E&O strategy.

A variety of formats were used to reach our audiences, including numerous public meetings, demonstrations and information sessions, workshops, extensive classroom education, college intern programs, technical training programs, restoration project tours, and coordinating internally with other DEP programs and externally with other agencies on review of many individual projects.

A number of achievements stand out during the reporting period. The multi-agency website, www.catskillstreams.org, grew substantially in both content and use, with nearly 150,000 individual "hits" and 100,000 files accessed. DEP continues to play a central role in contributions to both structure and content. Internet users have been using the site to access 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 stream stewardship information for the public.

Improving stream work that is conducted in the course of emergency flood response and recovery was a focal point for E&O activities this year. Yearly flood emergencies over the past several years have resulted in high interest in this aspect of stream management. First, CCE-Ulster sponsored a flood response workshop in March, with strong attendance by local, county, and state highway departments, emergency management officials, resource managers, regulatory officials, and sport fishing club members. In July, DEP hosted a special meeting of the Hydrologic and Habitat Modification (HHM) Subcommittee of the NYS Nonpoint Source Coordinating

Committee (NPSCC) to identify priority actions and policies for improving post-flood stream work practices. DCSWCD convened a workgroup of technical staff from DEP and the SWCDs to define learning objectives and design these workshops, which will be held in 2009.

DEP sponsored the second annual Batavia Kill Stream Celebration, co-hosted by GCSWCD and a private bed and breakfast owner. Various community businesses also supported the event by donating a total of $5,500. This well-attended event featured guided stream walks, plant and macroinvertebrate identification, fly casting and tying demonstrations, and other interactive activities for families. The Catskill Watershed Corporation (CWC) sponsored the "Turtle Island Medicine Show" performance by Arm of the Sea Theatre.

Heightened focus during the reporting period on riparian vegetation (in support of the developing SAP) led to numerous E&O activities. The program coordinated a workshop on Native Plant Seed Collection, a workshop on Willow Identification—in part to support diversification of the current native willow species collection at the USDA Natural Resources Conservation Service's (NRCS) regional nursery—and gave or hosted several talks related to riparian buffers and Japanese knotweed management. More detail on these efforts can be found in Section 4.7, Riparian Buffer Protection Program.

To advance its internal capacity for modeling source, transport and fate of suspended fine sediment, in July DEP co-sponsored a workshop to explore methods to model watershed-scale sediment loading, inviting researchers from Cornell University, the National Sedimentation Laboratory, USGS, and the Canaan Valley Institute.

Various projects involving students and community groups in stream stewardship activities were initiated in 2008. A project to plant trees along Rondout Creek at a ball field involved middle and high schools from four upstate and NYC communities. The Esopus Stream Stewards, a volunteer group coordinated by CCE Ulster, participated in a riparian planting project on upper Esopus Creek, began a Japanese knotweed assessment project along Warner Creek (a tributary to Stony Clove), and participated in a stream monitoring workshop led by Hudson Basin River Watch. CCE Ulster also started a program working with high-school-aged youth in the watershed. This program is called the Youth Watershed Stewards Program and will provide high-school-aged youth with education and volunteer opportunities associated with stream management.

4.6.3 Flood Recovery Efforts

A flash flood event on July 23-24, 2008, in the Pepacton watershed required DCSWCD and DEP to redirect staff to guide emergency stream work. The intense rainfall brought repeat damage to many of the areas impacted by the June 17, 2007, flash flood. Woody debris and sediment again choked long sections of stream channel, bridges and culverts. Flood flows damaged many areas restored following the 2007 event, including the DEP stream restoration project at Holliday Brook. Evaluation of the damage continues and stream assessments by DCSWCD will target the affected sub-basins in 2009.

As a result of the 2007 and 2008 flood events, a 500-foot section of Lower Beech Hill Brook just above Pepacton Reservoir at the NYS Route 30 box culverts was clogged with woody debris and sediment. If the culverts had become fully blocked, the condition would have threatened the integrity of the highway. DEP assisted NYSDOT with the removal of sediment and trash from the partially blocked box culverts. DEP prepared a plan for realigning the channel through the upstream sediments and lowered the channel bed and floodplain elevation to ensure that future storm events will not refill the culverts.

4.6.4 Floodplain Mapping

In 2008, DEP was notified by NYSDEC that it could not contract with DEP to revise the floodplain maps within the West of Hudson watersheds. In March 2008, DEP entered into discussions with the FEMA Risk Analysis Program to undertake the task of contracting for the revised flood studies. Since March, DEP and FEMA have prepared a scope of work and Memorandum of Understanding documents and are preparing to submit the documents for procurement. The agreement is expected to register and work commence in 2009.

4.6.5 Stream Restoration Projects

Figures 4.11 through 4.13 depict the status of 59 restoration projects at the close of 2008. 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 the SMP is involved with, in their scoping, design review, or as a secondary sponsor or partial funder.

Schoharie Basin Projects

Schoharie basin projects fall into three categories—riparian, restoration, and stormwater. Progress in each category is presented below.

Riparian Demonstration Projects

The Carr Road Project – Piloting the Streamside Assistance Program (Schoharie Creek)

The Carr Road Project extends for more than 2,300 feet of Schoharie Creek in the Town of Jewett. Initiated in 2007, 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-foot-wide buffer strip from the top of the streambank, establishing approximately 2.4 acres of buffer; and enhancing the existing buffer on the immediate streambank by tapering the bank and planting willow tublings and stakes. The project is located on two privately-owned parcels, and the landowners signed 10-year easements prior to the plantings. Japanese knotweed was treated at the site in 2007 and 2008, and planting was done over the same two-year period.

Sugar Maples Riparian Restoration (Batavia Kill)

In 2008, GCSWCD worked with Kaaterskill Engineering to complete the design, permitting, and bid documents for the restoration of 800 feet of riparian buffer along the Batavia Kill. Prior to restoration, this section of the Batavia Kill was heavily colonized with several invasive species, including Japanese knotweed and honeysuckle. To ensure long-term project success, an agreement between GCSWCD and the property owners was implemented that included a vegetative management plan to ensure plant establishment. In the fall of 2008, invasive species were removed from the site and several acres of riparian buffer were replanted with appropriate native vegetation.

Vegetation Enhancements (Batavia Kill, West Kill, Schoharie Creek, and Manor Kill)

Numerous vegetation enhancements were made in 2008. Root Production Method (RPM) trees were planted at the Big Hollow, Brandywine, and Ashland Connector restoration project sites on the Batavia Kill. A certified herbicide applicator treated Japanese knotweed by injection at the Big Hollow restoration project (Batavia Kill), the Carr Road and Schoharie Avenue projects (Schoharie Creek), and the upcoming Long Road restoration project site (West Kill, planned for 2009 construction). DEP conducted monitoring of vegetative techniques on a majority of these projects. Further, vegetation was installed as an enhancement to a Greene County Highway project on the West Kill (County Route 6) and at a FEMA project along the mainstem of Schoharie Creek (Faulkeys). Sedges were added to the County Route 13 culvert project that was completed in 2007. Finally, a volunteer planting was conducted in the Manor Kill behind the Conesville town hall.

Stream Restoration Projects

Schoharie Avenue Stabilization (Schoharie Creek)

DEP, GCSWCD, the Village of Hunter, the NYS Emergency Management Office (SEMO), and FEMA teamed up to treat a 180-foot section of failing streambank along the mainstem of Schoharie Creek in the Village of Hunter (Figures 4.14 and 4.15). DEP funded the project engineering, construction of 60 feet of the project area that had failed since FEMA first visited the site, and the vegetative components of the project. The GCSWCD provided oversight for the project, and was crucial to bringing all the various parties together to work through hurdles and complete the project. In 2008, a contractor was hired to install a series of pinned rockery walls, varying in height up to nine feet, keyed into the existing bedrock. Vegetation was incorporated into the project through the installation of topsoil and willow branch construction located between the rockery walls. Knotweed was also treated at this location, and Virginia creeper was planted throughout the project to provide wildlife forage.

Figure 4.14 Schoharie Avenue streambank stabilization was constructed to address this laterally expanding bank failure in the Village of Hunter.

Figure 4.15 Schoharie Avenue streambank stabilization following construction.

Long Road Stream Restoration Project (West Kill)

The Long Road project was identified as one of the top priorities for restoration in the West Kill Stream Management Plan. The Long Road project reach is considered to be the second largest source of turbidity in the West Kill. This project, for which assessments, permit preparation, landowner consultation, and design began late in the year, is planned for construction in 2009.

Sugar Maples Stream Restoration (tributary to the Batavia Kill)

This project was designed to restore 700 feet of stream and wetland function to an area that was historically channelized with mortared stone walls in the hamlet of Maplecrest. These failing walls have blocked the stream and created a flooding problem. The project goals include: reducing channel erosion, improving water quality, upgrading the farm's infrastructure (new culverts sized to properly convey storm runoff), developing and improving wetlands, improving public access to the site, providing public education on natural channel design and wetlands, improving habitat, and protecting the adjacent farm fields. In 2008, GCSWCD completed the topographic survey, hydrology, hydraulics, and natural channel design and permitting. Construction is planned for the summer of 2009.

Conine Stream Restoration Project (Batavia Kill)

The majority of this project was completed in 2007 and the project report can be viewed at http://www.catskillstreams.org/majorstreams_sc.html. In 2008, the project's performance was monitored at select cross-section locations. Riparian areas were seeded with a native seed mix, and the wetland area was also seeded with a native wetland seed mix. Sedges were added to the project to provide additional vegetative stability.

Farber Farm Stream Restoration Project Repairs (East Kill)

On April 3, 2005, the East Kill watershed experienced several inches of rain on snow resulting in a peak flow through the stream channel exceeding the bankfull flood stage. Another flow event occurred on April 16, 2007, causing excessive erosion that damaged four rock vanes and two cross vanes. The site was originally revegetated through the CREP with seedlings that never became well established. This repair project included repair, removal, or modification of damaged rock and cross vanes, treatment of the back channel area to reduce the frequency of flows in the back channel and to promote the use of the primary channel, and bank grading and vegetative stabilization to reduce erosion and to establish a riparian buffer along the restored reach. In addition to the vane retrofits, a bankfull bench was added, as well as 1,179 larger trees, willow stakes, and approximately 1,000 feet of willow fascines. Numerous shrubs, sedges, and herbaceous seed were also planted throughout the site.

Prattsville Streambank Project

DEP, GCSWCD, and the CWC have partnered to address this 1,130-foot eroding bank in the Hamlet of Prattsville. The final design will include a bankfull bench along the portion of the property with the highest erosion potential, and the remainder will be bioengineered to reduce erosion potential. A vegetated buffer is planned. The design for this project is underway and is planned for construction in 2009.

Stormwater Projects

The following projects are the result of collaborative efforts between DEP, CWC, and the US Army Corps of Engineers (ACOE). DEP funding of a stormwater specialist at the GCSWCD provides the expertise necessary to leverage multiple funding sources to maximize benefits to the basin communities.

Sugar Maples Stormwater Project (Mainstem Batavia Kill): This project is separate and distinct from the stream restoration project described above. The overall goal of the project is to address stormwater runoff from 4.5 acres of high density buildings and County Route 56. The project is designed to improve water quality by attenuating storm flows, providing a pervious handicap parking area, improving the storm sewer infrastructure along CR 56, improving public access to the Batavia Kill, and providing public education on stormwater management practices. In the fall of 2008, project partners including the Greene County Highway Department installed the upgraded conveyance system and demolished a single building to reduce impervious surfaces and to allow for construction of the pervious grass handicap parking area. The remainder of the work is planned to be completed in the spring of 2009.

Hunter Foundation Stormwater Retrofit/GCSWCD Schoharie Watershed Field Office (Tributary to Schoharie Creek): Stormwater runoff from 1.2 acres of high density and commercial land use discharge directly to Sawkill Creek. Field inspections confirmed that excessive runoff was causing erosion of existing parking surfaces and turbidity in the creek. In 2008, GCSWCD worked with Kaaterskill Engineering to complete the design, permitting, bid documents, and specifications for implementation of several structural stormwater management practices to address these impacts. Specific practices include the installation of multiple rain gardens, a stormwater planter, a new underground piping and TSS Separator, porous parking areas, and extensive native plantings. Several other components were incorporated into the design, including improved public access along the Sawkill in the form of a creek walk, signage to educate the public on impact and treatment of stormwater, an improved riparian buffer along the creek, and aesthetics.

Windham Mountain Stormwater Retrofit (Batavia Kill): The 600-acre area around Windham Mountain Ski Center that drains to the Batavia Kill represents one of the most developed areas within the Schoharie basin. In 2006 project partners developed a plan to address impacts from stormwater from several areas containing limited or no stormwater controls. In 2008 partners began the design of the first phase of the plan that addresses runoff from 16 acres of commer-

cial land use, including the ski center's parking areas and maintenance facility, and several identified stormwater hotspot locations. The completion of the final design, permitting, and construction specifications will be completed by spring of 2009, with construction to follow.

Ashokan Basin Projects

The Stony Clove at Lanesville Stream Restoration Project

In 2008, repairs were made on the Lanesville Demonstration Stream Restoration Project. Most of the repairs were associated with gullying on a high slope failure caused by poor drainage on the terrace above the slope, which had not been addressed as part of the restoration project. Some adjustments were made in the elevation of rock vanes protecting the base of this slope, and additional bioengineering was added to mitigate the gullying.

The Broadstreet Hollow Stream Restoration Project

Broadstreet Hollow has been the subject of monitoring and multiple restoration efforts since the mid-1990s. Stream channel restoration and dewatering wells that were installed in 2000 were damaged by an April 2005 flood. In 2008, repairs were made to one of the cross vanes in the project area.

The Esopus Creek at Woodland Valley Demonstration Project

In 2003, DEP contracted with UCSWCD to construct a stream restoration demonstration project designed by Craig Fischenich, Ph.D. The successfully completed project served as the demonstration project for the Upper Esopus Creek Management Plan. The April 2005 flood damaged sections of the demonstration project reach, most notably the removal of a substantially vegetated lateral bar upstream of the Woodland Valley bridge and the adjacent railroad grade embankment. UCSWCD with engineering assistance from NRCS designed a bank stabilization project for the damaged railroad embankment. The project was completed in fall of 2008. The bank stabilization includes three primary components (from the channel bottom up): (1) two rock vanes extending into the channel from the bankfull elevation along the bankline; (2) a stacked rock wall to an elevation just above the bankfull discharge stage; and (3) capping the rock wall by a vegetative reinforced soil slope (VRSS). The VRSS was used very successfully in the original project.

In October 2008, DEP hosted a meeting of project partners (DEP, UCSWCD, NRCS, FIScH Engineering), permitters (NYSDEC), and affected stakeholders (streamside landowners, white water recreation and angling representatives) to discuss the project's status and to evaluate its performance with respect to the stated goals and objectives. The majority opinion was that it had been successful in meeting the primary goals and objectives. The ensuing discussion also focused on how to use what was learned from this project to inform the selection and implementation of future stream restoration projects in the Ashokan basin.

Pepacton Basin Projects

Margaretville Pavilion Demonstration Stream Restoration Project

On the East Branch of the Delaware, DEP supported DCSWCD's efforts to complete the riparian buffer planting of the Margaretville Pavilion demonstration stream restoration project (Figure 4.16). This buffer planting included streambank and floodplain plantings adjacent to the community fairgrounds. A public walkway, planted with a border of native warm season grasses, was also installed to facilitate access from the fairgrounds to the streamside buffer area. This self-guided educational walkway will be supplemented with a public kiosk explaining the function of the three straight vanes and the value of the riparian buffer.

Figure 4.16 Straight rock vane with native warm season grass planting at Margaretville pavilion stream restoration project.

Cannonsville Basin Projects

Loewenthiel Streambank Stabilization Project

DCSWCD prepared designs for the Loewenthiel Farm streambank stabilization project on Trout Creek. Flood flow during the 2006 event resulted in debris blockage and channel avulsion on this site. The project is designed to improve sediment transport through the reach and reconnect the channel and floodplain through the removal of existing berms along the 1,200-foot reach. The landowner will provide personal funds for the 4-acre riparian buffer planting on the floodplain. The project, originally designed for construction in 2008, was put on hold when the property changed ownership. Construction is expected to be completed in 2009.

Emergency Watershed Protection – 2006 Flood Project Plantings

DCSWCD obtained over $30,000 in funding from NYSDEC to plant riparian vegetation at 13 sites where NRCS EWP projects had been constructed in 2007 but left unplanted. DCSWCD and DEP worked closely with NRCS to prepare planting plans and bid out the package. Planting was completed in October 2008 and will be monitored for additional planting in the spring of 2009.

4.6.6 Coordination with the CWC Stream Corridor Program

In 2008, DEP and the CWC developed and initiated a Stream Corridor Protection Program. Following much discussion, it was decided that the program would be focused on projects that mitigate or correct existing situations in hamlets, villages, or population centers that present imminent and substantial danger to persons or properties. Projects that are eligible for grants under the program (1) shall describe the project's design and/or the construction being proposed to repair stream conditions that pose a threat to a village, hamlet, or population center in the watershed which, if left uncorrected, present an imminent and substantial danger to persons, property, or water quality, as determined by CWC, and (2) must be consistent with the recommendations set forth in any applicable stream management plan. Program rules and application guidelines can be found at http://www.cwconline.org/.

The program was initiated with an approximately $1 million budget, and was intended to rely partially upon the technical assistance provided through county SWCDs, which DEP has fostered and supported since 1995. DEP, CWC, and county SWCD staff reviewed 31 proposed projects throughout the NYC West of Hudson Watershed (Figure 4.17). Thirteen projects were awarded funding prior to the program funds being depleted in October 2008. The funded projects included 12 bank stabilizations and one undersized culvert replacement. Through the efforts of DEP, CWC and the SWCDs, seven projects were designed to incorporate vegetation to "soften" each project's footprint. The seven projects will add approximately 54,099 square feet—representing 1,600 linear feet—of replanted riparian buffer. Two of the projects were completed in 2008, with the balance scheduled for construction in 2009.

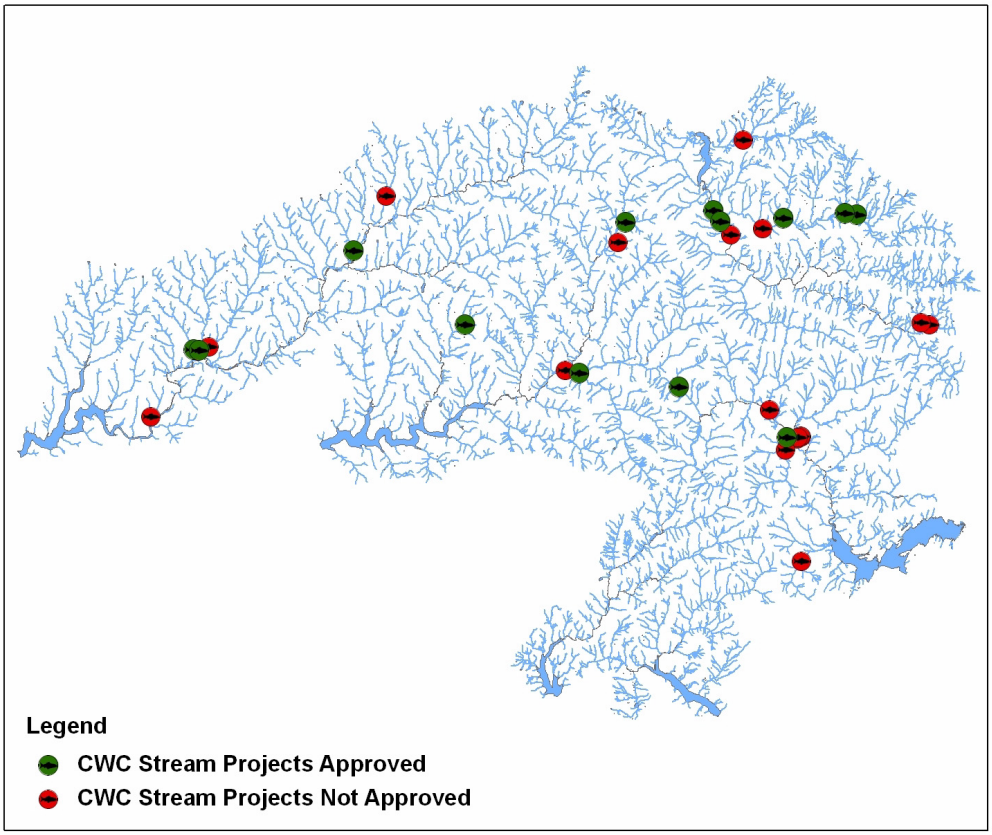

Figure 4.17 CWC stream project sites, approved and not approved. Note: Because of clustering around the Village of Phoenicia, not all not approved sites are visible.

4.6.7 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 its stream managers and partners for the long term, DEP has developed a geodatabase of stream information for the West of Hudson watersheds. In 2008, DEP continued to make progress populating the stream geodatabase, with new assessment data from the Manor Kill and Woodland Valley, as well as for the previously assessed West Branch Delaware River. Stream research data from all reference reaches and BMP reaches was also added this year.

Stream Process Studies

DEP's multi-year effort to develop and distribute regional stream morphology databases is designed 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 study, and a study monitoring the effectiveness of stream restoration demonstration sites. Specific sites and elements of the projects are summarized in the April 2006 Stream Management Program Second Biennial Program Evaluation Report. These projects have refined and strengthened DEP's knowledge of how streams in the Catskills function, and how DEP as stream managers 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 drainage area/ hydraulic geometry relationships ("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 geomorphic assessment is the basis of DEP's stream management plans and their recommendations, but also importantly, it is the basis of project review, project design, landowner site visits (to evaluate problems and potential solutions), and design of restoration projects. Geomorphic assessments also guide the channel dimensions of emergency flood response actions.

Regional curves have been an essential tool in helping DEP and its regional partners evaluate appropriate stream recovery actions in the numerous floods since 2005. This year, DEP and the design staff at the SWCDs began to develop a "rapid channel dimensioning decision tool" for use in emergency flood response, based in part on the hydraulic geometry curves. This tool will be piloted and evaluated during the 2009 DCSWCD and DEP flood response training for contractors. During 2008, the regional curves for all of New York State, developed by USGS under DEP guidance, were integrated into a database to support a web-based search engine, StreamStats, which is now in beta development and will be available for public use in 2009.

Reference Reach and Fluvial Process Database: DEP has initiated a project to create design geometry and fluvial processes data and characterize the associated biological and aquatic habitat for up to 15 reference Catskill stream reaches. This data set will also facilitate an understanding of sediment transport and hydraulic characteristics for stable streams, which may then be compared with sediment transport and hydraulics in unstable streams. Better understanding of these features can also be used in the design of project sites. Studies of fish population dynamics, associated aquatic habitat, detailed morphology, and sediment transport measurements provide a better understanding of the variability range one can expect in stable stream settings.

In January 2008, DEP convened a meeting of its partnering stream design staff to discuss the reference reach data and the database itself. DEP sought a critical evaluation of the quality of the information as well as an understanding of how best to present the information to ensure its access and ease of utility. The database table was subsequently revised and distributed to partners, and the study results are now being used in the design of projects in the West of Hudson watersheds by the GCSWCD and DCSWCD.

Monitoring Stream Restoration Projects: Staff turnover likewise constrained progress toward completion of another project, a pilot study to monitor the effectiveness of stream restoration demonstration projects installed on three unstable stream reaches. This study seeks to compare status and trends regarding geomorphic structure and process, and fish community and habitat, at three restoration projects over a five-year period, with paired stable reference and paired unstable control sites. The project is approximately 65 percent complete at this time. Accomplishments during 2008 consisted mainly of the geomorphic survey (which was also necessary to meet routine ACOE permit requirements for all restoration project sites), and analysis and reporting of the fish and habitat component of the study. DEP's USGS partner in the study published three journal articles, while four others were accepted for publication (Baldigo et. al. 2008a, 2008b, and 2008c; Warren et al 2008; Mulvihill et al. 2008, and Ernst et al. 2008). DEP is currently evaluating how to complete this study.

4.7 Riparian Buffer Protection 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.

The following discussion provides an update on each of the milestones set forth within the 2007 FAD, including the progress of existing DEP programs, the Conservation Reserve Enhancement Program (CREP) evaluation and implementation effort, the new Streamside Assistance Program (SAP), and education and outreach activities.

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 among these programs is covered as well.

Land Acquisition Program

The Land Acquisition Program seeks to prevent future degradation of water quality by acquiring real property interests. The overarching goal of the program is to ensure that undeveloped, environmentally sensitive watershed lands receive permanent protection. Section 4.2 of this report conveys the comprehensive progress of the Land Acquisition Program in 2008.

Riparian buffers are defined as those areas 100 feet from the centerline of streams and rivers, but excluding the length of "shoreline" around reservoirs, ponds, lakes, or wetlands. 34.8% of the entire 1,049,466-acre Catskill/Delaware watershed system is now defined as "protected," being owned outright or under easement by DEP, the Watershed Agricultural Council (WAC), or NYSDEC, or held by other public or private open space entities such as municipal parks or land trusts. Within this area lie roughly 30.4% (23,232.3 acres) of all stream buffers in the watershed. Including lands it owned before 1997, DEP alone protects 12% of 100-foot stream buffers. This represents a 4.5% increase in buffer ownership since 2004.

DEP also funds WAC's acquisition of conservation easements on farms. Such easements allow farming to continue under Whole Farm Plans, and also prohibit agricultural use within a defined area along streams. During 2008, the model easement was revised to expand the width of this protected riparian buffer from 15 feet to 25 feet.

Land Management Program

DEP works to protect the riparian buffers on City-owned lands in a variety of ways, including inspecting the lands on a regular schedule tied to a priority ranking, and thoroughly evaluating all applications for permitted activities. The latter include agricultural and silvicultural activities, as well as stream work. Evaluating these proposed activities is a major focus of collaboration among BWS staff, with an emphasis placed on riparian buffers. On lands where DEP is actively conducting forest management, buffers are afforded special protection, with consideration given to multiple values like streambank stability, ecological functions, and forest vigor. Section 4.3 reports the full progress of the Land Management Program in 2008.

Substantial progress in 2008 included:

- Advancing a Memorandum of Agreement between DEP and the US Forest Service to develop a forest management plan for all City watershed lands, including a comprehensive forest inventory. An important component of this plan will be the guidance it provides on how forestry projects are selected, planned, and carried out with respect to riparian areas (including wetlands, springs, and seeps)
- Establishment of an Invasive Species Working Group
- Development of a series of guidebooks for activities on DEP conservation easements, including agricultural activities, forestry, bluestone mining, work in or near streams and ponds.

Activities on Privately-owned lands

Streams that flow across privately owned lands make up approximately 69.6% of the total riparian buffer acreage (53,090 acres) in the Catskill/Delaware System. Among all Catskill/Delaware reservoir basins, Cannonsville has the highest percentage of privately held riparian lands (86.5%) and Neversink the least (42.9%). Table 4.17 reports approximate riparian buffer acres within each basin and their respective ownership. Many of these riparian buffers are also

protected to some degree by various combinations of MOA programs. For instance, Whole Farm Plans and Watershed Forestry Plans have been largely developed and implemented in the Cannonsville and Pepacton basins where private ownership is the greatest.

The following sections detail efforts to enhance and protect riparian buffers on private land.

Table 4.17. Total acres of protected riparian buffers by basin as of December 2008.

	Catskill / Delaware System**									
	Riparian Buffer Acres									
Protection Type	Ashokan	Boyds Corner	Cannonsville	Kensico	Neversink	Pepacton	Rondout	Schoharie	West Branch	Total Cat/Del
NYC non-LAP	308.8	10.0	508.1	96.4	319.3	444.4	77.8	117.1	62.2	1,944.0
NYC LAP Fee*	497.1	394.9	655.4	11.8	141.4	834.2	373.6	1,091.3	427.5	4,427.2
NYC LAP CE*	160.7	52.3	145.4	20.7	229.0	381.4	47.8	266.9	34.7	1,338.8
NYC LAP WAC CE*			945.5		19.0	281.8	88.2	78.1		1,412.6
NY State	5,073.0	118.3	218.0		2,206.2	1,412.6	1,659.0	2,566.6	116.3	13,370.0
Other OS	151.4	19.5	65.0	27.2	162.9	160.4		114.3	38.9	739.6
Subtotal	6,190.9	594.9	2,537.5	156.0	3,078.0	3,514.8	2,246.4	4,234.2	679.7	23,232.3
Privately-owned	5,188.9	592.7	16,244.7	292.3	2,311.5	12,194.1	2,551.2	13,135.9	578.5	53,089.9
Grand Total	11,379.9	1,187.6	18,782.2	448.3	5,389.5	15,709.0	4,797.6	17,370.1	1,258.1	76,322.2

* Under contract or closed as of December 31, 2008.

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

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

Stream Management Program

The Stream Management Program (SMP) is an important component of the City's efforts to protect and enhance riparian buffers. The SMP's mission is to restore stream stability and ecosystem integrity by encouraging long-term stewardship of Catskill Mountain streams and floodplains. The SMP and its regional partners address riparian buffers through corridor planning, mapping riparian vegetation, designing and constructing stream restoration projects, removing invasive plants, conducting extensive education and outreach, and developing and implementing the Streamside Assistance Program (SAP). The comprehensive effort of the SMP in 2008 is reported in Section 4.6.

By the close of 2008, stream management plans with corresponding riparian buffer mapping had been completed for the Batavia Kill, Broadstreet Hollow, Chestnut Creek, East Kill, Esopus, Manor Kill, Schoharie, Stony Clove, East and West Branch Delaware, and West Kill watersheds.

Significant accomplishments of the SMP and its program partners in 2008 towards the protection and enhancement of riparian buffers included:

- Development of the SAP guidelines, native plant materials development, a planting "Corps," and initial staffing.
- Sponsored riparian activities at 16 restoration projects, which addressed 24,500 feet of stream and included installation of over 5,000 native trees and shrubs, 6,400 willow posts, and 2,000 feet of willow fascines.
- With DCSWCD, enhanced vegetation at 13 NRCS Emergency Watershed Protection Program project sites by preparing planting plans, acquiring materials, and contracting for the planting of the sites.
- Secured more than 60 volunteers to install over 700 individual trees and shrubs.
- Analyzed vegetation monitoring data collected by DEP and partners from 22 buffer planting projects, and extended monitoring results for improving riparian buffer design and management.
- Presented preliminary monitoring findings at "Working at the Waters's Edge: Riparian Buffers and Ecosystems" conference.
- Mapped the riparian vegetation on two Catskill streams, the Manor Kill (Schoharie) and Woodland Valley (Ashokan)**.**
- Provided nine presentations on riparian buffers or Japanese knotweed to over 270 individuals representing private landowners and a variety of agencies.

Watershed Agricultural Council

The Watershed Agricultural Council (WAC) is a non-profit organization with the mission to support the economic viability of agriculture and forestry through the protection of water quality and the promotion of land conservation in the Watershed. The WAC operates through two main programs, the Watershed Agricultural Program (WAP) and the Watershed Forestry Program (WFP). Section 4.5 reports the broad range of accomplishments of the WAC and WFP in 2008.

Watershed Agricultural Program

WAP is a voluntary partnership between watershed farmers and the City 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.

To date, approximately 95% of all commercial farms in the West of Hudson Watershed have agreed to participate in the program. There are presently 289 farms with approved whole farm plans. WAP has developed an Environmental Review/Problem Diagnosis (ER/PD) Assessment of these 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 has been identified by the ER/PD is unlimited livestock access to watercourses. Livestock can cause erosion on streambanks, deposit their waste directly into streams, and denude riparian vegetation. The planner identifies the barriers or BMPs necessary to limit nonpoint source pollution from farms.

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

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) that supports well-managed working forests as a beneficial land use for watershed 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. These initiatives include the Forest Management Plans, the Management Assistance Program, and the Forestry BMP Program. 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.

Significant accomplishments in 2008 include:

- Fifty-eight new Forest Management Plans were completed covering approximately 10,740 acres, of which an estimated 8,851 acres are forested.
- Six existing WAC plans were either updated or upgraded to newer WAC plan specifications. These plans include riparian management recommendations for 253 riparian acres.
- Completed the three-year Management Assistance Program (MAP) pilot project, which was developed to provide landowners having a WAC forestry plan with up to $2,500 in grant funding assistance to implement specific practices recommended in their plans.
- Within the Forestry BMP Program, WAC supported the implementation of three bridge projects and the completion of 52 forest road BMP projects.

Catskill Watershed Corporation (CWC) Stream Program

The purpose of the CWC Stream Corridor Protection Program is to fund stream projects that mitigate or correct existing situations in hamlets, villages, or population centers that present imminent and substantial danger to persons or properties. To be considered for funding under the program, a proposed project must be consistent with the recommendations set forth in any applicable stream management plan. To this end, DEP and CWC project staff encourage proposed projects to incorporate riparian components where applicable. Seven of the 13 projects funded through the program in 2007 proposed riparian buffers accounting for an additional 1.25 acres of

enhanced buffer. The largest project, the Prattsville Streambank Project, includes a major riparian component and is proposed to be protected for a longer period of time through the USDA and CREP.

4.7.2 Conservation Reserve Enhancement Program Evaluation and Implementation

In August 1998, DEP entered into a five-year MOA with NYSDEC and the United States Department of Agriculture (USDA) to implement CREP in the Catskill and Delaware watersheds. DEP was later granted a continuation through the current Farm Bill of the New York City Watershed CREP Agreement.

The 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. The USDA pays the farmer on average an enhanced rental rate as well as 50 percent of the cost of all BMPs associated with establishing riparian buffers and/or permanent vegetative cover. DEP, through its agreement with the WAC, pays the remaining 50 percent of BMP costs for participating farms, as well as technical and administrative assistance costs. In federal fiscal year 2000, the USDA added two significant financial incentives, the Signup Incentive Payment (SIP) and the Practice Incentive Payment (PIP).

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 pastureland, 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.

WAC seeks to add 150 new riparian forest buffer acres in the CREP Program annually, and is working towards an evaluation of CREP, which is due in December 2009. The evaluation includes a survey of farmers to identify why some are reluctant to participate or enroll cropland and, for those participating, to find out what they like about the program. The evaluation will also include some performance monitoring of past plantings.

Significant 2008 accomplishments include:

- CREP protected an additional 43.6 acres containing 3.6 stream miles. This brings the total acreage protected with CREP riparian buffers to 1,928.8, which represents 185 stream miles. The average width of these buffers is 86 feet.
- More than 192 acres of riparian buffer were approved by WAC and are in the contract development "pipeline".
- The total number of livestock excluded from stream buffers is now 10,000.

- Approximately 58 surveys (36 CREP participants and 22 non-participants) were completed.
- Monitoring plots on a set of 16 farms with CREP plantings were established and preliminary observations were conducted. Performance evaluations are planned for summer 2009.

4.7.3 Streamside Assistance Program (SAP)

DEP with its partnering agencies identified the need for a program for private properties that do not qualify for participation in other partnership programs, such as small, non-agricultural lands. DEP initiated the SAP to provide private landowners enhanced education and training opportunities as well as access to technical assistance in the design and installation of riparian buffer projects. Many agencies and organizations contributed to the development of guidelines over the past 18 months, including the Watershed Soil and Water Conservation Districts, various DEP units, and the Riparian Buffer Working Group. Professionals overseeing similar programs in other states were also consulted on the main components of this new program. As per the FAD, SAP Guidelines were submitted on December 31, 2008.

The overall goal of the SAP is to inform and assist landowners in better stewardship of their riparian areas through protection, enhancement, management, or restoration. DEP and its partners will assist private, riparian landowners throughout the West of Hudson Watershed by providing:

- Riparian Corridor Management Plans to create awareness about riparian management issues specific to individual properties;
- Best management practice design and/or prescriptive measures and installation to encourage positive riparian stewardship; and
- Educational materials and activities as needed by landowners to understand the critical role of their buffers and how to maintain them in optimal functioning condition.

Riparian Buffers Working Group (RBWG) 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 five of these meetings, recently featuring Ed Toth, Director of the Greenbelt Native Plant Center, on "The Importance of Local, Native Genotypes," and Fred Sechler of NY Natural Heritage on "Establishing Riparian Reference Reaches in the Catskills". These meetings provide an opportunity for valuable dialogue about the various components included in the Riparian Buffer Protection Program. For instance, the December 2008 meeting focused on receiving feedback from participants on draft SAP guidelines. RBWG members also serve on three subcommittees assisting development of the overall SAP.

After developing, printing, and distributing the booklet, "Catskill Streams and You: Living Streamside in the Catskill Region," the outreach committee of the RBWG formally launched the multi-agency website, www.catskillstreams.org. DEP has continued to maintain this website on the partners' behalf, adding timely information as needed.

Site Prioritization

An important component of the SAP is determining site eligibility. In 2008, DEP led the SAP Guidelines Subcommittee in a field exercise, visiting three sites and scoring them using a draft site visit evaluation form. The exercise proved very useful in that it allowed the group of partners to discuss what types of parcels and projects might be eligible for SAP. The exercise, coupled with discussion at the winter RBWG meeting, helped shape the final rating criteria included in the SAP Guidelines.

Streamside Management Guidance

The SAP will be implemented by a core team of five Coordinators—four working from SWCD offices in the West of Hudson Watershed and led by one overall program manager from DEP in Kingston, New York. The SAP Coordinators will work independently within their assigned reservoir basin(s), but will also meet frequently together and with DEP and other partners throughout the year to receive training, and to share, discuss, and critique experiences.

DCSWCD and GCSWCD hired coordinators and both began their work in January 2009.

Native Plant Material Exploration

DEP and partners have stressed the importance of maintaining ecological integrity by facilitating the use of plant materials that are native to the Catskill region. For this reason, in spring 2008, the NY Natural Heritage Program (NYNHP) was contracted by the GCSWCD and DEP to inventory, classify, and describe a set of riparian natural community reference types for the West Kill watershed. Reference community descriptions will include recommendations for restoration and management, such as the most appropriate species to plant and the most appropriate mix of size classes to strive for when restoring each community type. These reference community descriptions can then be used as a guide for stream corridor re-vegetation within the Schoharie watershed, with potential application throughout the larger West of Hudson Watershed.

A critical element of providing native plant material is growing it, which starts with seed collection. This year, DEP established an agreement with the NYC Parks Department's Greenbelt Native Plant Center to collect, clean, store, and propagate seed from the Catskills. Over 255,000 seeds of herbaceous, shrub, and tree material were collected. Greenbelt will provide the first material installment in fall 2009.

Training opportunities for DEP and partnering staff are also critical to the development of native plant material supply. To this end, Greenbelt led a workshop teaching how to collect native plant seed, and the NRCS, with DCSWCD and DEP, led a workshop teaching how to identify native willows. The latter workshop identified Catskill species for propagation at the NRCS nursery at Big Flats, which will commence in 2009.

Substantial progress was made identifying the roles of the private and public sectors in implementing the SAP. A Student Conservation Association (SCA) member investigated plant material supply and demand in the Catskills, the availability of appropriate material to install on project sites, and similar programs in the U.S. Using a survey, quotes were sought from 210 businesses in the plant production industry for seed collection and propagation, grow-out, installation, buffer design, and educational services. Thirty-four companies participated in the survey. The greatest interest was in providing propagation and grow-out services, indicating that DEP can rely on the private sector to fulfill this role. Only two entities indicated they could assist with plant installation, supporting the need to develop internal project installation capability.

Finally, to provide additional hands-on assistance in native planting and invasive species removal, DEP established a summer intern program, the "Streamside Assistance Corps", with SUNY Delhi. Three interns assisted DEP, DCSWCD, Delaware County Highway Department (DCDPW), and GCSWCD with CREP evaluation, sedge planting, wetland seeding and plug planting, tree and shrub plantings, and Japanese knotweed removal.

Communication Materials

In 2008, DEP issued a competitively bid request for proposals to develop communications materials for the SAP. These materials will include a needs assessment, a marketing strategy, potentially a proposal for a new program name, and a program slogan and logo. CRSR, the consulting firm which also designed the Catskill Streams website, was the successful bidder and will begin work in 2009.

4.7.4 Education, Outreach, and Marketing

Numerous education and outreach activities were undertaken in 2008 in support of riparian buffers, and these are reported in Sections 4.5 and 4.6.2 of this report, as well as in other sections of Chapter 4.

4.7.5 Recommendations

Building upon a strong existing program framework for the protection, management, and enhancement of riparian buffers, in 2008 DEP effectively began to close a programmatic "gap" in protections for riparian buffers by establishing the guidelines for the Streamside Assistance Program and beginning to staff the program. The stage was well set at the close of the reporting period to accomplish the requirements and direction established by the 2007 FAD. Most important now is the continued collaboration and integration of DEP and partnering programs toward our common goals. In support of these goals and of DEP's partnering agency efforts, DEP will

continue to convene coordination initiatives such as the Riparian Buffer Working Group, the Invasive Species Working Group, and extensive partnering projects documented throughout the FAD annual report. DEP will also continue to effectively implement its existing Watershed programs.

In 2009, DEP's most important task will be to launch the SAP by fulfilling its staffing requirements, kicking off implementation with partners using communications materials developed by CRSR, developing its first set of Riparian Corridor Management Plans, and soliciting its first applications for the program. In advancing an ecologically-based effort, DEP will incorporate findings from the NYS Natural Heritage Study into the SAP, and, to ensure a supply of native plant materials, DEP will continue to support its substantial effort with the Greenbelt Native Nursery.

In 2009, DEP's most important task will be to complete the CREP evaluation, and the education, outreach, and marketing strategy for riparian landowners.

4.8 Wetlands Protection Program

DEP's Wetlands Protection Strategy, initiated in 1996 and most recently updated in 2007, consists of regulatory and non-regulatory elements designed to protect and preserve the water quality function of wetlands in the watershed (DEP 2007). The strategy uses wetlands mapping and research to inform protection programs. Data collected through wetland mapping and monitoring provide baseline information for protection and partnership programs such as permit review, land acquisition, and stream and forest management. In 2008, DEP continued its review of federal, State, and municipal wetland permit applications, and also reviewed proposed land uses under SEQRA and the Watershed Rules and Regulations to recommend measures to avoid, minimize, and mitigate wetland impacts to the extent practicable. Data collection continued from automated monitoring wells in reference wetlands and a Wetlands Status and Trends study was completed for the West of Hudson Watershed.

4.8.1 Permit Review Program

A main component of DEP's Wetland Protection Strategy is reviewing and commenting on applications for federal, State, and municipal wetland permits, as well as proposals subject to environmental review under the State Environmental Quality Review Act (SEQRA).

United States Army Corps of Engineers Section 404 Permit Applications

During 2008, DEP continued to receive on-line notifications and to check the ACOE website regarding Public Notices for permit applications within the NYC watershed. In its review, DEP encourages the Corps to require an alternative project design, or a location that will avoid adverse impacts. If this is not entirely achievable, DEP pursues opportunities with the Corps to minimize impacts, also through modification of the project design and/or its location. Finally, if opportunities to avoid or minimize impacts do not exist, DEP assesses mitigation options that

would compensate for any wetland impacts that result from the project. In these cases, DEP proposes alternatives that might better replicate any water quality function(s) of the impacted wetland.

Table 4.18. DEP commented on two proposals from the ACOE during 2008.

Project Name	NYC Reservoir Basin	Notification/ Permit	Activity
Lake Carmel Dam	Middle Branch	ACOE/DEC	Dam Valve Repair/Installation
Arrowhead Subdivision 708 Underhill Avenue Corporation	New Croton	ACOE	Discharge of fill material into wetlands for culvert crossings and storm drain installations for a residential subdivision

NYSDEC Article 24 Wetland Permit Applications

In 2008, DEP continued to review NYSDEC Freshwater Wetland Permit Applications subject to Article 24 of New York State's Environmental Conservation Law. DEP's review of freshwater wetland permit applications assesses the proposal's impact on wetlands and their regulated adjacent areas and identifies measures to avoid, minimize, or mitigate those impacts. Once DEP becomes aware of a permit application through DEC's Environmental Notice Bulletin, discussions with DEC, or other means, DEP's wetland permit review team reviews the permit applications. Comments issued by DEP include identifying omissions in the applications and measures that should be incorporated into a proposal to protect wetland functions and water quality. Elements of the proposed projects are often changed based on DEP's comments, resulting in a project with less impact to the wetland or the adjacent area. DEP reviewed eight NYSDEC Article 24 Freshwater Wetland Permit applications during 2008 (Table 4.19).

Table 4.19. DEP reviewed eight DEC Article 24 Freshwater Wetland Permit applications during 2008.

Project Name	NYC Reservoir Basin	Notification/ Permit	Activity
Peter Kamenstein Stream Crossing	Titicus	Article 24	Installation of a new 48"-diameter HDPE culvert and gravel stream crossing
Putnam Bikeway II Stages 2 and 3	Middle Branch	Article 24	Grading and filling associated with a paved bicycle path, culverts, headwalls, riprap, and wetland mitigation along abandoned railroad bed

Table 4.19. (Continued) DEP reviewed eight DEC Article 24 Freshwater Wetland Permit applications during 2008.

Project Name	NYC Reservoir Basin	Notification/ Permit	Activity
Clearwater Excavating	Muscoot	Article 24	Wetland restoration
Meadows at Cross River	Cross River	Article 24	Piping and planting in buffer
Yorktown Farms	Muscoot	Article 24	Stormwater basin outfall through buffer and into wetland
Durand Walking Trail	Titicus	Article 24	Walking trail
Cheng Property	Kensico	Article 24	Pond restoration—project withdrawn
River Run Farm LLC	East Branch	Article 24	Stabilization of streambank on East Branch Croton River

Wetland Violations

DEP issued five Notices of Violation for wetlands in 2008.

Table 4.20. DEP issued five Notices of Violation involving wetlands in 2008.

Project Name	NYC Reservoir Basin	Notification/ Permit	Activity
Town of Mt. Kisco transfer station	New Croton	Violation	No SPDES permit for stormwater basin. Town has consent order with DEC
Richard Szentkuti-CV Building Concepts	Titicus	Violation	Erosion
New City Diner	New Croton	Violation	Sewage discharge into DEC Wetland A-10
Josephine's Restaurant	New Croton	Violation	Sewage discharge into DEC Wetland A-10
Small commercial property	Cross River	Violation	Sewage discharge into DEC Wetland F-6

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 the State and federal application, DEP assesses the proposal's impact on wetlands and regulated adjacent areas and identifies measures to mitigate those impacts. As with the Article 24 reviews, elements of the proposed projects were often altered based on DEP's comments. DEP reviewed 15 local municipal wetland reviews during the reporting period.

Table 4.21. DEP reviewed 15 local municipal wetland reviews during 2008.

Project Name	NYC Reservoir Basin	Notification/ Permit	Activity
Bissonette/Silvestri Property	Titicus	Local Municipal	Pond restoration
The Auburn Group	Titicus	Local Municipal	Gravel driveway in buffer, stormwater pond, bridge over wetland stream
John & Marilyn Gizzi	East Branch	Local Municipal	Construction of pool in wetland buffer, repair erosion, build steps to lake, create beach in wetland next to lake.
Whitford/Madaloni	Titicus	Local Municipal	Wetland restoration
Peter Kamenstein	Titicus	Local Municipal	Dredging of waterbody
213 High Ridge Road	Titicus	Local Municipal	Subdivision with a stormwater detention basin in wetland buffer
Schwartz Residence	Muscoot	Local Municipal	Construct pool house and wood pergola, and extend existing stone terrace in buffer. Plantings in buffer as mitigation
Ira and Madeline Rothman	Titicus	Local Municipal	Installation of electric deer fence around perimeter of property with portions located within a non-DEC wetland
Mary-Elizabeth Reeve	Titicus/ Muscoot	Local Municipal	Install a 4 ft. high fence along portion of property line
Robert Abrams	Titicus	Local Municipal	Erosion Control, walking path, pond creation in buffer. Possible second pond creation in wetland
Trelawny Farm LLC	Muscoot	Local Municipal	Wetland mitigation/restoration
Anton Kola	Cross River	Local Municipal	Renovation of single-family residence, wetland mitigation
Monomoy Farm LLC	Titicus	Local Municipal	Horse farm improvements including farm roads, bridge, drainage, and mitigation planting.

Table 4.21. (Continued) DEP reviewed 15 local municipal wetland reviews during 2008.

Project Name	NYC Reservoir Basin	Notification/ Permit	Activity
Laurence D. Fink	Titicus	Local Municipal	Enlarge an existing man-made pond, install concrete and stone veneer retaining wall and weir, install equestrian bridge and associated landscape plantings
Steven Rattner (aka Monomoy Farms)	Titicus	Local municipal	Repair or replace a portion of the house foundation/retaining wall, excavation, remove garage partially located within the buffer, rebuild deck and stairs, remove tree and install plantings

Article 15 Protection of Water Permit Reviews

In 2008 DEP continued to receive and review NYSDEC stream disturbance permit applications. DEP issues comments to DEC Regions 3 and 4 concerning proposals with potential wetland impacts. The comments identify instances of noncompliance, potential impacts on water quality, and measures that could be incorporated into a proposal to avoid, minimize, and mitigate the water quality impacts anticipated from the activity. During 2008, DEP reviewed and commented on one NYSDEC Article 15 Protection of Waters Permit application represented in the table below.

Table 4.22. DEP reviewed and commented on one NYSDEC Article 15 Protection of Waters Permit application.

Project Name	Town	Stream	State Permit	Project Type
Fletcher Farm Stream Intervention Project	Walton	Third Brook	Article 15	Stream Restoration

SEQRA Documents

In addition to documents received through DEP's SEQRA Coordination Section, DEP continued to review SEQRA documents as received from towns that forward projects to DEP for review. DEP reviewed one project at the request of a watershed town through the SEQRA process for wetland impacts in 2008.

Legislative Reviews

In 2008, DEP commented on the USEPA's and Army Corps of Engineers' *Guidance Regarding Clean Water Act Jurisdiction after Rapanos*. The guidance was published in June 2007 to address jurisdiction over waters of the United States under the Clean Water Act in the wake of the United States Supreme Court's decision on the consolidated cases of Rapanos v. United States and Carabell v. United States.

4.8.2 Non-Regulatory Programs

Acquisition of Wetlands:

DEP calculates (using updated data) that 15,196 acres (1.45%) of the Cat/Del System are non-inundated wetlands as defined by NYSDEC or the US Army Corps of Engineers (Table 4.23). Within land protected since 1997 are 2,060 acres of wetland, which represents 13.6% of these wetlands in the watershed.

Table 4.23. Wetlands acquired or protected by DEP in the Catskill/Delaware and Croton Systems as of December 31, 2008*.

Description	Acres	% of Total Watershed Acreage	% of Total Land Acquired	% of Total Wetland Type in System
For Catskill/Delaware (Ashokan, Schoharie, Rondout, Neversink, Pepacton, Cannonsville, West Branch, Boyd Corners, Kensico basins):				
Total Acreage of Entire Watershed	1,049,465			
Total Acreage of Wetlands (both NWI and DEC-regulated) in Entire Watershed (excluding Deepwater Habitats**)	15,196	1.45%		
Total Acreage of Deepwater Habitats in Entire Watershed	28,925	2.76%		
Total Acreage of Wetlands and Deepwater Habitats in Entire Watershed	44,121	4.20%		
Total Lands Under Contract or Closed by DEP as of December 31, 2008†*	90,017	8.58%		
Within those total lands under contract or closed:				
Total Acreage of Wetlands (both NWI and DEC-regulated, excluding Deepwater Habitats**)	2,060		2.29%	13.56%
Total Acreage of Deepwater Habitats**	144		0.16%	0.50%
Total Acreage of Wetlands and Deepwater Habitats**	2,204		2.45%	5.00%

Table 4.23. (Continued) Wetlands acquired or protected by DEP in the Catskill/Delaware and Croton Systems as of December 31, 2008*.

Description	Acres	% of Total Watershed Acreage	% of Total Land Acquired	% of Total Wetland Type in System
For Croton:				
Total Acreage of Entire Watershed	212,577			
Total Acreage of Wetlands (both NWI and DEC-regulated) in Entire Watershed (excluding Deepwater Habitats**)	20,150	9.48%		
Total Acreage of Deepwater Habitats in Entire Watershed	10,806	5.08%		
Total Acreage of Wetlands and Deepwater Habitats in Entire Watershed	30,956	14.56%		
Total lands under contract or closed by DEP as of December 31, 2008†*	2,245	1.06%		
Within those total lands under contract or closed:				
Total Acreage of Wetlands (both NWI and DEC-regulated, excluding Deepwater Habitats**)	127		5.65%	0.63%
Total Acreage of Deepwater Habitats**	2		0.07%	0.02%
Total Acreage of Wetlands and Deepwater Habitats**	129		5.73%	0.42%

* Source: WLCP GIS, January 2009. Note: Acres are calculated directly from areas of GIS polygons and therefore may not match exactly other acreage totals submitted by DEP. NWI Wetlands acreages exclude all upland (U), unconsolidated shore (L2US), and streambeds (RSB) categories.

** Categories considered "deepwater habitats" from NWI wetlands include reservoirs or large lakes (L1), unconsolidated shoreline (L2US), riverbeds (RUB), and streambeds (RSB), but not ponds or small lakes.

† Includes fee, conservation easements, and farm easements.

Wetland Mapping and Research

The wetland mapping and research projects are designed to support both the regulatory and non-regulatory aspects of DEP's Wetlands Protection Strategy (DEP 2007). To date, mapping and research projects have included the National Wetlands Inventory, Wetland Status and Trends studies, and Wetland Monitoring and Functional Assessment programs. The National Wetlands Inventory has provided baseline data for previously completed wetland mapping projects such as landscape level wetland functional assessment both East and West of Hudson, and for East of Hudson status and trends analyses (Tiner and Stewart 2004, Tiner et al. 2004, Tiner et al. 2005). In 2008, the National Wetlands Inventory, as updated in 2005 using 2003/2004 aerial photography, provided baseline data for a West of Hudson Status and Trends Study (Tiner et al. 2005a, Tiner 2008).

WOH Wetlands Trends and Analysis

Through an agreement with the US Fish and Wildlife Service (USFWS), an analysis of wetland gains, losses, and cover type changes was completed for the West of Hudson Watershed for two time periods: from the mid-1980s to mid-1990s and from the mid-1990s to 2004. The USFWS superimposed 2004, and then mid-1980s, NWI data on mid-1990s aerial photography to identify wetland gains from uplands, losses to upland, and changes in wetland cover types between the two time periods. Changes in non-vegetated wetlands were annotated separately from vegetated wetlands because their functions differ in many respects. For example, conversion of a vegetated wetland to a pond was recorded in the database as a loss of vegetated wetland and a gain of a non-vegetated wetland, and the conversion of a pond to a vegetated wetland was recorded as a gain of a vegetated wetland and the loss of a non-vegetated wetland. Next, aerial photography was interpreted to identify specific land use or land cover associated with wetland losses or gains. While a brief summary of the findings is provided below, a detailed description of methods and findings can be found in a report provided by the USFWS entitled *Wetlands of the West-of-Hudson Watershed of the New York City Water Supply System: 2004 Status and Trends since the Mid-1980's* (Tiner 2008).

Approximately 10,560 acres of wetlands were detected in the West of Hudson Watershed using the 2003 and 2004 aerial photography. Palustrine emergent wetlands comprised 29% of the acreage, ponds represented 26%, forested wetlands 21%, and shrub swamps 15%. Non-vegetated wetlands accounted for the remaining 9% (Table 4.24). From the mid-1980s to the mid-1990s, there was a net loss of approximately 87 acres of vegetated wetlands in the West of Hudson Watershed. Non-vegetated wetlands (ponds) increased by a net of 527 acres. Approximately 94% of the total loss of vegetated wetlands was due to pond construction (106 acres), and an additional 440 acres of ponds were constructed in uplands. Forty-two percent of the ponds constructed on uplands were on farmlands, 30% from forests, and 18% from shrub thickets. Eighty percent of the ponds constructed in wetlands were from palustrine emergent systems.

Table 4.24. 2004 wetland acreage for the West of Hudson Watershed of the New York City Water Supply System (from Tiner 2008).

NWI Wetland Type	Acreage	% of Wetlands
LACUSTRINE WETLANDS		
Unconsolidated Shore	**586.8**	**5.6**
PALUSTRINE WETLANDS		
Aquatic Bed	**0.1**	**--**
Emergent		
Emergent	2582.8	
Emergent/Forested	13.7	
Emergent/Scrub-Shrub	416.5	
Subtotal Emergent	***3013.0***	***28.5***

Table 4.24. (Continued) 2004 wetland acreage for the West of Hudson Watershed of the New York City Water Supply System (from Tiner 2008).

NWI Wetland Type	Acreage	% of Wetlands
Scrub-Shrub		
Scrub-Shrub, Deciduous	1279.1	
Scrub-Shrub, Evergreen	11.9	
Scrub-Shrub, Mixed	40.1	
Scrub-Shrub/Emergent	207.8	
Scrub-Shrub/Forested	25.2	
Scrub-Shrub/Unconsolidated Shore	1.9	
Scrub-Shrub, Dead	4.6	
Subtotal Scrub-Shrub	***1570.6***	***14.9***
Forested		
Forested, Deciduous	1362.9	
Forested, Evergreen	533.8	
Forested, Mixed	259.8	
Forested/Emergent	12.1	
Forested/Scrub-Shrub	28.8	
Forested, Dead	63.4	
Subtotal Forested	***2260.8***	***21.4***
Unconsolidated Bottom	**2741.1**	**26.0**
Unconsolidated Shore	**14.3**	**0.1**
Subtotal Palustrine	**9599.9**	**90.9**
RIVERINE WETLANDS		
Unconsolidated Shore	373.5	3.5
GRAND TOTAL (ALL WETLANDS)	***10560.2***	

From the mid-1990s to 2004, a loss of 15.25 acres of vegetated wetlands was recorded along with a gain of 18.75 acres, for a net gain of 3.5 acres of vegetated wetlands. Non-vegetated wetlands (ponds) showed a net increase of approximately 109 acres. Eleven percent of new ponds were constructed in wetlands, mostly in palustrine emergent systems, accounting for 90% of the loss of vegetated wetlands. The remaining ponds were constructed in uplands, 35% on agricultural land, 20% from shrub thickets, and 18% from forests.

The rate of vegetated wetland loss and pond construction declined between the two time periods. When counting both non-vegetated and vegetated wetlands as part of the watershed's wetland total, there was a net gain of 440 acres from the 1980s to the mid-1990s, which translates into an increase of 44 acres per year. From the mid-1990s to 2004, there was a net gain of 113

acres, or 11 acres per year. However, the gain for both time periods is due to pond construction and did not result in a significant increase in vegetated wetlands. In both time periods, pond construction was responsible for the vast majority of vegetated wetland losses. This increase in pond acreage, often at the expense of vegetated wetlands, is consistent with national trends. The water quality and ecological consequences of this trend have not been documented.

DEP has documented that approximately 40% of the wetland acreage included in its West of Hudson reference wetland monitoring program is not represented in the NWI. This is largely due to difficulty in detecting temporarily or seasonally saturated wetlands in forested conditions. Thus, it is likely that this report may underestimate the loss of forested wetland cover types. In 2009, DEP will continue to review the geodatabase generated through this analysis. In the event that DEP's quality assurance review reveals substantial discrepancies, revised findings will be issued.

WOH Reference Wetland Monitoring Program

DEP implemented a monitoring program at 22 wetlands located throughout the West of Hudson Watershed in 2003. Water quality, soils, vegetation, and water table data were collected from 2004 through 2005 to characterize the conditions and water quality functions of wetlands in the West of Hudson Watershed, and to verify the extent, distribution, classifications, and functions ascribed to wetlands by the USFWS in the NWI and Functional Assessment projects (Tiner and Stewart 2004, Tiner et.al. 2004). While these objectives have been largely met and summarized (DEP 2006), DEP has continued its monitoring program at the 22 West of Hudson wetlands. Specifically, DEP has maintained automated monitoring wells throughout the reference sites. In 2008, DEP replaced several wells with updated, more reliable models and continued to analyze data collected to date. DEP will continue to maintain these wells, and to analyze the water table elevation data, which is collected in 6-hour increments.

Continued monitoring of reference wetlands enables DEP to obtain a long term record to assess baseline conditions and hydrologic functions of watershed wetlands among various landscape settings. This information, in turn, benefits DEP's wetland protection program. For example, reference wetland data is used to assess wetland conditions and functions in the permit review program, and is used to set standards for soil, hydrologic, and vegetation conditions for proposed mitigation sites that DEP is reviewing or constructing. In addition, much of the data collected has enabled DEP to characterize the conditions and functions of headwater wetlands. This information potentially benefits protection of these wetland types, which currently require demonstration of a significant ecological or hydrologic "nexus" to receiving waters to be afforded Clean Water Act jurisdiction (USEPA 2008). Reference wetland monitoring can also provide hydrologic data to support wetland determinations and delineation, and can support the development or validation of wetland assessment methodologies.

Wetland Color Pamphlet

In 2008, DEP began plans to produce a revised version of the previously published *Wetlands in the Watersheds of the New York City Water Supply System* (Tiner 1996). This document will be produced through collaboration with the US Fish and Wildlife Service, and will draw on information gathered from the DEP's mapping and monitoring programs to describe the distribution, characteristics, and functions of wetlands located throughout the watershed.

4.9 East of Hudson Nonpoint Source Pollution Control Program

The East of Hudson Nonpoint Source Pollution Control Program (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 treatment systems (SSTS).

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 basins. The inspection program includes identifying defects and assessing those that may result in exfiltration of effluent to surface water. Digitized data includes sewer pipe size, estimated age, composition, and precise location; manhole location, size, and estimated age; pump station locations, size, and flow capacity; interceptor sewer location, size, and estimated age; and other pertinent data concerning cross and illicit connections.

DEP began infrastructure inspections in 2004. During the contract it was discovered that the number of structures and length of pipe were substantially more than initially estimated. The work to inspect and digitally map the remaining 250,000 feet of sewer pipelines and 1,200 structures will be completed under a new contract. DEP submitted the recommendation to award the contract to Fred A. Cook, Inc. in November 2008. Once the inspection and mapping are complete, DEP will coordinate the remediation of any identified failures with the responsible entity.

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

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 SSTSs. Within Westchester County, DEP worked with the County Health Department during its review of their five-year Septic Management Program (SMP), which was implemented between 2003 and 2008. DEP provided input on the development of enhancements to the program to improve data collection, data sharing, and monitoring associated with the program. County and DEP staff drafted and signed an agreement that outlined the proposed program implementation and enhancements for the next five-year period (2008 to 2013).

Funding to continue the contractor training, contractor licensing, and septic repair database was provided through the East of Hudson Water Quality Investment Program Fund (WQIP), as provided for in Section 140 of the 1997 Watershed Memorandum of Agreement. To date, the County has developed a preliminary database of sewage service status and is currently conferring with local municipalities in order to increase the accuracy of the database.

Within Putnam County, DEP works with 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 4.18). The funds necessary to carry out the County's SRP were provided through the WQIP. Putnam County initially allocated WQIP funds to repair septic systems in the highest priority areas and has since allocated additional funds to allow areas in other phases to be included in the program earlier than initially planned. By moving to lower priority areas earlier than planned, the County risks depleting available program funds before high priority areas have been fully addressed. DEP will continue to coordinate with the County and will assess other opportunities to address priority septic failures if WQIP funds are exhausted.

Additionally, NYSDEC has issued the Phase II MS4 permit requirements that call for specific measures to reduce the impacts of improperly functioning SSTSs. 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 part of the inspection program, home owners will be required to inspect their system once every three years. As EOH MS4s implement these Phase II MS4 requirements, DEP will evaluate its existing activities in order to avoid duplicative or conflicting efforts.

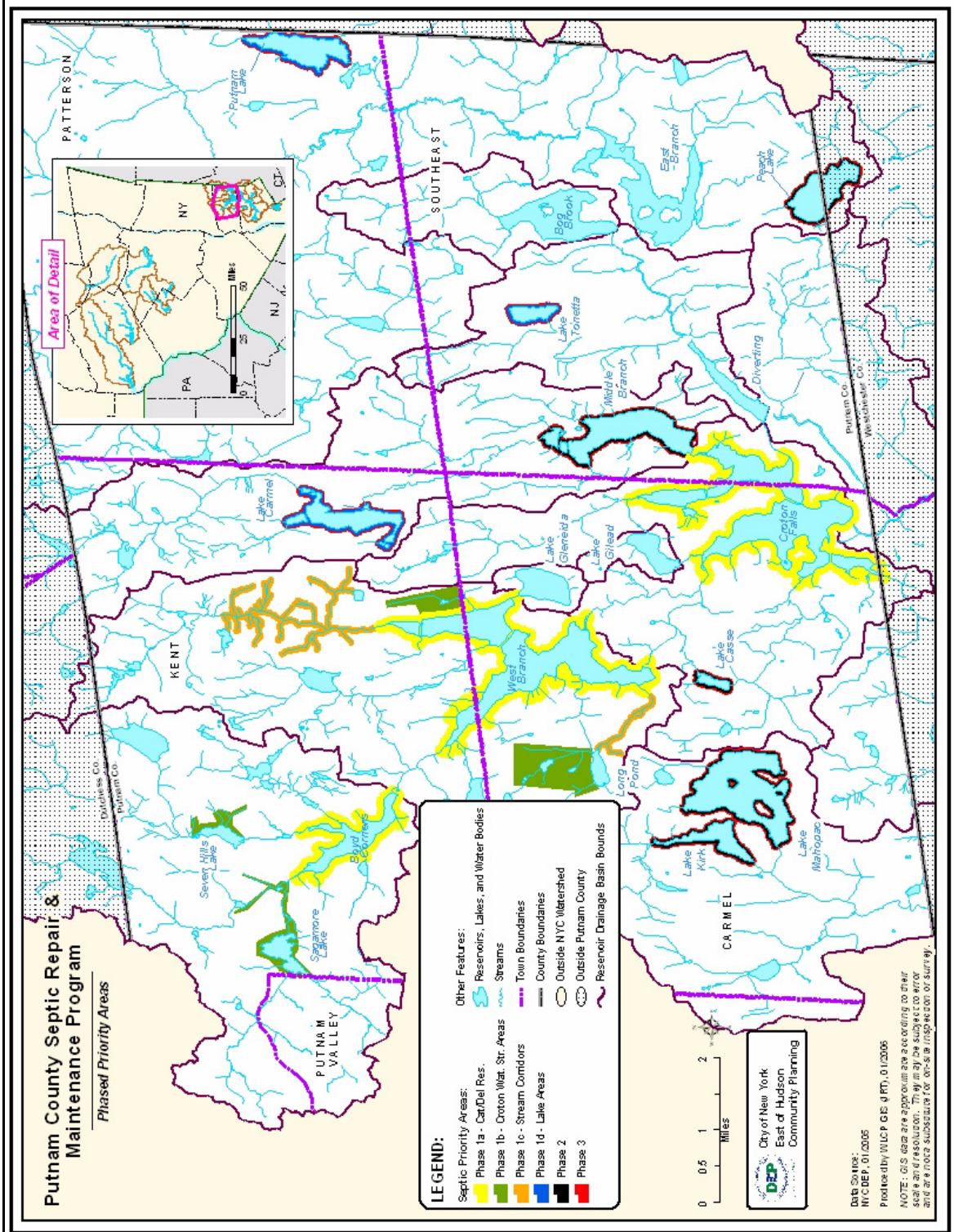

Figure 4.18 Putnam SRP – Phased Priority Areas.

4.9.2 Stormwater-Related Nonpoint Source Pollution Management Programs

Stormwater Retrofit and Remediation

In an effort to further reduce pollutant loading from stormwater runoff, DEP is working on multiple nonpoint source reduction projects within the EOH CAT/DEL basins. 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 unpaved roads 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 involves making roadway improvements as well as improving the functionality of the existing stormwater conveyance system along the roadways.

In January 2008, 90% complete drawings and specifications were received by DEP for internal review. While this review was ongoing, permit applications were prepared and submitted to NYSDEC, as well as the local townships. DEP has taken steps to minimize regulatory involvement from the United States Army Corps of Engineers by avoiding impacts within the boundaries of waters of the United States, including wetlands. However, State and local regulatory requirements afford protection to wetland buffer areas beyond boundaries of delineated waters of the State wetlands. To meet the objectives of the project, it is necessary to perform work in these buffer areas to achieve the intended water quality mitigation and minimize the impact both to the reservoir and nearby wetlands. This required several site visits by local authorities to delineate wetlands and determine the extent of proposed construction, which led to further design modifications.

The construction contract drawings and specifications were finalized in June 2008. DEP advertised the project for bidding in July, held the pre-bid conference, and opened bids in September 2008. DEP awarded the construction contract to Harrison Park Associates in January 2009. DEP continues to take steps in an effort to register the contract as early as possible to enable the contractor to complete the work as soon as possible.

Stormwater Remediation Projects

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

Maple Ave, Town of Bedford, Westchester County: Previously, DEP selected a site (CR-1) along a stretch of Maple Avenue that occasionally experienced accelerated erosion and sedimentation during periods of high precipitation. DEP worked with town officials in an attempt to find a suitable solution. However, ultimately it was the wish of local residents to maintain the road as

unpaved as an expression of rural community character and a cost effective solution was not possible. Therefore, DEP chose another site along Maple Avenue that will have a similar water quality benefit for Cross River Reservoir.

The Maple Avenue site consists of two roadside ditches carrying a significant amount of suspended solids that discharge into Cross River Reservoir. To prevent the continued build-up of sediment along the hillside and water's edge, a sediment and gravel collection system is being designed to concentrate deposition at a location where it can be easily accessed and periodically cleaned. The system will be designed to handle the combined flow, with an engineered overflow controlling the flow of clean water over a weir and to the reservoir. The survey and preliminary design work for this project was initiated in December 2008.

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. The 60% design drawings for this stormwater management facility are complete.

Drewville Road, Town of Carmel, Putnam County: This site replaced the original Joseph Court site (WB-1) in the town of Kent that was found to require acquisition of an access agreement that would cross through and require the demolition of private property. The Drewville Road site consists of a roadside drainage ditch that drains to Croton Falls Reservoir. The drainage ditch has eroded in several locations and is undermining the adjacent rock wall. The ditch will be improved to minimize erosion and repair areas where the wall is being undermined and a micropool extended detention basin will be installed. The basin will be designed to maintain the existing conveyance way, with consideration to any established wetland dependent species along the existing flow path. Preliminary designs for this site are underway.

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 be constructed to 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. Stormwater treatment practices to be installed include two biofiltration areas to collect and treat runoff from the paved areas as well as a vegetated drainage swale to provide additional water quality treatment. Preliminary site plans have been reviewed by the Town of Carmel Recreation Department and their comments are being incorporated into final design drawings. The 60% design drawings for this site are complete.

Nemarest Club, Town of Kent, Putnam County: Improvements to this site include replacing the existing partially collapsed culvert with a larger span concrete structure capable of conveying the 100-year storm and minimize sediment runoff from the damaged roadway entering Boyd Corners Reservoir. Specifically, 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. The 30% design drawings are complete.

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 basins. 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 permitting 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 4.19 shows a typical site selected for inclusion in the program.

Figure 4.19 Eroded drainage ditch at Hemlock Road.

Approximately 30 sites were selected for remediation, of which DEP has completed seven. Due to the limited progress of contract work during the latter part of 2007 and early 2008, DEP consistently pursued options with the general contractor to expedite the site selection, design, permitting, and implementation of repairs. However, in March 2008, DEP received notification that the general contractor had voluntarily defaulted the project to the bonding company. Several attempts to directly ascertain the status and capacity of the contractor to meet its obligations were fruitless and as a result, DEP legal and contract specialists began default proceedings in September 2008.

To complete the 23 remaining sites, DEP initiated negotiations with the registered bonding company to secure and register a replacement contractor. DEP and the bonding company have worked to select a replacement contractor and are currently finalizing review of the agreement. The initial contract was officially deregistered in December 2008 in accordance with DEP contractual procedures and in advance of the pending re-registration process.

In the interim, DEP staff have periodically monitored and inspected the seven completed sites which were properly stabilized in accordance with the contract requirements and remain in good condition. Maintenance of the completed sites rests with the replacement contractor for the duration of the extended contract. Ultimately, completed sites are included in DEP's Facility Inspection and Maintenance Program.

Facility Inspection and Maintenance

The facility inspection and maintenance program was developed 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 3-year maintenance contract thereafter. Inspection and maintenance follow procedures identified in DEP's Operation and Maintenance Guidelines (DEP 2000, revised 2003); 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 implementing a program to digitally map and video inspect stormwater infrastructure in the West Branch and Boyd Corners Reservoir basins, having already completed the contract to map Croton Falls, Cross River, and portions of West Branch and Boyd Corners Reservoir basins. Digital data include stormwater pipe size, estimated age, material and location, catch basins, manholes, culvert outfalls, and all pertinent data concerning cross and illicit connections. In 2007 and 2008, DEP's contractor mapped some 146,000 linear feet of stormwater infrastructure. All stormwater infrastructure in the West Branch and Boyd Corners Reservoir basins has now been mapped.

DEP's contractor also completed the video inspection of the stormwater infrastructure in the West Branch and Boyd Corners Reservoir basins. The inspections have revealed some areas with deformation, breakage, and/or clogging. Figure 4.20 shows typical pipe deformation.

Figure 4.20 Pipe deformation on Westleigh Court.

Digital mapping from the program has been added to DEP's GIS system and is being edited for quality control. DEP has notified the relevant municipalities that the mapping and inspection information will be made available to them so that they can effectively plan for their compliance with the Phase II MS4 permit requirements.

Illicit Connections

During the inspection effort, any potentially illicit connections to the storm sewer system were identified and documented. DEP notified the responsible municipality or county agency so that appropriate steps could be taken to eliminate all illicit inputs and remediate other sources as appropriate. Follow up by DEP with local municipalities and/or county agencies did not indicate that these were illicit connections. Rather, sources such as roof and footing drains were identified.

Stormwater Infrastructure Capacity Evaluation

Upon completion of the digital mapping and inspection program, DEP will initiate a program to evaluate the adequacy of infrastructure within priority areas of the four EOH CAT/DEL basins. 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 draft scope of work for the program has been developed and is currently being reviewed by a consulting firm. The consultant is tasked with evaluating the available data gathered under the digital mapping program, offering recommendations concerning the hydraulic modeling requirements, and providing a refined scope of work. The consultant will additionally provide estimates relative to the cost and level of effort for the future contract.

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 is to include the 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

During the reporting period, DEP and NYSDEC submitted a joint proposal to reallocate a portion of the $4.5 million in funds that were allocated to provide a grant program to reduce stormwater pollution in Cross River and Croton Falls Reservoirs and the upstream basins that flow into these reservoirs, toward the support of a regional stormwater entity (RSE) in the EOH Watershed. DEP, NYSDEC, and the New York State Department of State met with EOH MS4s to begin discussions on the formation of an RSE and potential uses of these funds. The meeting included a discussion of potential legal structures of an RSE led by the director of Pace University's Municipal Law Resource Center. DEP and NYSDEC provided a general overview of the goals as well as some of the potential RSE activities that might be eligible for matching funds under the program. It appeared that interest in a possible RSE remained high and municipalities are determined to continue the RSE discussions at monthly meetings.

Additionally, DEC released the final Phase II MS4 regulations which clarified the obligations on individual MS4s. A meeting focused on the Phase II MS4 regulations and the RSE was held in April that included participants from DEP, NYSDEC, DOS, NYSWIG, Putnam County, Westchester County, and several municipal supervisors. Importantly, as part of the new Phase II MS4 requirements, NYSDEC included a provision that provides municipalities with additional time to implement a stormwater retrofit program if they participate in an RSE. Additionally, NYSDEC has indicated that they anticipate that mutual compliance under the permit will be possible for MS4s that work together as part of an RSE.

EOH municipalities have secured grants to assess potential locations for stormwater retrofits and possible means of establishing an RSE. It is anticipated that the results of these intermunicipal efforts will be available in time for MS4s to make a full determination on the feasibility of forming an RSE in accordance with the timeframes outlined in the MS4 permit. The determination of whether to form an RSE would be needed prior to the permit deadline for submitting a regional retrofit plan in December 2009. Given the possible formation of an RSE prior to that date, DEP prepared a conceptual outline for the expenditure of the $4.5 million. While the timeframe for implementation will be dependent upon the retrofit implementation documents under the MS4 permit, the conceptual plan for the $4.5 million does outline the general structure of the proposed program and provides the RSE with needed flexibility in addressing issues of heightened concern while preserving the majority of funds for stormwater practices that reduce pollutant loading and promote the long-term stability of the RSE.

4.9.3 Other Activities

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, recommend measures 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 under the same timeframe in order to enable the public comment periods to be coordinated and simultaneous. In 2008, a new mayor or supervisor began serving in five of the six municipalities in Putnam County that are involved in the Croton Planning process. As such, many of the recommendations in the Draft Plan were generated by previous administrations. Each new municipal leader would review the findings and recommendations within the Draft Plan. In 2008, Westchester County released a revised draft version of the *Comprehensive Croton Watershed Water Quality Protection Plan for Westchester County* based on comments received from public and municipal officials.

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 to reduce pollutant loads conveyed to the reservoir by stormwater. The facilities, shown in Figure 4.21, 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.

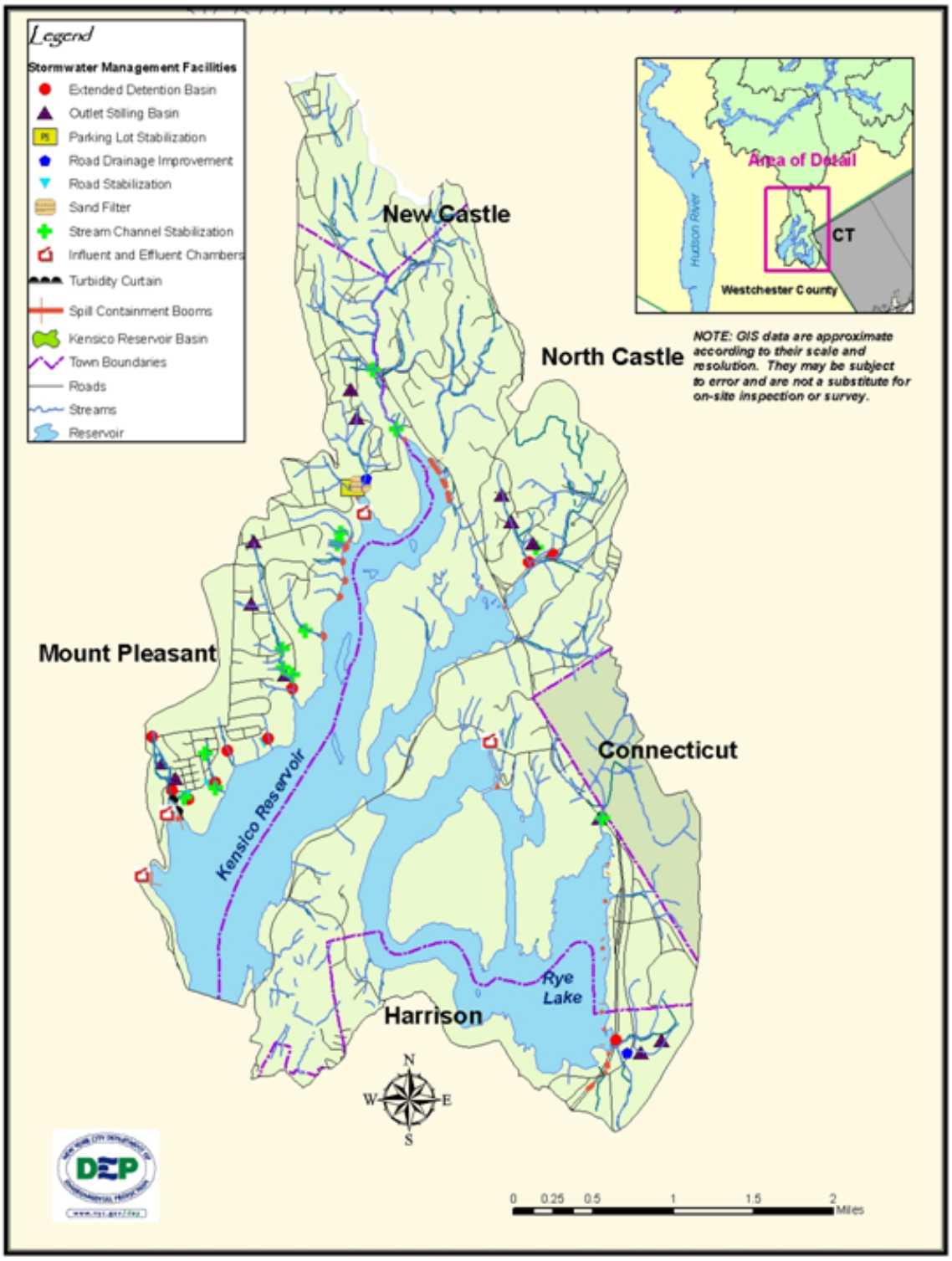

Figure 4.21 Stormwater management facilities in the Kensico Reservoir watershed.

DEP updated the scope of the next 3-year maintenance contract and the new contract was in place in August 2008. Repairs and maintenance activities during 2008 are described in Table 4.25. Typical maintenance activity is shown in Figure 4.22.

Table 4.25. Kensico stormwater and erosion abatement facility construction and completion schedules and maintenance activities.

Basin	Facility Number and Type	Construction Dates	2008 Maintenance Activities
Malcolm Brook	2, extended detention basin	6/17/00 11/21/00	Weed whacked, debris removal, sediment removal forebay (30 CY)
	4, stilling basin	8/31/99 9/13/99	
	8, drop pipe, velocity dissipation box, outlet stabilization	6/14/99 8/20/99	
	12, extended detention basin	4/12/99 11/5/99	Weed whacked Debris removal—upstream and downstream sides Sediment removal upstream (19 CY), fence repair
Young Brook	13, extended detention basin	3/29/99 11/5/99	Sediment removal (4 CY), weed whacked
Young Brook	14, 15 road, outlet, and channel stabilization	3/29/99 11/5/99	
N2	16, outlet stabilization	10/27/99 10/27/99	
N2	18, 19, 20, extended detention basin, and road, outlet, and channel stabilization	9/28/99 9/14/00	Weed whacked
N3	2A, extended detention basin	10/12/99 9/14/00	Weed whacked
N4	23, 24, extended detention basin and road stabilization	12/22/99 9/14/00	Weed whacked, debris removal, replace wetland plants

Table 4.25. (Continued) Kensico stormwater and erosion abatement facility construction and completion schedules and maintenance activities.

Basin	Facility Number and Type	Construction Dates	2008 Maintenance Activities
N5	37, 39, and 40, extended detention basin, road stabilization and channel stabilization	3/27/00 9/14/00	Weed whacked, BMP 40 sediment removal (2 CY) BMP 37—Debris removal multiple times, sediment removal forebay (100 CY)
N5	5A, drop pipe, manhole and stabilized outlet	3/27/00 4/25/00	
N5	35, outlet stabilization	5/24/00 5/25/00	
N5	34, stream channel stabilization	5/23/00 5/23/00	
N5	31, stream channel stabilization	10/25/99 11/22/99	
N5 tributary	28, outlet and stream channel stabilization	10/25/99 10/25/99	Weed whacked, sediment removal (6 CY), reposition rip rap, debris removal
N5	25, outlet stabilization	10/25/99 11/12/99	
N6	41, stream channel stabilization	12/8/99 12/28/99	Sediment removal (1 CY)
Bear Gutter	63, outlet stabilization	4/5/00 4/5/00	
Bear Gutter	64, outlet stabilization	5/26/00 5/26/00	Sediment removal (1 CY), reposition rip rap
Bear Gutter	65, outlet stabilization	5/27/00 5/27/00	Sediment removal (1 CY) , reposition rip rap
Bear Gutter	66, extended detention basin	4/24/00 9/14/00	Weed whacked
Bear Gutter	67, extended detention basin	6/7/00 11/8/00	Weed whacked, replace 1 tree
Bear Gutter	8A, stream channel stabilization	4/18/00 4/20/00	

Table 4.25. (Continued) Kensico stormwater and erosion abatement facility construction and completion schedules and maintenance activities.

Basin	Facility Number and Type	Construction Dates	2008 Maintenance Activities
N8	43, stream channel stabilization	12/3/99 4/3/99	
N9	44, stream channel stabilization	4/18/00 4/18/00	
N12	7A, outlet stabilization	11/16/99 11/17/99	Sediment removal (2 CY)
N12	47, outlet stabilization	11/17/99 11/18/99	Sediment removal (3 CY)
N12	57, sand filter 58, road drainage improvements 59, parking area stabilization	1/11/00 12/15/00 (57) 8/2002 (58 & 59)	Weed whacked, debris removal
Whip	60, stream channel stabilization	12/1/99 12/3/99	
Whip	61, stream channel stabilization	11/29/99 12/3/99	
E9	68	4/10/00 4/10/00	Sediment removal (4 CY), debris removal
E9	68A	5/1/04 11/28/04	
E11	70, outlet stabilization	4/6/00 4/7/00	
E11	71, outlet stabilization	4/7/00 4/7/00	Sediment removal (2 CY)
E11	74, 75	11/6/00 11/28/04	Weed whacked, added item 4 to roadway

Table 4.25. (Continued) Kensico stormwater and erosion abatement facility construction and completion schedules and maintenance activities.

Basin	Facility Number and Type	Construction Dates	2008 Maintenance Activities
Turbidity curtain			Curtain sections put back together from station 0=00 through 9+00, missing anchor connections replaced on the north side of the curtain with stainless steel chain, 30' of seam on top of curtain repaired, small tears from station 0+00 through 9+00 repaired

Figure 4.22 Accumulated sediment being removed.

Spill Containment Facilities

DEP installed, and now maintains, spill containment facilities around Kensico Reservoir (Figure 4.23). The facilities improve spill response, clean up, and recovery, thereby minimizing water quality impacts in the event of a spill.

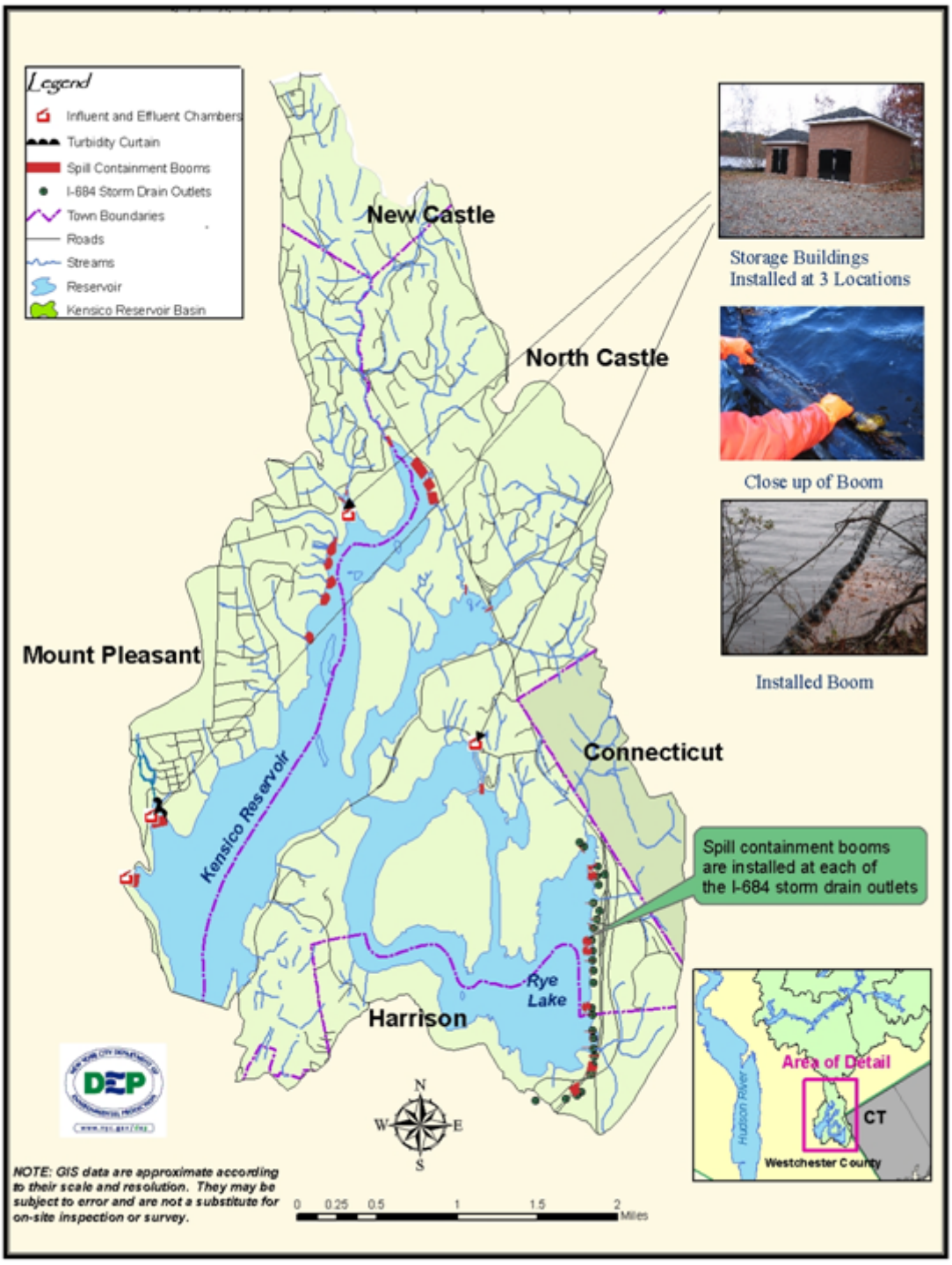

Figure 4.23 Spill containment facilities in Kensico Reservoir.

In 2008, DEP continued to maintain the 39 spill containment facilities installed at the outlets of 26 storm drains along Interstate 684 and Route 120.

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.

Turbidity Curtain

Since its installation in 1995, the 1,100-foot-long turbidity curtain installed in the reservoir between the Catskill Upper Effluent Chamber and Malcolm and Young Brooks has effectively deflected discharges from the two watercourses away from the effluent chamber.

In 2008, DEP monitored the extended turbidity curtain, and performed the following maintenance tasks:

- November 2008 – A diving inspection was performed which generated a list of items requiring maintenance.
- November and December 2008 – Twenty curtain seams from 0–1000 feet were tied together and any broken anchor connections were replaced with stainless steel chain on the north side of the turbidity curtain. In addition, small tears in the curtain were repaired and 30 feet of fabric was resealed on the flotation part of the curtain.

4.10.2 Kensico Action Plan

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.

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 Creek, and 4) drainage improvements along West Lake Drive 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.

During the reporting period, DEP reviewed the completed project specifications that were submitted by the design consultant. Design and contract documents were finalized and received legal review and approval. In December 2008, DEP initiated the bid process.

4.10.3 West Lake Sewer

The Westlake 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 Trunk Sewer to provide real-time detection of problem events such as leaks or system breaks, overflows, and blockages. The proposed system would make it possible to respond quickly to such problems. During the reporting period, DEP met with the Director of Maintenance for the Westchester County Department of Environmental Facilities (WCDEF) to establish a scope of work for this project and discuss language for an inter-municipal agreement (IMA). It was agreed by both agencies that DEP would be responsible for drafting the IMA for approval by the Westchester County Board of Legislators. The WCDEF would provide the contracting services for installation, monitoring, and maintenance of the system. The IMA will contain language that will establish a procurement process for reimbursement of expenses to Westchester County.

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 October 2008. 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 Sewers

The contract to complete the digital mapping and video inspection of the entire remaining sanitary infrastructure in the Kensico watershed 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 basin from point source and non-point 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. In September 2007, DEP prepared and submitted a package to the Town of Harrison Engineering Department including the aforementioned evaluation memo, along with copies of the pipe segment inspection reports and manhole reports for the areas indicated within the evaluation memo. DEP submitted a follow-up request in June 2008 to the Town of Harrison Engi-

neering Department for any investigation completed on the collection system and its components. 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

DEP initiated the development of the Kensico Septic System Rehabilitation Reimbursement Program to reduce the potential water quality impacts that might occur through failing septic systems. 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 4.24).

During the reporting period, DEP considered several alternative means of implementing the Program. After review of each alternative, DEP determined that an agreement with the New York State Environmental Facilities Corporation (EFC) would be the most effective and efficient means of implementing the Program. In 2008, DEP entered into negotiations with EFC to develop the necessary contract language for Program implementation. DEP and EFC subsequently came to terms on a contract agreement and scope of work for the services that EFC would provide. In October 2008, EFC's Executive Board approved the contract agreement and scope of work, thereby enabling EFC's Executive Director to enter into a contract agreement with DEP. In November 2008, DEP's Agency Chief Contracting Office issued the Notice of Award to EFC. Following award, DEP and EFC began the development and review of the mailing lists and Program materials in preparation for the start of the spring 2009 construction season. Since the conclusion of the reporting period, DEP has completed the registration of the contract and held a project kick-off meeting with EFC.

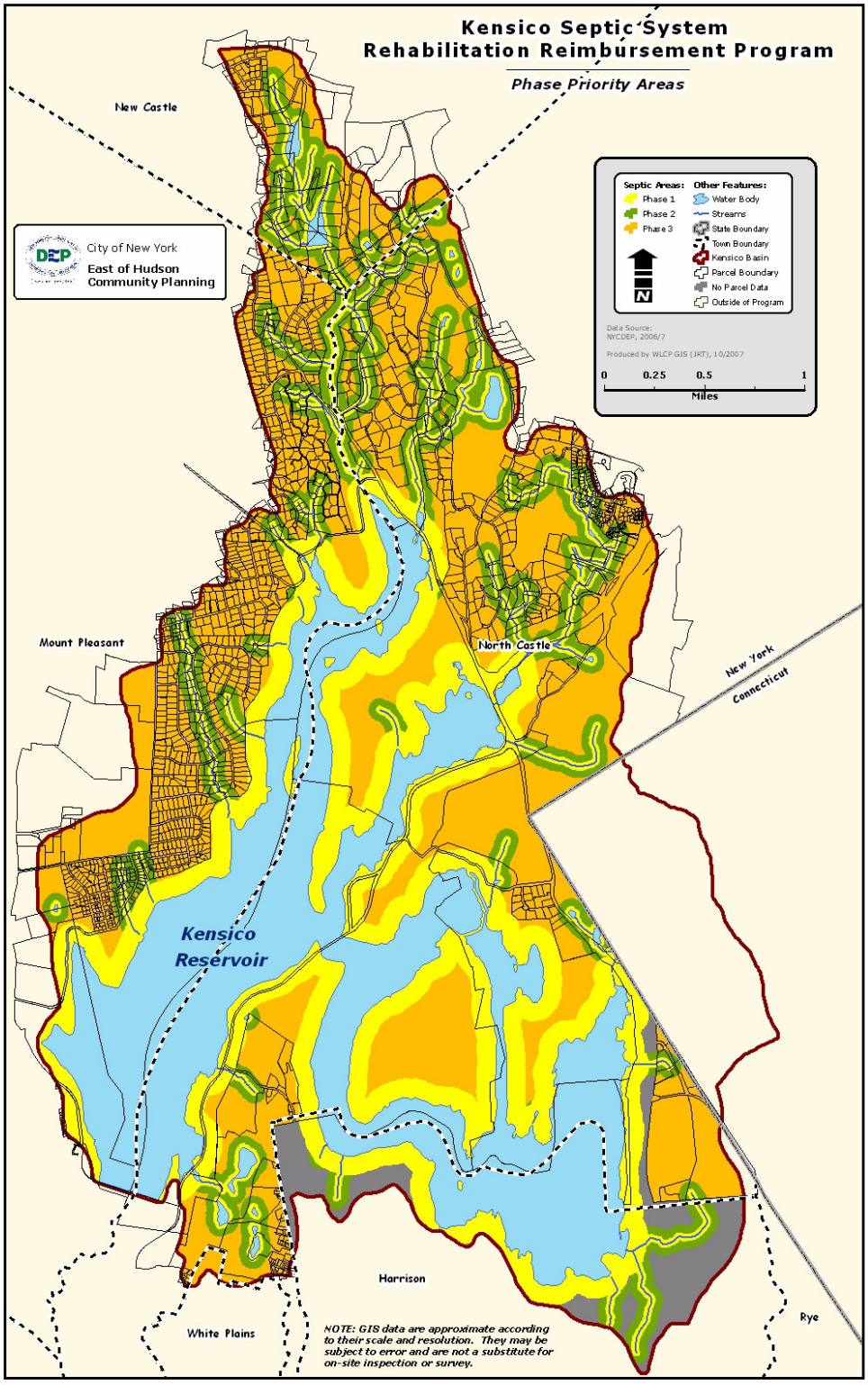

Figure 4.24 Kensico Reservoir Septic Program priority areas.

4.10.6 Turbidity Reduction

The Catskill Upper Effluent Chamber (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. The cove then extends south and east into the main basin of the reservoir. Water from Kensico Reservoir enters CATUEC and is transported to the Catskill Lower Effluent Chamber (CATLEC) where Kensico Reservoir's Catskill Lower Effluent Chamber (CATLEFF) monitoring site is located. When wind velocities are sufficient to create wave action 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.

DEP determined that a shoreline stabilization project south of the chamber would 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. Design work commenced in the first half of 2008.

DEP considered several options for implementing the stabilization project, including combinations of geotextiles, rip rap, and proprietary products. After review of each alternative, DEP determined that rip rap would be the best material for stabilization and that a coffer dam would be the best means to dewater the work area adjacent to the shoreline during installation. The final design was completed in December 2008. DEP is working on preparing bid documents and all necessary permit applications.

4.10.7 Route 120

During the 2008 reporting period, there was no activity on the New York State Department of Transportation 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. Due to a pending permit requirement from Connecticut, it is now 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 spring/summer of 2009.

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 were still pending in 2008. At this time, DEP has not identified serious concerns with the proposals. 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 incomplete letters on the project's Stormwater Pollution Prevention Plan (SPPP) in February and March 2008. Soils testing for the SPPP was done in September 2008. There has been no activity since then, as the project design is being re-worked. Delays in obtaining federal grants to fund this project are contributing to project delays.

- 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. There was no new activity in 2008. A delay in obtaining federal grants to fund this project is contributing to project delays.

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 streambeds, and suspend the glacial clays that underlie the streambed armor. The design of the Catskill System accounts for the local geology, and provides for settling within Schoharie, Ashokan West Basin, Ashokan East Basin, and the upper reaches of Kensico Reservoir. Under normal circumstances the extended detention time in these reservoirs is sufficient to allow the turbidity-causing clay solids to settle out, and the system easily meets turbidity standards at the Kensico effluent. Periodically, however, the City has had to use chemical treatment to control high turbidity levels.

DEP has undertaken the Catskill Turbidity Control Study to provide 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 support this effort, along with JV subconsultants Upstate Freshwater Institute (UFI) and HydroLogics, Inc. The study has been conducted in three phases. Phase I provided a preliminary screening-level assessment of turbidity control alternatives at Schoharie and Ashokan Reservoirs, and identified potentially feasible, effective, and cost-effective measures for subsequent detailed evaluation. As described in more detail in the 2007 FAD Annual Report, Phase II and Phase III of the study included detailed engineering, conceptual designs, cost estimates, and performance evaluation of turbidity control alternatives at Schoharie and Ashokan Reservoirs, respectively. The following sections summarize work on the Catskill Turbidity Control Study conducted in 2008.

4.11.1 Phase II Study (Schoharie)

In August 2008 DEP received conditional approval from regulatory agencies for the Phase II Implementation Plan (submitted December 2006), in which DEP proposed Modification of Reservoir Operations at Schoharie Reservoir and development of a system-wide Operations Support Tool (OST). The proposed OST will utilize the OASIS-W2 linked model framework developed during the Phase II Study, and will include links to real-time hydrologic and water quality data, as well as a substantial suite of enhancements that allow operators to optimize reservoir release and diversion decisions at Schoharie and throughout the system.

In 2008 DEP issued a Request for Proposals (RFP) for the OST and selected a consultant team to develop the OST. The contract is expected to be finalized in early 2009, and work on the project is planned to begin by October 30, 2009.

Regulatory agency approval of the Phase II Implementation Plan was conditioned on additional sensitivity and uncertainty analyses of the modeling tools used to evaluate the performance of the Schoharie turbidity control alternatives. The scope of this work is similar to that conducted for the Ashokan alternatives under the Phase III study, as described in more detail below. Additional sensitivity and uncertainty analyses for the Schoharie alternatives began in 2008 and are expected to be completed in April 2009.

4.11.2 Phase III Study (Ashokan)

In December 2007 DEP submitted the Phase III Final Report, which evaluated alternatives at Ashokan Reservoir that could reduce turbidity levels entering Kensico Reservoir. Alternatives evaluated included a West Basin Outlet Structure, Dividing Weir Crest Gates, East Basin Diversion Wall, Upper Gate Chamber Modifications, a new East Basin Intake, Catskill Aqueduct Improvements, and Modified Operations.

In January 2008 the NYC Office of Management and Budget organized a Value Engineering (VE) session to review the Phase III Final Report. During the one week VE session a panel of 10 consultants reviewed the findings, designs, and cost estimates for the Ashokan turbidity control alternatives, and identified recommendations related to the design, implementation, or performance evaluation of these alternatives. Four of the VE recommendations were related to the modeling and performance evaluation of alternatives, including:

- Expansion of modeling sensitivity and uncertainty analyses
- Further evaluation of the Esopus Creek flow-turbidity relationship used in model simulations
- Application of the 3-D model for additional alternatives and runoff events
- Adding new performance metrics for evaluation of alternatives

In March and April 2008 regulatory agencies requested additional information and evaluation related to the Phase III study, including:

- Clarification on the time periods used for calibration versus validation of the Ashokan water quality model, and on the values of model inputs used in those simulations
- Request for additional testing of the Ashokan water quality models for time periods not used in initial model testing
- Consideration of the validity of using water quality models to simulate the performance of alternatives for conditions outside of those addressed in testing, including features of transport related to implementation of the alternatives

In 2008 substantial additional analyses were conducted to address each of these recommendations and requests, as described below.

Sensitivity Analysis of Ashokan W2 Model Predictions

The Phase II and Phase III turbidity control performance evaluations were based primarily on the linked OASIS-W2 model. This consists of a water supply model (OASIS) of the NYC reservoir system and the Delaware basin, linked with reservoir water quality models (W2) of Schoharie, Ashokan, and Kensico Reservoirs. Additional sensitivity analyses were conducted to identify the W2 model inputs that have the greatest impact on predictions of Ashokan diversion turbidity. The analysis evaluated sensitivity to 26 model inputs, including model segmentation/bathymetry, boundary conditions/meteorological drivers, and coefficients/algorithms used in the hydrodynamic/transport, hydrothermal, and turbidity submodels.

The sensitivity analysis was performed by varying one model input at a time over a realistic range of values, and conducting simulations using historical (observed) model drivers (e.g., meteorological data, Esopus turbidity levels, Catskill Aqueduct diversion rates). The sensitivity of model predictions to each of the inputs was evaluated with respect to the percent of simulation days in which the predicted Catskill Aqueduct diversion turbidity exceeded 8 NTU.

Model predictions were found to be relatively insensitive to reasonable variations in the majority of parameters. Model predictions were found to be most sensitive to uncertainty in the Esopus Creek turbidity-flow relationship, which was further evaluated as described below.

Esopus Creek Turbidity-Flow Relationship

Because Esopus Creek turbidity observations are not available for much of the long-term model simulation period (1948-2004), daily turbidity values are necessarily predicted based on known flow values from a turbidity-flow relationship. Development of a predictive empirical relationship (i.e., regression) for turbidity is complicated by several factors, including a relatively small data set of paired flow-turbidity observations, substantial variability in the relationship between measured turbidity and stream flow in Esopus Creek, and limited representation of very large storm events by actual observations.

The variability in the turbidity-flow relationship for Esopus Creek is the primary source of uncertainty for the turbidity model for Ashokan Reservoir. Empirical analyses were expanded to evaluate the potential effects of various factors on the turbidity-flow relationship, such as seasonality, antecedent flow conditions, and portions on the hydrographs of runoff events (e.g., rising versus falling limbs), in an effort to build a stronger turbidity-flow model. While rather strong relationships were resolved for individual events, these relationships were found to vary greatly for different events. These features lead to a probabilistic (Monte Carlo) representation of the variability and uncertainty in the turbidity-flow relationship, where the corresponding random

selections were drawn from the population of documented individual runoff events. This representation in the linked OASIS-W2 model formed the basis for providing uncertainty limits for model forecasts for the turbidity control alternatives.

Additional 3-D Modeling

Evaluation of the East Basin Diversion Wall Improvements requires simulation with the 3-D model of the East Basin due to the need for lateral resolution of turbidity patterns within the reservoir. Additional 3-D simulations were conducted for this alternative for all the predicted alum treatment events in the 1948-2004 simulation period. The results of the additional 3-D modeling were consistent with prior simulations, in that the Diversion Wall was found to reduce turbidity levels for 1-2 days at the beginning of storm events, but provide very little benefit for the large storm events that may require alum treatment.

Additional modeling of the East Basin Intake alternative was also conducted using the 3-D model. The results of this modeling were generally consistent with 2-D model predicted performance for this alternative.

Additional Performance Measure

Under the terms of the Catskill Aqueduct Influent Chamber SPDES Permit, DEP is required to periodically remove accumulated alum floc from Kensico Reservoir. In order to provide a screening-level estimate of the ability of alternatives to reduce the magnitude and frequency of alum floc removal, an additional performance measure was developed to quantify the total mass of alum applied over the 57-year simulation period, based on the predicted alum dose for each day in the simulation period on which alum treatment was predicted to be required. Alum dose was estimated from the predicted Catskill Aqueduct diversion turbidity, using a regression based on the historical relationship between turbidity and alum dose.

Calibration and Validation of Ashokan Water Quality Models

DEP clarified the process of developing, calibrating, and validating the Ashokan water quality models used for the Phase III analysis. A detailed description was provided for the process used to develop the models, including tabulation of which data were used for which aspect of model testing. Descriptions and testing of the hydrothermal/transport and turbidity submodels were provided. Validation runs conducted for time periods not incorporated in model calibration were also identified, and validation testing was extended.

4.11.3 Phase III Implementation Plan

Results of the preceding analyses were documented and presented in the Phase III Implementation Plan, submitted by DEP in July 2008. Taken together, the additional analyses provided a detailed characterization of the modeling tools used to evaluate the Phase III alternatives, and supported findings that were consistent with those presented in the Phase III Final Report. Key findings included:

- Reducing diversions from the Catskill System during elevated turbidity conditions is the most effective way to reduce the turbidity load entering Kensico Reservoir and reduce the frequency and duration of alum treatment events. DEP's ability to readily reduce diversions from the Catskill System during turbidity events could be substantially improved by physical improvements to the Catskill Aqueduct. Such improvements would allow the aqueduct to be routinely operated at minimal flow rates during turbidity events, while still maintaining service to the outside communities that withdraw water from the aqueduct. Completion of the Croton WTP in 2012 will also substantially increase DEP's ability to reduce diversions from the Catskill System during elevated turbidity conditions.
- Releasing water from the West Basin during or in anticipation of a turbidity event was also found to be effective at reducing turbidity levels entering Kensico Reservoir and the frequency and duration of alum treatment events. Such releases could be accomplished either via a new West Basin Outlet Structure or operation of the existing Waste Channel.
- Combining Catskill Aqueduct Improvements with Modified Operations (including operation of the Waste Channel for turbidity control purposes and drawdown of the West Basin during low turbidity conditions) provides substantial reductions in the predicted frequency and duration of alum treatment events. The remaining alternatives (West Basin Outlet Structure, Dividing Weir Crest Gates, East Basin Diversion Wall, Upper Gate Chamber Modifications, and new East Basin Intake) provide little or no additional improvement in turbidity control performance beyond that provided by Catskill Aqueduct Improvements and Modified Operations.

Based on the results of the Phase III study and the associated additional analyses, DEP proposed in the Phase III Implementation Plan to proceed with implementation of the following turbidity control measures:

- Catskill Aqueduct Improvements: This alternative includes a study phase for detailed hydraulic modeling, site investigations, and final selection among three main improvement options: improvements to stop shutter locations, improvements to outside community taps, or a connection to Shaft 4 of the Delaware Aqueduct. This phase would be followed by design and construction of the selected option(s).
- Waste Channel Operation: This alternative includes interim releases of up to 250 MGD for turbidity control purposes via the existing Waste Channel. Releases up to 1,200 MGD would be feasible subsequent to restoration of the original release capacity at the Lower Gate Chamber, development of operating protocols using the Operations Support Tool, and acquisition of low-lying portions of the Ashokan Field Campus and restoration of the stream channel. DEP is proceeding with each of these actions.
- West Basin Drawdown: This alternative includes increasing the frequency of diversions from the West Basin during low turbidity conditions. Development of formal operating rules for and full implementation of this practice will require the monitoring and forecasting capabilities provided by the OST.

After review of the Phase III Implementation Plan, regulatory agencies requested in October 2008 additional clarification on several issues, including further characterization of stratification conditions, characterization of the 8 NTU turbidity front travel times for various alternatives,

evaluation of performance based on event size, and evaluation of the sensitivity of performance predictions to various system demand and infrastructure capacity assumptions. DEP responded to these questions in December 2008.

4.11.4 Reservoir Monitoring

UFI conducted a monitoring program on Ashokan Reservoir in 2008 that focused on robotic monitoring and turbidity-related water quality issues. The monitoring program covered the period April 4-December 9, 2008. A total of 21 sampling trips were made on a biweekly basis. Water column samples were collected from six sites in the West Basin (2, 1.7, 1.4, 1, 3.1, 3) and three sites in the East Basin (7, 4.2, 5) at five meter depth intervals, and analyzed for turbidity, total/volatile/fixed suspended solids, beam attenuation coefficient, and scanning electron microscopy interfaced with automated image and x-ray analyses (SAX). In addition, sediment traps were deployed at two depths (metalimnetic and near-bottom) at seven locations. Samples were analyzed for total/volatile/fixed suspended solids. A thermistor chain was deployed in the west basin at Site 1 for most of the field season. Seabird drops (continuous profiles of temperature, specific conductance, and optical backscatter) were made at all robotic monitoring stations, all sediment trap locations, and at Site 7.

The robotic monitoring program consisted of four buoy deployments (Sites 1.4, 2, and 3.1 in the West Basin and Site 4.1 in the east basin) over the period April 4-December 9, 2008. Full water column profiles of temperature, specific conductance, and turbidity were measured at one meter intervals every six hours at Sites 1.4, 3.1, and 4.1 and once per day at Site 2. The data were transmitted in near-real-time to UFI and uploaded to a website accessible by DEP personnel.

One runoff event was captured in late October (approximately October 26-November 5). UFI conducted Seabird "gridding" at approximately 30 locations on four dates to resolve the impacts of the event in the West Basin.

4.12 Sand and Salt Storage

During the first few months of 2008, DEP, in consultation with CWC, finalized the language of a draft contract agreement to provide guidelines for implementing a new Institutional Sand and Salt Storage Facilities Program that was authorized in the 2007 FAD. The final contract was executed on July 2, 2008, and registered with the City Comptroller's Office on August 6, 2008.

CWC is currently in the process of drafting program rules to implement the program. It is expected that the program rules will be finalized and approved by CWC's Board of Directors in the first half of 2009. Once the program rules are approved, CWC will request that institutional facilities (e.g., schools, camps, hospitals, and places of worship) in the West of Hudson Watershed submit applications to see if they are eligible to build new or rehabilitate existing sand and salt storage facilities to meet the requirements of the Watershed Rules and Regulations.

5. Watershed Monitoring, Modeling, and GIS

5.1 Watershed Monitoring Program

DEP's monitoring activities for 2008 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. The monitoring plan is designed to meet the broad range of DEP's many regulatory and informational requirements. These requirements include: compliance with all federal, state, and local regulations to ensure safety of the water supply for public health; watershed protection and improvement to meet the terms of the 2007 Filtration Avoidance Determination (FAD); the need for current and future predictions of watershed conditions and reservoir water quality to ensure that operational decisions and policies are fully supported over the long term; and the need for ongoing surveillance to ensure delivery of the best water quality to consumers. In 2008, the monitoring plan was revised and updated, as required by the FAD, and the *2009 Watershed Water Quality Monitoring Plan* was delivered to EPA and DOH in October 2008 and implemented in January 2009.

The overall goal of the plan 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 objectives of this plan were defined as a consequence of the requirements of the information "end-users", i.e., DEP management, regulators, and other external agencies. More specifically, the monitoring requirements were derived from legally binding mandates, agreements, operations, and watershed management information needs. The foremost regulatory requirements are specified in: the Safe Drinking Water Act (SDWA) and its rules, the Clean Water Act (CWA), the New York State Water Quality Regulations (Title 6, Chapter X, Parts 700-705), the FAD, and the NYC Watershed Rules and Regulations (WR&R), as well as Administrative Consent Orders.

The updated plan essentially builds on the experience gained from previous monitoring plans. Other plans that are direct predecessors of this one are the 1997 Water Quality Surveillance Monitoring report (DEP 1997), Comprehensive Watershed Monitoring (ILSI 1998), and the 2003 Integrated Monitoring Plan (DEP 2003). As DEP's monitoring plan has evolved over the years since the first Filtration Avoidance Determination in 1993, the need to document the program in detail has intensified. Documentation of the monitoring program preserves the original intent of objectives, allows for transfer of knowledge to new generations of samplers, allows for coordination and planning of time and materials needed for implementation, and systematic adjustment of the program to suit new requirements. Monitoring programs typically last for five years before the next major review is needed. As time passes, new developments in methods, circumstances, regulations, and infrastructure all create a new situation and accumulate to finally warrant a thorough

review and update of the plan. These are the reasons that the monitoring plan should be considered a basic tool for managing the programs, but it should be recognized that adjustments of the plan must be made to meet new conditions. As watershed protection programs develop and analytical techniques for key parameters change, it is necessary to reassess the monitoring program to ensure that it continues to support watershed management. The monitoring program must retain its ability to evaluate the effectiveness of programs established under the FAD and MOA. Small adjustments to the plan to accommodate changing conditions are documented and approved by management prior to implementation. This allows for an organized and systematic tracking of adjustments to the plan over time.

Pursuant to the City's Long-Term Watershed Protection Program, DEP also 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 2008 report (due 2009), the limnology and hydrology components of the document will draw largely from information obtained from approximately 233 routinely-sampled reservoir and stream sites, resulting in almost 5,400 samples and about 70,000 analyses. For the pathogen component, a total of 964 routine samples were analyzed for *Giardia*, *Cryptosporidium*, turbidity, pH, and temperature (6,528 analyses) at 76 sampling sites (including keypoints), while 276 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 ongoing 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 2008:

- Weekly results of *Cryptosporidium* and *Giardia* sampling at the three source waters are routinely posted on DEP's web site
- Monthly Filtration Avoidance Reports
- Monthly Croton Consent Decree Reports
- Mid-term report on DEP pathogen studies of *Giardia* spp., *Cryptosporidium* spp., and human enteric viruses (annual)
- Kensico Reservoir Report (annual)
- Watershed Water Quality Annual Report
- Drinking Water Supply and Quality Annual Report

Additional reports are submitted as part of FAD Section 4.10, Kensico Water Quality Control Program. DEP submits a semi-annual Kensico Watershed Management Report to EPA in January and July, which focuses on program implementation. A companion report is issued in March that focuses on water quality. The water quality report presents, discusses, and analyzes monitor-

ing 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, sampling for toxic substances, and applications of the Kensico water quality model to guide operations.

Finally, non-routine water quality monitoring, referred to as Special Investigations (SIs), are conducted when appropriate to document man-made or natural events occurring in the watershed that have the potential to negatively affect water quality. 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 that impact the water supply may necessitate intense water quality monitoring to forecast the movement of the contamination, provide guidance for operations to avoid treatment, or 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 over long-term operation 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).

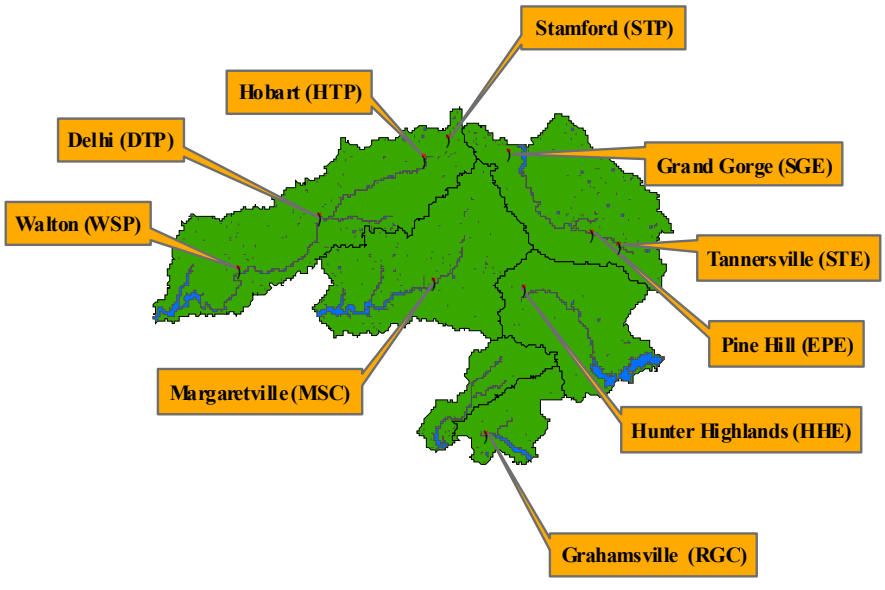

Figure 5.1. Wastewater treatment plants monitored by DEP in 2008.

All plants were sampled at least four times in 2008 for *Giardia, Cryptosporidium,* and human enteric viruses (HEV). Of the 10 treatment plants, two were re-visited this year to collect enhanced samples in response to routine quarterly *Giardia* results. Monitoring for *Cryptosporidium* and *Giardia* involved the collection of 50 L aliquots, and samples were analyzed according to Method 1623 (USEPA 2001). Human enteric virus samples involved the collection of 200 to 300 L aliquots, and samples were analyzed as per the ICR method (USEPA 1996).

Giardia

Five of the ten WWTPs sampled in 2008 were negative for *Giardia* cysts: Delhi, Hobart, Margaretville, Grand Gorge, and Tannersville (Table 5.1). A total of 11 samples were positive for *Giardia* among the other five WWTPs. Pine Hill and Walton had one *Giardia* detect each (1 cyst maximum), while Stamford and Hunter Highlands had 2 and 3 *Giardia* detections, respectively (5 cysts maximum). All four samples collected at the Grahamsville treatment plant were positive for *Giardia*.

Enhanced samples were obtained on two occasions in 2008. The first was in response to five *Giardia* cysts recovered at Hunter Highlands on February 6. The other enhanced sample was in response to one *Giardia* cyst detected at Walton on December 9. No protozoa were detected in either of these follow-up samples.

The Grahamsville WWTP was positive for *Giardia* for each of the quarterly sampling events. However, as DEP has reported previously, Grahamsville has been the subject of additional sampling in the past due to positive results. DEP hypothesizes that the routine sample location, which is located downstream of an uncovered chlorine contact tank, is the cause of the positive results, due to the potential for wildlife to contaminate the system post-microfiltration. Consequently, the sample location has now been shifted to a location prior to the uncovered chlorine contact tank as part of the new 2009 DEP Watershed Water Quality Monitoring Plan.

Cryptosporidium

All the WWTPs sampled in 2008 were negative for *Cryptosporidium* oocysts (Table5.1).

Human Enteric Viruses

All the WWTPs sampled in 2008 were negative for human enteric viruses (Table 5.1). In summary, all WWTPs sampled show very low pathogen concentrations in the effluents and these do not constitute a significant pathogen source for the water supply.

Table 5.1. Protozoan and human enteric virus results for WWTPs, 2008.

Site	Sample Date	*Cryptosporidium* (oocysts?50L^{-1})	*Giardia* (cysts?50L^{-1})	Human Enteric Viruses (MPN?100L^{-1})
DTP	25-Mar-08	0	0	NI
DTP	16-Jun-08	0	0	-110
DTP	24-Jun-08	nsr	nsr	NI
DTP	18-Aug-08	0	0	NI
DTP	09-Dec-08	0	0	NI
EPE	18-Mar-08	0	0	NI
EPE	13-May-08	0	0	NI
EPE	21-Jul-08	0	0	NI
EPE	20-Oct-08	0	1	NI
HHE	06-Feb-08	0	5	NI
HHE	25-Feb-08	0	0	nsr
HHE	22-Apr-08	0	1	NI
HHE	14-Jul-08	0	0	NI
HHE	29-Dec-08	0	1	NI
HTP	17-Mar-08	0	0	NI
HTP	19-May-08	0	0	NI
HTP	11-Aug-08	0	0	NI
HTP	16-Dec-08	0	0	NI
MSC	01-Apr-08	0	0	NI
MSC	13-May-08	0	0	NI
MSC	21-Jul-08	0	0	NI
MSC	20-Oct-08	0	0	NI
RGC	01-Apr-08	0	4	NI
RGC	23-Jun-08	0	1	NI
RGC	15-Sep-08	0	3	NI
RGC	03-Nov-08	0	2	NI
SGE	24-Mar-08	0	0	NI
SGE	10-Jun-08	0	0	-110
SGE	24-Jun-08	nsr	nsr	NI
SGE	22-Sep-08	0	0	NI
SGE	16-Dec-08	0	0	NI

Table 5.1. (Continued) Protozoan and human enteric virus results for WWTPs, 2008.

Site	Sample Date	*Cryptosporidium* (oocysts?50L^{-1})	*Giardia* (cysts?50L^{-1})	Human Enteric Viruses (MPN?100L^{-1})
STE	06-Feb-08	0	0	NI
STE	21-Apr-08	0	0	NI
STE	14-Jul-08	0	0	NI
STE	10-Nov-08	0	0	NI
STP	17-Mar-08	0	1	NI
STP	19-May-08	0	0	NI
STP	11-Aug-08	0	1	NI
STP	15-Dec-08	0	0	NI
WSP	25-Mar-08	0	0	NI
WSP	16-Jun-08	0	0	NI
WSP	18-Aug-08	0	0	NI
WSP	09-Dec-08	0	1	NI
WSP	22-Dec-08	0	0	nsr

NI = non-isolated, -110 = sample rejected due to field issue (over hold time, chlorine residual over 0.09 mg L^{-1}), nsr = no sample required (protozoa and HEV samples were not always collected on the same day).

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 2008, the modeling program focused efforts on the following modeling applications and development activities (DEP 2008a):

- Modeling of turbidity transport in Kensico Reservoir for short-term operational support
- Preliminary analyses of possible effects of climate change on the quality and quantity of the WOH supply;
- Organizing a sediment modeling workshop
- Development and application of an integrated PROTECH—one dimensional reservoir eutrophication model;
- Modeling data acquisition and organization
- Publication and presentation of Modeling Program activities

Short Term Operational Support - Simulations of Kensico Reservoir Turbidity

During 2008, DEP used reservoir model simulations of turbidity transport through the Kensico Reservoir to aid in operational decisions related to flows in the Catskill Aqueduct. These simulations helped to avoid the potential use of alum during a series of storm events occurring in the late winter and early spring.

A series of storms beginning in February 2008 and culminating in two closely spaced events between March 5 and 12, 2008, increased Ashokan Reservoir turbidity levels and the turbidity of water entering the Catskill Aqueduct. Peak turbidity levels measured in Esopus Creek, just upstream of the confluence with the Ashokan Reservoir, exceeded 250 NTU, which when combined with high discharge, led to an increase in Ashokan Reservoir turbidity to between 6 and 8 NTU at the Catskill Aqueduct effluent. Turbidity levels of this magnitude approach the threshold that would historically have triggered alum treatment. For this storm, however, as was the case for the storms which occurred during 2007 (DEP 2007), DEP pursued an alternative strategy that relied on reducing the Catskill Aqueduct flow, while maximizing Delaware System withdrawal. This was a viable operating strategy under these conditions, given that Ashokan turbidity levels were high, but not extreme, and that Kensico Reservoir was well mixed, which maximized the dilution of turbidity as it traveled between Kensico influent and effluent locations. Model simulations were used to help define safe levels of Catskill Aqueduct flow as turbidity changed over the course of the event.

A first set of simulations was made as the turbidity event unfolded. Following the storm on March 5, 2008, Catskill Aqueduct turbidity increased to 8 NTU, and at the time of these simulations, turbidity was still increasing. Also at this time the flow level in the Catskill Aqueduct was 600 MGD, which is normal for this time of year. The purpose of these simulations was to examine the effects of elevated Catskill input turbidity levels, and to investigate whether reduced Catskill Aqueduct flows would be necessary to maintain Kensico effluent turbidity below the 5 NTU regulatory threshold. Simulations were run for a range of Catskill Aqueduct flows and potential future turbidity values. The model simulation results suggested that Catskill Aqueduct flow could be safely maintained at 600 MGD, provided that the aqueduct turbidity did not exceed 10 NTU.

Actual Catskill Aqueduct turbidity levels remained below 10 NTU, but on a number of occasions peaked close to this value. Given that DEP had the capability to reduce the Catskill flows and that Catskill turbidity levels were approaching a level that could lead to increased in Kensico effluent turbidity, a decision was made to reduce Catskill Aqueduct flows by approximately 50 percent (from 600 MGD to 300 MGD) on March 11.

In April, Catskill Aqueduct turbidity was following a downward trend and was between 3-4 NTU. At the this time, another set of simulations was performed to test the effects of increasing the Catskill Aqueduct flow up to the normal flow rate of 600 MGD at the presently measured tur-

bidity levels, and also at somewhat higher levels that might occur as a consequence of future storm events. Again, simulations were run for a range of Catskill Aqueduct flows and potential future turbidity values. The simulations indicated that bringing the Catskill Aqueduct back up to a normal flow rate of 600 MGD would not cause Kensico effluent turbidity to rise near the threshold level, and therefore, it was recommended to resume normal operating flow levels.

As with the event in 2007, turbidity increases were not extreme enough to demand immediate use of alum treatment. 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 again a powerful tool which helped DEP avoid the use of alum treatment.

Preliminary Results and Progress for Use of DEP Models for Analysis of Potential Effects of Climate Change

During the previous year DEP began the first phase of an integrated modeling project to estimate the effect of future climate change on the quantity and quality of water in the NYC water supply. This first phase of the project is aimed at providing a first-cut evaluation of the effects of climate change on water quantity and quality, using DEP's existing modeling system and available global climate model (GCM) data.

Progress on the project has been made in five areas, including (1) development of preliminary model input climate projections, (2) implementation of these projections into DEP's watershed model, (3) integration of watershed model results into the OASIS water system model, (4) initial investigation of climate effects on turbidity in Schoharie Reservoir using the CEQUAL-W2 reservoir model, and (5) initial runs of the one-dimensional reservoir model for Cannonsville Reservoir.

Preliminary results of this analysis suggest that winter temperatures will increase, creating less snow, more winter rain, and smaller snowpack accumulation. This may, in turn, lead to increased late fall and winter streamflows and slightly decreased spring snowmelt. Both turbidity and nutrient loads will increase in winter due to increase flows. Increases in turbidity loads during winter and fall can potentially lead to greater reservoir turbidity levels. Additionally, reservoir thermal stratification is expected to last longer and be more intense under future conditions. The combination of increased nutrient loads and stronger thermal stratification may lead to increases in phytoplankton production, especially in the fall.

Sediment Modeling Workshop

A two-day Sediment Modeling Workshop, jointly organized by the DEP Water Quality Modeling Group and the DEP Stream Management Program, was held at the DEP offices in Kingston, NY, in July 2008. The workshop was attended by representatives of the USDA

National Sedimentation Lab (NSL), USDA Pasture Systems Lab, Cornell University, USGS, Upstate Freshwater Institute (UFI), Soil and Water Conservation Districts (SWCD) of Greene and Delaware County, Canaan Valley Institute, and DEP.

The workshop focused on investigating modeling methodologies that could help DEP better understand and simulate watershed processes that regulate stream turbidity levels. There are two broad scales at which models might be useful for the Modeling and Stream Management programs: 1) Predicting watershed-wide turbidity loads to reservoirs; and 2) evaluating watershed and stream management strategies and practices on the stream reach to sub-basin scale. At the watershed scale, potential model applications include: predicting sediment and turbidity loads to NYC water supply reservoirs for a range of hydrologic events, and predicting changes to these loads under a variety of watershed protection, management, and climate change scenarios. Finer scale models would support characterization/prediction of sediment loading at reach scale as a function of discharge for management evaluation of specific projects or programs.

The overall goals of the workshop were to gain an overview of the models developed by the NSL to address the above two scales; to gain an understanding of the data requirements of the models, along with the additional monitoring and field work that could be required in order to parameterize the models and validate their predictions; and to begin a conversation with the NSL and other participants at the workshop that could eventually lead to a collaborative project on suspended sediment transport modeling.

After presentations by the workshop participants, the workshop featured a round table discussion on modeling and data needs to support model development and testing. Both the applicability and data needs for a number of watershed and sediment transport models were discussed. These models include a reach scale bank stability assessment tool (BSTEM); a physically based channel simulation model (CONCEPTS); and watershed simulation models (AnnAGNPS and SWAT).

Data needed to support the sediment transport modeling include: Rapid Geomorphic Assessment (RGA) data, to inform which modeling approach to use and how to discretize models; geomorphic assessments performed by the Stream Management Program using the Rosgen BEHI approach, which may provide much of this background information; stream cross-section geometry and bed and bank properties; and stream monitoring data on total suspended solids (TSS) and turbidity.

The workshop was a valuable exploration of sediment modeling as a potential tool to address turbidity issues in the NYC water supply, and has opened the way for future collaboration, including two SDWA grant proposals—one submitted by NSL and Cornell researchers in early 2009 and one submitted by USGS in late 2008.

PROTECH/One Dimensional Cannonsville Reservoir Eutrophication Model Upgrade

The DEP Water Quality Modeling Group has managed a contract with the Upstate Freshwater Institute (UFI) to develop an upgraded version of the present Cannonsville Reservoir water quality model, by merging the latest version of the Cannonsville eutrophication model (UFI 2003) and the PROTECH model (Reynolds et al. 2001).

The DEP Cannonsville model had a superior description of hydrodynamic processes and nutrient kinetics, but a relatively simple description of phytoplankton biomass, which was expressed as a single chlorophyll concentration. The PROTECH model simulates not only the total biomass of phytoplankton as chlorophyll, but also the biomass of commonly occurring phytoplankton groups such as large and small diatoms, and colonial nitrogen fixing cyanobacteria. Simulations of cyanobacteria are particularly important from a water quality perspective as these phytoplankton can impact water use.

The new composite model compared well with, and sometimes better than, the current version of the Cannonsville eutrophication model. The reservoir temperature structure, total chlorophyll *a*, NO_3, and TP concentrations are all similarly simulated by the two models. In addition, the new composite model described seasonal patterns of phytoplankton succession, including changes in the relative magnitude of phytoplankton functional group biomass.

A FAD report describing the new model and its calibration and testing was submitted to EPA on July 31, 2008. The contract with UFI has been extended for an additional year so that the model can also be set up and tested on Pepacton Reservoir, and to provide funding to UFI to support DEP's efforts to use this model to evaluate the possible effects of future climate change on biomass and species composition of phytoplankton in Cannonsville and Pepacton Reservoirs. Preliminary climate change simulations of Cannonsville Reservoir (reported above) made use of the PROTECH model upgrade.

Modeling Data Acquisition and Organization

During 2008, Water Quality Modeling staff developed and drafted monitoring requirements to meet the FAD-related goals of DEP's Water Quality Modeling Program for inclusion in the Watershed Water Quality Monitoring Plan (DEP 2008b). The goals of the monitoring focus on the continuation of modeling efforts from previous and current FAD projects. The monitoring data needs were divided into three major areas: stream monitoring, reservoir monitoring, and meteorological data. The stream monitoring includes flow monitoring and targeted water quality sampling to support watershed and reservoir model development, testing, and applications. Reservoir monitoring includes flow and reservoir operations data to support reservoir water balance calculations as necessary model input; and reservoir water quality monitoring to test, apply, and further develop DEP's 1D and 2D modeling tools. The meteorological data collection effort provides critical input data necessary to meet both watershed and reservoir modeling goals.

GIS staff continued to update spatial data layers of importance to modeling. Data layers indicating point locations of DEP stream monitoring sites, meteorological stations, and snow monitoring sites were improved. In addition, soil attribute tables in the SSURGO2 format were exported from ACCESS and incorporated into the DEP geodatabase.

Time series data used for modeling are collected at specific locations within the watershed and placed in a modeling time series data library. During 2008, the following dataset updates (through 2007) were added to the time series data: meteorology data from the Northeast Regional Climate Center, USGS Streamflow, DEP Stream and Limnology Water Quality, DEP Key Point, and Reservoir Operations.

Modeling Program Publications and Presentations

The modeling group and the UFI prepared a paper entitled "Use of automated monitoring to estimate the load of turbidity entering a drinking water reservoir" (Pierson et al. 2008a). This paper showed the advantages of using direct high frequency monitoring of stream discharge and stream turbidity to calculate turbidity loads entering Ashokan Reservoir. Differences between turbidity loads based on direct measurement and loads estimated using turbidity versus flow relationships were examined.

The preliminary results of the use of DEP's models for analysis of potential effects of climate change (see above) were presented at the Watershed Science and Technical Conference at West Point, NY, in September 2008 (Pierson et al. 2008b).

5.4 Geographic Information System

This section presents an overview of continued development and utilization of the upstate Geographic Information System (GIS). 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. A sample list of many map products created during 2008 can be found in Appendix A.

The upstate GIS is used to create, store, visualize, and analyze spatial data of the watershed region in support of existing FAD and MOA programs. DEP utilizes 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.

5.4.1 Progress in Utilizing GIS for Watershed Management Applications

Water Quality (WQ)

Wildlife Program: GIS was used to display historic nesting sites, activity status, number of eggs, incubation status, and bird identification information to control Canada Goose reproduction on 15 reservoirs. GIS was also used to support the project review process, where federal- and State-endangered species are always considered, via visual representation of known bald eagle nesting areas. Buffers are easily created, helping the program provide guidance for both successful completion of projects and maximum fitness for this endangered species. Upon completion of CEQR review by DEP, pyrotechnic restrictions were implemented for waterfowl hazing at Hillview Reservoir, including buffer areas around nearby residential streets where no pyrotechnics may be launched. GIS was used to identify woodchuck burrows slated for mitigation in a woodchuck management project conducted at Amawalk Dam in response to Dam Safety Compliance under DEC.

Water Quality Operations: GIS was used to determine ownership of lands where DEP performs routine stream monitoring. Owners were to be contacted for permission to remove poison ivy, brush, etc., in an effort to provide safer access to the selected sites.

Water Quality Modeling: The Modeling Program used the SWAT model interface for ArcView 3 (AVSWAT) to delineate EOH reservoir drainage basin boundaries from 10- and 30-meter Digital Elevation Models (DEMs). Resulting areas were provided for comparison with previously-derived basin information. The new watershed boundaries may also prove useful in future EOH WQ modeling efforts. The Soil Data Viewer extension for ArcGIS and the SSURGO2 soil database (ACCESS) were used to derive soil parameters for the drainage basin above the USGS stream gauge at Walton. Soil characteristics included depth to restrictive layer, field capacity, wilt capacity, and satiated capacity. The data were created for exploratory work on enhancing the VSLF (Variable Source Loading Function) model.

Watershed Protection and Planning (WPP), Regulatory Review & Engineering (RRE)

RRE used GIS to identify protected water resources on project sites. GIS layers were used to depict potential watercourse/wetland areas that would require US Army Corps of Engineers, NYSDEC or DEP involvement and/or permitting. GPS field data were combined with GIS library data to support watercourse determinations and identify sensitive wetland areas. This was used to complete mapping and geographic database management for EPA Deliverables (FAD 6.1.1, 6.1.2, 308i), semi-annual and annual reporting requirements, and the Watershed Rules and Regulations.

GIS was regularly used in conjunction with site inspections and GPS data collected in the field to evaluate environmental site constraints for new development. Prior to conducting a site inspection, RRE prepared layouts and maps showing hydrography, soils, watercourse limiting dis-

tances, steep slopes, and other potentially sensitive features. These data were compared with orthoimagery to reveal potentially unmapped drainage features. Maps were then uploaded as geo-referenced images for use in the field with ArcPad and Trimble GPS units. Locations of water-courses and wetlands areas were GPSed and downloaded back to the GIS. Development sites not covered under existing Stormwater Pollution Prevention Plans (SPPPs) were evaluated using GIS to determine if permit thresholds were exceeded, thereby triggering DEP or NYSDEC regulatory review.

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

- Moresville Energy-Invenergy, Stamford: Drainage features and wetlands were identified that may be impacted by proposed access routes for heavy equipment, road widening, etc.
- Green-Del Sanitation & Recycling, Windham: Potential impacts to water resources resulting from this operation were identified.
- McMurdy Brook Farm Subdivision, Kortright: Potential impacts to wetlands/watercourses resulting from lot development were assessed.
- Tuck Eastside Partners, Windham: Seeps, springs, and watercourses that may be impacted by road re-grading were located and mapped.
- John Killourhy Property, Hunter: Watershed boundary on owner's property was identified and delineated.
- Town of Ashland Sanitary Sewer: Proposed stormwater treatment and wastewater treatment locations were evaluated to determine wetland or watercourse impact.

WPP Watershed Lands and Community Planning (WLCP)

The WLCP GIS Program continues to provide technical support and data development for all other WPP and WLCP programs as outlined below.

Digital Orthoimagery and LiDAR Data Acquisition: The GIS Program initiated an inter-governmental agreement with the New York State Office of Cyber Security and Critical Infra-structure Coordination (NYS CSCIC) to obtain three aircraft-based remotely-sensed GIS data products to be collected wall-to-wall for the entire watershed, including a buffer zone extending beyond the watershed boundary and aqueducts of approximately one mile. These products are:

- LiDAR at 1 m resolution, produces topography for analyzing slopes, drainage areas, and hydrography
- Leaf-off Color-Infrared (CIR) orthoimagery at 1 ft resolution, for mapping and tracking impervious surfaces as done in 2001
- Leaf-on CIR orthoimagery at 1 ft resolution, for mapping land use and land cover

These datasets will encompass a total area of approximately 2,700 square miles and will enable the BWS GIS to continue to be a useful tool to perform analysis of land cover/land use to map wetlands, urban, agricultural, and forested areas; provide estimation of the effects of water-

shed management programs on long-term water quality; and support terrestrial and reservoir modeling of water quantity and quality in the watersheds. Over flights are expected to commence in Spring 2009.

Watershed Lands Information System (WaLIS): Under the management of WLCP GIS, PAR Government Systems Corporation (PAR) continues to develop, upgrade, and maintain WaLIS to provide and manage information about the lands and resources owned by NYC, as shown in Figure 5.2. WaLIS Version 4 was released for use in May 2008 and is currently used by approximately 120 users throughout BWS. This project will be ongoing through the end of June 2010 with remaining feature-specific programming to include the integration of the LATS, TAXIS, Engineering, and Land Use Permits databases. During 2008, the WaLIS Development Team began the process of migrating all components of the Engineering database application from a Microsoft Access application to the WaLIS framework. This effort is about 70% complete; once completed, all RRE users will benefit from using the standardized, OIT-supported framework that WaLIS provides. Existing capabilities are being enhanced to include mapping Engineering projects from within WaLIS.

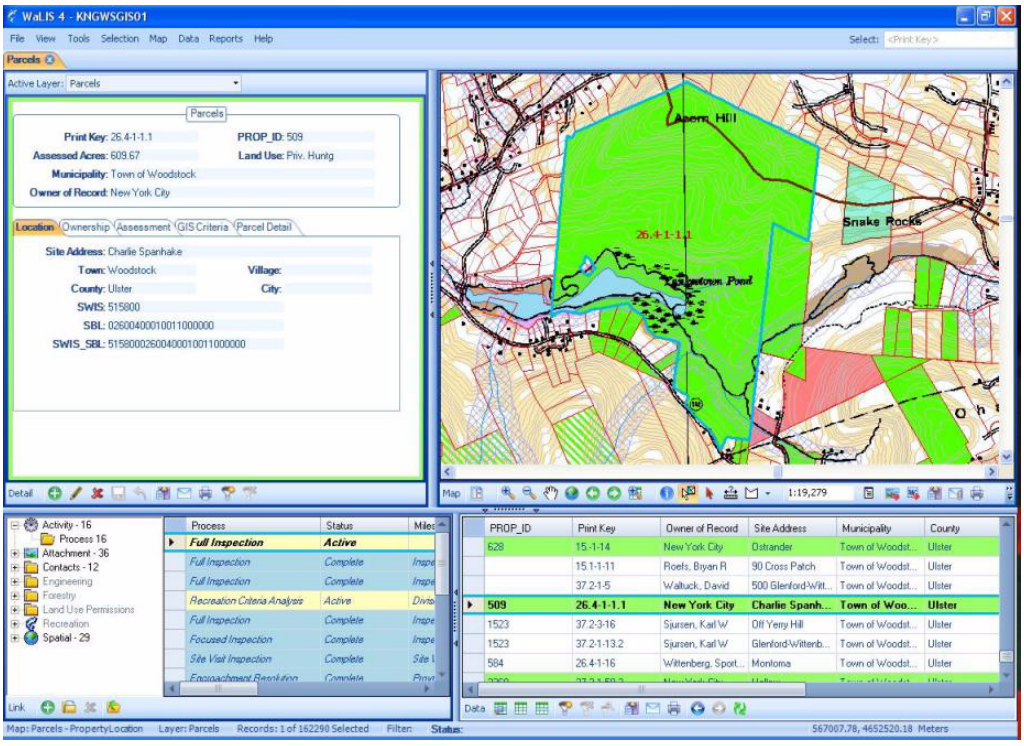

Figure 5.2. A view of the v.4 user-interface of the Watershed Lands Information System (WaLIS), which manages information about the watershed lands and resources owned by NYC and its neighbors. It uses Geographic Information System (GIS) data analyses and relational database reporting capabilities to support DEP WPP Natural Resource Management, Land Acquisition, and Engineering Programs.

Natural Resources Management Program (NRM): NRM used GIS over the past year for a diverse range of applications, including baseline documentation of conservation easements, revocable land use permit inventory, and review of approximately 28 wetland permit applications for federal, state, and local wetlands in the watershed. NRM used orthoimagery, wetland, topography, and soil layers to determine whether wetlands or other sensitive features were present on numerous construction and SEQRA projects reviewed. GIS was also used to analyze wetland trends and invasive species occurrences on City-owned land and elsewhere in the watersheds. In several cases where parcels of interest straddled the 1:24,000 scale GIS-mapped NYC Watershed boundary, NRM worked with WLCP GIS and LAP to interpret and revise the locations of the watershed boundary based on field survey and GIS, as shown in Figure 5.3.

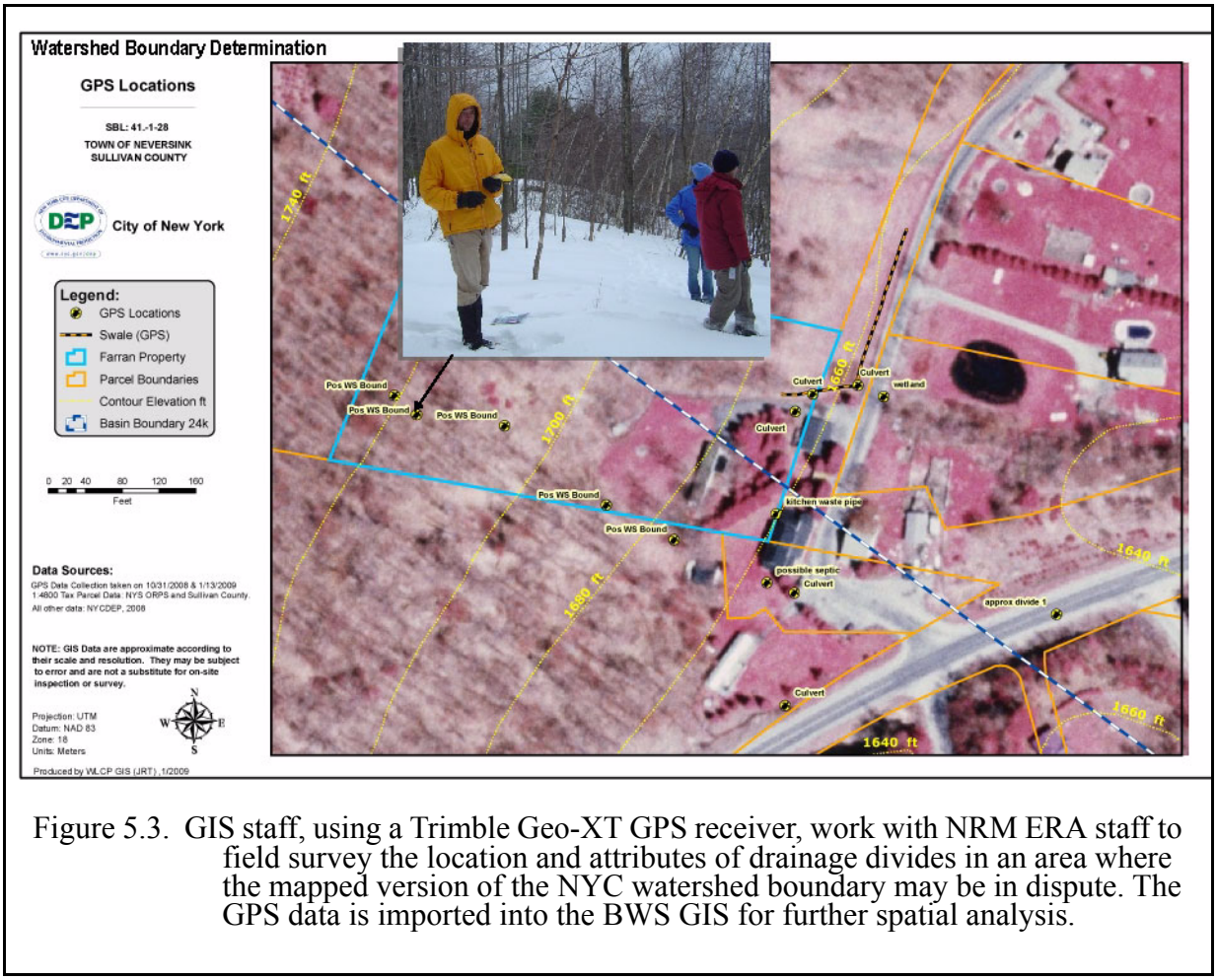

Figure 5.3. GIS staff, using a Trimble Geo-XT GPS receiver, work with NRM ERA staff to field survey the location and attributes of drainage divides in an area where the mapped version of the NYC watershed boundary may be in dispute. The GPS data is imported into the BWS GIS for further spatial analysis.

In the area of forestry, NRM used GIS and WaLIS to routinely produce maps and evaluate geographic data in support of forest science and management activities, including soils map and wetland evaluations, Natural Heritage data assessment, location of significant natural resources, forest stand reconnaissance, forest type location, inventory planning, site evaluation, firefighting/

incident command support, deer management, project review on city and private lands, evaluation of conservation easement land management activities, and forest management project maps. The initial planning for the Forest Management Plan project, a FAD deliverable, relied heavily on GIS analysis of City lands and forests for forest inventory and project planning. The forest management program also educated the public on DEP programs and environmental issues through GIS products developed by the program.

Stream Management Program (SMP): SMP continued to use GIS to develop a riparian vegetation classification coverage, with Greene County SWCD completing work on the Manor Kill, Cornell Cooperative Extension of Ulster County completing Woodland Valley, and DEP completing the Rondout Creek basin. This information was used by the DEC Natural Heritage Program in 2008 in its study of reference riparian vegetation communities for the West Kill basin. The results of the mapping and the Natural Heritage Program study are being used to guide the restoration of riparian communities under the Streamside Assistance Program. GIS and GPS were used to assess and map stream characteristics and conditions, as shown in Figure 5.4. 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. Work also continued on the Stream Management geodatabase in integrating stream survey data into a geographically-referenced database. Data collected by program partners continues to be entered into the geodatabase, which now includes Esopus Creek (including Woodland Valley), Schoharie Creek, Manor Kill, East Kill, Stony Clove, Broadstreet Hollow, and East and West Branch Delaware streams.

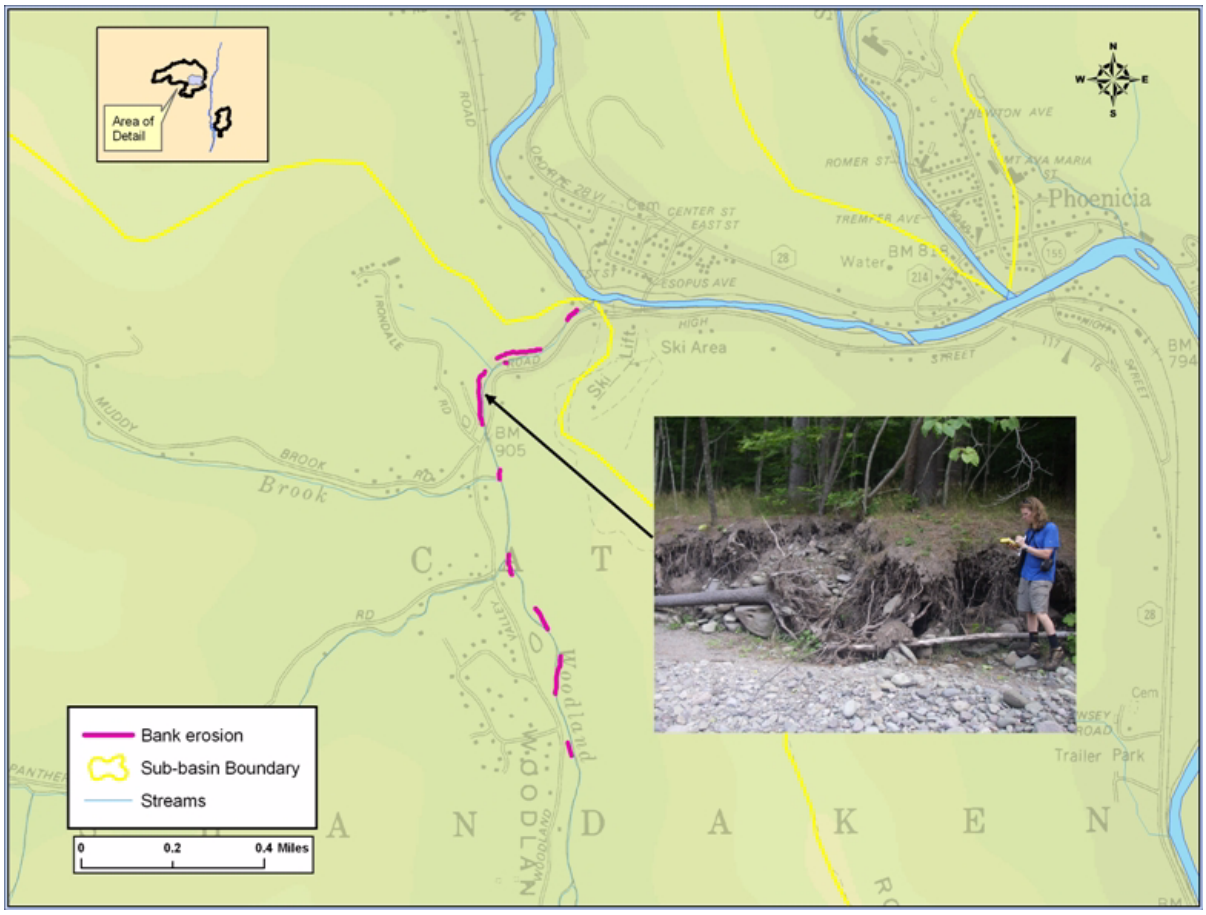

Figure 5.4. SMP staff using a Trimble Geo-XT GPS receiver in 2008 to record the location and attributes of stream bank erosion in the Woodland Creek watershed. The data is imported into the streams geodatabase for spatial analysis.

Land Acquisition Program (LAP): LAP continues to use GIS in maintaining an open space geodatabase, displaying GPS field locations over orthoimagery for use in contract negotiations, and resolving survey issues in WaLIS. GIS is also used in conjunction with WaLIS for research on public and in-house real property inquiries. GIS and WaLIS continue to be used to design acquisition configurations and negotiate easements. Contracts for easements contain GIS orthoimagery maps depicting easement configurations on a detailed parcel scale used to inform surveyors and in the community review process. To implement new solicitation goals established in LAP's 2008 Solicitation Plan, an extensive GIS analysis was performed to update ownership and natural features overlays related to tax parcels. This serves as input to revised LAP parcel rankings for the 2008 Plan. On re-solicitation, GIS analysis is used 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.

EOH Community Planning Program: The GIS Program provided GIS database support for the Kensico Septic Program, which is tracking septic systems to tax parcel data in a geodatabase.

5.4.2 Completion of New Data Layers

Several new feature classes and tables were created and placed in the GIS Library in 2008, including:

- Basin24_mask: enhancement of 1:24,000-scale basin boundary feature class that allows users to mask basins not of interest
- Dot_county24_shoreline: 1:24,000-scale NYS county boundaries, clipped to shorelines, presents more visually appealing portrayal of county boundaries, especially in NYC-Long Island area
- Bath_kensi_catuec_2006: bathymetry (1-foot interval) of intake channel at Catskill Upper Effluent Chamber, Kensico Reservoir, created in 2006 by CR Environmental, under contract to DEP
- Bath_kensi_shaft18_2006: bathymetry (1-foot interval) of intake channel at Shaft 18, Kensico Reservoir, created in 2006 by CR Environmental, under contract to DEP
- Westchester County orthoimagery (2007, natural color, 0.5-foot resolution), obtained from Westchester County GIS
- Select SSURGO2 soil tables (mapunit, component, chorizon), extracted from ACCESS database and placed in the geodatabase for use with the SSURGO2 polygon feature class
- NY Natural Heritage Program GIS datasets on threatened and endangered species
- Dam and Dyke inspection areas for WOH reservoirs

Several existing feature classes were updated during 2008, including:

- Digital Tax Parcels for 2007 for all watershed counties
- DEP LAP fee and easement properties through December 31, 2008
- Metdep—point feature class of DEP meteorological stations
- Sitehyd—point feature class of DEP routine stream monitoring sites
- Sitebiom—point feature class of DEP stream biomonitoring sites
- Sitesnow—point feature class of DEP snow monitoring sites
- Pre-1997 MOA land updates via takings maps and 2007 tax parcels
- NYS-owned land updated via 2007 tax parcels
- Protected Open Space
- Steam Management Planning Basins
- Stream Management Restoration Projects

5.4.3 Incorporation of Data Layers into the Modeling Database

Two point feature classes of National Climate Data Center (NCDC) meteorological stations used to develop precipitation inputs for water quality modeling were added to the geodatabase. Each was accompanied by a feature class of thiessen polygons derived from the point features and used to derive weighted-average model input parameters.

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

Using data sharing policies developed in cooperation with DEP Legal, the WLCP GIS Program continues 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 semi-annual 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, SUNY ESF, 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, Greene County Soil and Water, Ulster County Soil and Water, Sullivan County, Westchester County GIS, Open Space Institute, The Nature Conservancy, Trout Unlimited, 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 EOH and WOH watersheds, including dam rehabilitation and other DEP construction and engineering projects.

5.4.5 GIS Infrastructure Improvement

In a shift away from contracted IT resources, 2008 marked the first year that the BWS GIS infrastructure has been supported primarily by dedicated personnel from DEP OIT, working closely with BWS GIS personnel. Also of particular significance during 2008, DEP completed the migration in April of the BWS GIS from an aging Unix/Oracle platform to a DEP OIT-standard Windows 64-bit/SQL Server platform. The spatial data Coverage Library and Geodatabase were transferred to Windows, as was the FlexLM license manager used to distribute floating seats of ArcGIS software. In conjunction with these changes, a detailed tutorial was prepared to assist users in "repointing" their software to the License Manager and in accessing data from the new locations. A customized tool, the "MXD Migration Tool," was created to automate the process of changing data paths in previously-created MXD project files. Additionally, pre-symbolized Layer Files were created and placed in a hierarchical structure of thematically-named folders. Users may now access these Layer Files as an alternative means of adding data to an ArcMap document. In addition to improving performance for users of native-GIS software such as ArcMAP, this migration simplifies the manner in which the GIS is integrated into other database management systems such as WaLIS and LATS, due to SQL Server being the common database platform. This platform is also more easily supported by in-house DEP OIT resources, who are now managing the SDE geodatabase as well as providing ESRI software management enterprise-wide. At the last stage of the migration, WaLIS and LATS (among other application databases) were moved to the same SQL Server instance as the ArcSDE enterprise geodatabase. Both applications are now

highly integrated with the ArcSDE enterprise geodatabase. As a final step of this process, the ArcSDE enterprise geodatabases residing on UNIX servers (CLIFF and CAVE) were decommissioned.

In addition to performing most of the steps involved in the server migration outlined above, the 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:

- Continued to create new geodatasets and update existing geodatasets in the ArcSDE enterprise geodatabase.
- Continued to maintain both the ARCLIB file geodatabase (an up-to-date copy of all vector and selected raster datasets from the ARCLIB portion of the ArcSDE enterprise geodatabase) and the ARCLIB archive file geodatabase (an historical archive of ARCLIB geodatasets).
- Added a 2001 1ft. CIR raster dataset mosaic of aqueduct areas to the ArcSDE enterprise geodatabase.
- Continued to support WaLIS 4 development by creating and updating geodatasets and spatial views upon request and troubleshooting geodatabase-related issues.

Hardware and Software

A new plan-scale scanner (Contex Premier G600 Puma Wide Format) was received and installed as a networked device for the WPP Regulatory Review and Engineering Division (RRE). During 2008, users of ArcGIS were upgraded to Version 9.2, Service Packs 5 and 6. Licenses of ArcEngine Runtime and ArcEngine Developer's Toolkit were acquired for use in continued development and deployment of WaLIS.

Professional Development

Training

Two GIS personnel attended the ESRI seminar, "Improve Your Entire GIS Workflow with ArcGIS 9.3" (White Plains, NY, 12/9). The seminar demonstrated how new functionality in ArcGIS 9.3 improves organizational workflow through better data management and dissemination.

Office of Engineering-Training: Individual assistance was provided as needed to Engineering personnel in the use of ArcGIS features and functionality.

Two OIT personnel who support the BWS GIS attended an ESRI seminar titled "GIS Resources for Water Utility Solutions" on September 4, 2008. In the first half of the seminar, the presenters offered an overview of asset management, operation planning, and mobility using ESRI technology, specifically geared toward organizations working with water utilities. In the second half, ESRI business partners showcased their asset tracking and management software packages, and the customizations available for water utilities.

Conferences and User Groups

One GIS staff member attended the 24th annual NYS GIS Conference, "Expanding GIS Participation: Something from Everyone" (Liverpool, NY, 10/6-7). Among the informative presentations was a keynote address by Dr. Michael Goodchild (University of California Santa Barbara) on "Leveraging the Power of Web 2.0: The Impact of Volunteered Geographic Information on the GIS Community."

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 WR&R, also promulgated as State law, the federal Clean Water Act, NPDES, and SEQRA, as well as local ordinances. Of these, the primary mechanism for protection of the water supply is 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 new projects received in 2008 in the Boyd Corners, West Branch, Croton Falls, Cross River, and Kensico Reservoir basins. The new, delegated, and remediated individual septic systems are listed in Table 6.2. Figures 6.1 through 6.3 show the locations of these projects.

Table 6.1. Boyd Corners, West Branch, Croton Falls, Cross River, and Kensico Reservoirs new projects for 2008.

Map#	Reservoir Basin	Project Name	Town	DEP Approval Required	Project Status as of 12/31/08
1	Cross River	Riina (John)- 0/34,36,38,40 & 42	Lewisboro	Other	No Application
2	Cross River	Truesdale Lake Lot 11&19/Patyi	Lewisboro	Variance	Incomplete
3	Cross River	Thistlewaite Learning Center	Lewisboro	Stormwater	Approved
4	Croton Falls	Lake Casse Sub. Lot 181	Carmel	Variance	Approved
5	Croton Falls	CRO-490 Stormwater Remediation at Croton Falls Reservoir	Multiple	Stormwater	Approved
6	Croton Falls	Senior Citizen Apartments/Quis	Carmel	Stormwater	Incomplete
7	Croton Falls	CRO-420 Michael Brook	Carmel	Other	No Application
8	Croton Falls	Lake Casse View Sub. Lot 37	Carmel	Variance	Approved
9	Kensico	Westchester County Airport	North Castle	Stormwater	Incomplete
10	Kensico	Chiselhurst Sub. Lot 6/Fitzsimmons	New Castle	Stormwater	Complete
11	West Branch	Mountain View Realty	Kent	Stormwater	Incomplete

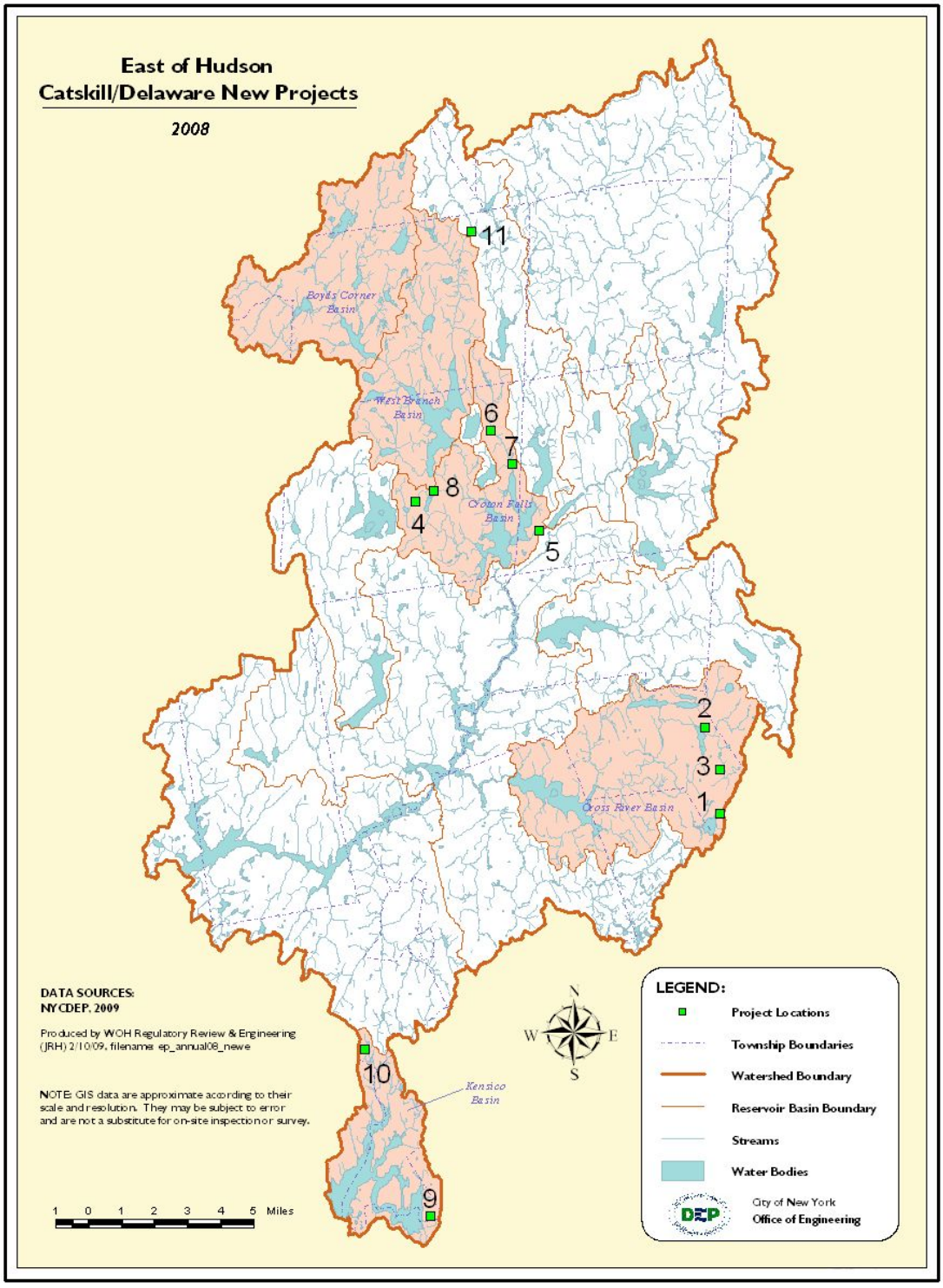

Figure 6.1. East of Hudson Catskill/Delaware new projects for 2008.

All new and repaired individual septic system applications in Kensico, West Branch, Boyd Corners, Croton Falls, and Cross River basins (all of which are located in Putnam and Westchester Counties) are subject to delegated review by county health departments. The new and repaired individual septic systems located in Dutchess County are reviewed and approved by DEP

Table 6.2. Boyd Corners, West Branch, Croton Falls, Cross River, and Kensico Reservoirs individual SSTSs for 2008.

Reservoir	Town	# of Delegated Septics	# of New Septics	# of Septic Repairs	# of Approvals	# of Constructions
Boyd Corners	East Fishkill	N/A	1	0	2	0
Boyd Corners	Kent	3	N/A	11	10	0
Boyd Corners	Putnam Valley	0	N/A	0	0	0
Cross River	Bedford	4	N/A	0	3	3
Cross River	Lewisboro	12	N/A	0	5	4
Cross River	Pound Ridge	1	N/A	0	3	1
Croton Falls	Carmel	11	N/A	16	15	4
Croton Falls	Kent	0	N/A	3	3	0
Croton Falls	Southeast	5	N/A	1	2	0
Croton Falls	Somers	0	N/A	0	0	0
Croton Falls	Yorktown	0	N/A	1	2	1
Kensico	Mt. Pleasant	0	N/A	0	0	0
Kensico	New Castle	1	N/A	0	2	2
Kensico	North Castle	0	N/A	0	0	1
Kensico	Harrison	0	N/A	0	0	0
Kensico	Greenwich, Ct.	N/A	0	0	0	0
West Branch	Carmel	3	N/A	15	10	4
West Branch	East Fishkill	N/A	1	0	1	0
West Branch	Kent	3	N/A	10	7	8
West Branch	Putnam Valley	0	N/A	0	0	0
Totals		**43**	**2**	**58**	**65**	**28**

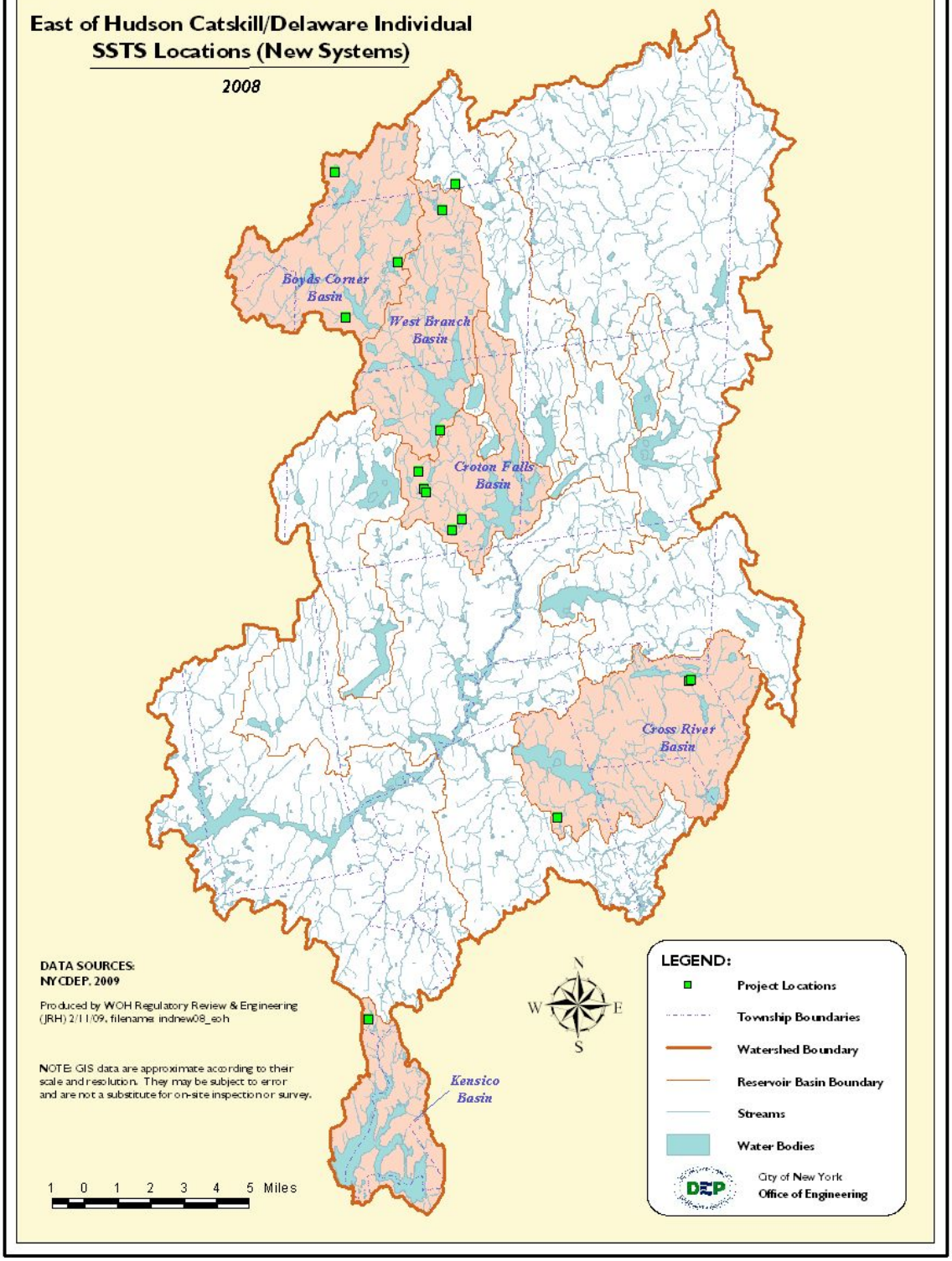

Figure 6.2. East of Hudson Catskill/Delaware new individual SSTS locations for 2008.

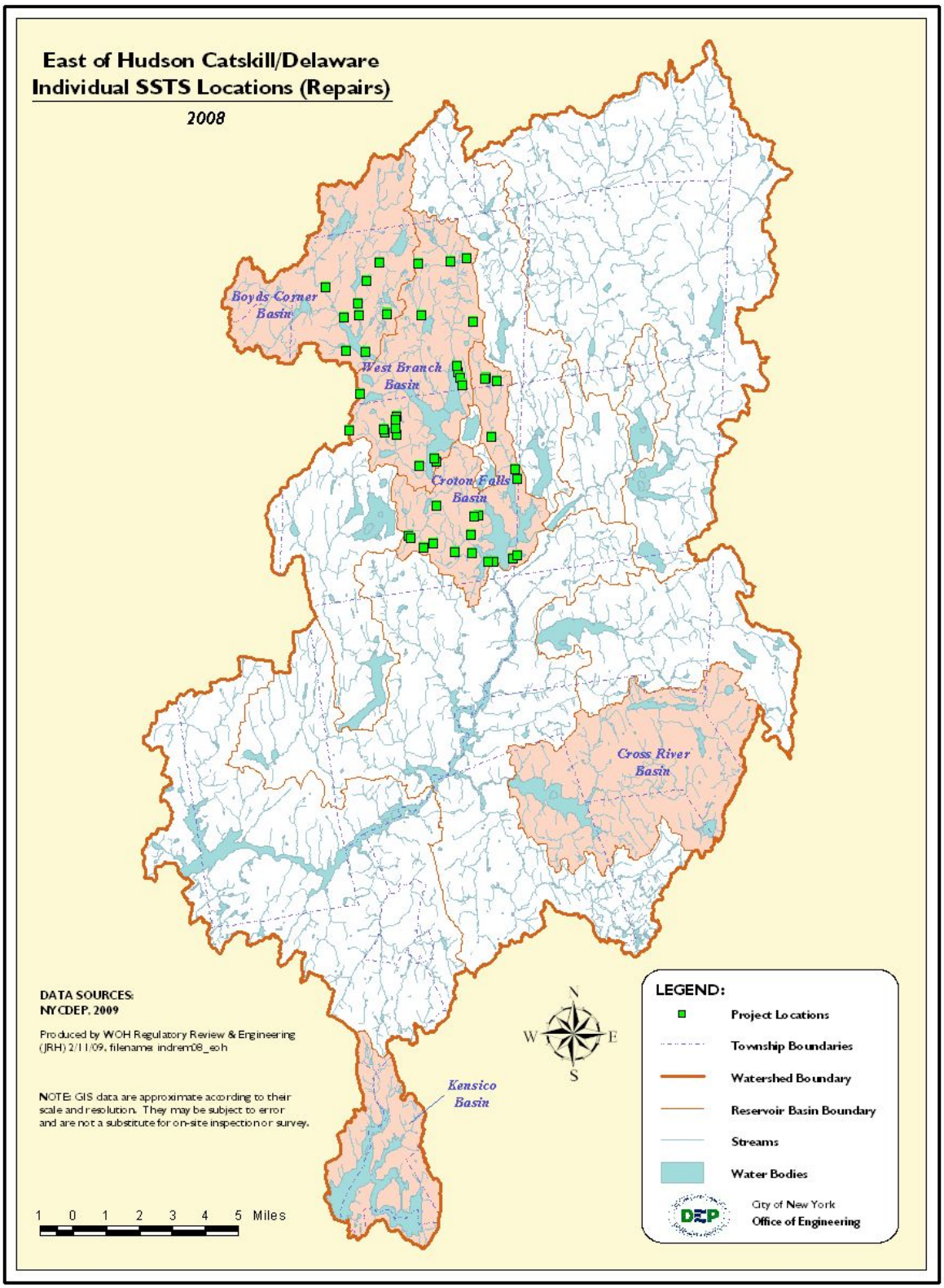

Figure 6.3. East of Hudson Catskill/Delaware repaired individual SSTS locations for 2008.

Table 6.3 lists new projects received in 2008 in the Cannonsville, Pepacton, Rondout, Neversink, Schoharie, and Ashokan basins. The "Other" projects consist of DOT projects, wetland and stream disturbances, mining applications from DEC, timber harvesting, and stormwater retrofit projects. The projects listed in Table 6.3 are new or repaired commercial, institutional and multi-family septics, or individual advanced aerobic treatment units (ATU). The new, delegated, and remediated individual septic systems are listed in Tables 6.4 and 6.5. Figures 6.4 through 6.6 show the locations of these projects.

Table 6.3. Ashokan, Cannonsville, Neversink, Pepacton, Rondout, Schoharie Reservoirs new projects for 2008.

Map No.	Reservoir Basin	Project Name	Town	DEP Approval Required	Project Status as of 12/31/08
46	Ashokan	Broad Street Hollow Bridge Replacement	Lexington	Stream Disturbance	Closed
56	Ashokan	Boiceville-Proposed WWTF	Olive	Sewer Collection	Approved
56	Ashokan	Boiceville-Proposed WWTF	Olive	Stormwater	Approved
57	Ashokan	Davis, Steve	Olive	Stream Disturbance	No Application
58	Ashokan	Zeines, Victor	Olive	Intermediate Repair	Complete
64	Ashokan	Town of Shandaken GIS Implementation Project - LTAP	Shandaken	Other	Closed
84	Ashokan	Grogkill Property Owners Stream Disturbance	Woodstock	Stream Disturbance	Closed
85	Ashokan	Howard, Henry (Woodstock Manor)	Woodstock	Intermediate Repair	Closed
6	Cannonsville	Coulter Brook Meadow (aka:DFF Subdivision)	Bovina	Stream Disturbance	Closed
8	Cannonsville	Holiday Brook Slope Stabilization - Site #4	Colchester	Stream Disturbance	Closed
10	Cannonsville	Cairns Property Stream Disturbance	Delhi (V)	Stream Disturbance	No Application

Table 6.3. (Continued) Ashokan, Cannonsville, Neversink, Pepacton, Rondout, Schoharie Reservoirs new projects for 2008.

Map No.	Reservoir Basin	Project Name	Town	DEP Approval Required	Project Status as of 12/31/08
11	Cannonsville	Elk Creek Road Streambank Stabilization	Delhi (V)	Stream Disturbance	Closed
12	Cannonsville	Scour Repair - Route 10 over Elk Creek	Delhi (V)	Other	No Application
13	Cannonsville	Stormwater Mitigation Measures for Delhi	Delhi (V)	Other	Closed
14	Cannonsville	Town & Village of Delhi Comprehensive Plan - LTAP	Delhi (V)	Other	Closed
17	Cannonsville	County Route 21 Stream Channel	Franklin	Stream Disturbance	Closed
29	Cannonsville	Banchi Property	Hamden	Stream Disturbance	Closed
31	Cannonsville	Hamden Town Property (Giles, Richard)	Hamden	Stream Disturbance	Closed
32	Cannonsville	River Valley New Holland Inc. (Pinkey)	Hamden	Intermediate SSTS	Approved
32	Cannonsville	River Valley New Holland Inc. (Pinkey)	Hamden	Stormwater	Withdrawn
34	Cannonsville	Hobart Quickway	Hobart (V)	Stormwater	Incomplete
47	Cannonsville	Karme Ling Retreat Center	Meredith	Intermediate SSTS	Approved
47	Cannonsville	Karme Ling Retreat Center	Meredith	Stormwater	No Application
65	Cannonsville	Ferris Property	Stamford (T)	Stream Disturbance	Closed
66	Cannonsville	Houshmand, John	Stamford (T)	Intermediate SSTS	Complete

Table 6.3. (Continued) Ashokan, Cannonsville, Neversink, Pepacton, Rondout, Schoharie Reservoirs new projects for 2008.

Map No.	Reservoir Basin	Project Name	Town	DEP Approval Required	Project Status as of 12/31/08
69	Cannonsville	Demarest Stream Disturbance	Tompkins	Stream Disturbance	Closed
70	Cannonsville	Henley Property Stream Disturbance	Tompkins	Stream Disturbance	Closed
71	Cannonsville	County Route 22; Gabion Slope	Walton	Stream Disturbance	Closed
72	Cannonsville	DCSWMC Gas Extraction System	Walton	Other	No Application
73	Cannonsville	DCSWMF - 1st Quarter 2008	Walton	Other	No Application
74	Cannonsville	Delaware River @ Bridge Street	Walton	Stream Disturbance	Closed
75	Cannonsville	Fletcher Stream Repair	Walton	Stream Disturbance	Closed
76	Cannonsville	Hulbert Property	Walton	Stream Disturbance	Closed
77	Cannonsville	Miller Property Stream Disturbance	Walton	Stream Disturbance	Closed
78	Cannonsville	T/Walton Drainage Improvements	Walton	Other	Closed
79	Cannonsville	Turner Stream Disturbance	Walton	Stream Disturbance	Closed
86	Cannonsville	DCSWMF - 2007 Annual Report (Not Mapped)	Delhi (V)	Other	No Application
15	Neversink	Denning Road Bridge Replacement	Denning	Other	No Application
16	Neversink	Town of Denning Comprehensive Planning - LTAP	Denning	Other	Closed

Table 6.3. (Continued) Ashokan, Cannonsville, Neversink, Pepacton, Rondout, Schoharie Reservoirs new projects for 2008.

Map No.	Reservoir Basin	Project Name	Town	DEP Approval Required	Project Status as of 12/31/08
1	Pepacton	Barkaboom Road Slope Stabilization	Andes	Other	No Application
2	Pepacton	Cole, Harold Subdivision	Andes	Intermediate SSTS	Complete
2	Pepacton	Cole, Harold Subdivision	Andes	Stormwater	New
3	Pepacton	Fenton Property	Andes	Other	Closed
4	Pepacton	Geiger Property Stream Disturbance	Andes	Stream Disturbance	Closed
5	Pepacton	Town of Andes Highway Garage	Andes	Intermediate SSTS	Approved
5	Pepacton	Town of Andes Highway Garage	Andes	Stormwater	Complete
7	Pepacton	Holiday Brook Slope Stabilization - Site #3	Colchester	Stream Disturbance	Closed
30	Pepacton	Graf-Von Schoenborn Stream Disturbance	Hamden	Stream Disturbance	Closed
33	Pepacton	Gould, Kingdon, Jr.	Hardenburgh	Stream Disturbance	Closed
48	Pepacton	DCDPW - Br 6-1 County Route 6 Stream Disturbance	Middletown	Stream Disturbance	Closed
49	Pepacton	Johnson, James R. (DEC NOV)	Middletown	Stormwater	New
50	Pepacton	Mann, Karen	Middletown	Intermediate SSTS	Approved
51	Pepacton	Margaretville Community Pool and Rec Facility	Middletown	Sewer Connection	New
51	Pepacton	Margaretville Community Pool and Rec Facility	Middletown	Stormwater	New

Table 6.3. (Continued) Ashokan, Cannonsville, Neversink, Pepacton, Rondout, Schoharie Reservoirs new projects for 2008.

Map No.	Reservoir Basin	Project Name	Town	DEP Approval Required	Project Status as of 12/31/08
52	Pepacton	Middletown Sand & Gravel Mine	Middletown	Other	Closed
53	Pepacton	Mill Brook Road Stream Disturbance	Middletown	Stream Disturbance	Closed
54	Pepacton	Smith Road Stream Disturbance	Middletown	Stream Disturbance	Closed
60	Pepacton	Roxbury - Proposed WWTP	Roxbury	Stream Disturbance	No Application
61	Pepacton	Stone Tavern Farm - Horse Camp	Roxbury	Intermediate Repair	Approved
61	Pepacton	Stone Tavern Farm - Horse Camp	Roxbury	Intermediate Repair	Incomplete
62	Pepacton	Stone Tavern Farm - House/B&B	Roxbury	Intermediate Repair	Incomplete
63	Pepacton	Town of Roxbury Planning and Assessment	Roxbury	Other	Closed
55	Rondout	Carreras, Debora	Neversink	Variance	New
9	Schoharie	Bear Kill Road Culvert Replacement	Conesville	Stream Disturbance	Closed
18	Schoharie	Lake in the Sky - Lot #13 (Walla)	Gilboa	Stormwater	New
19	Schoharie	Lake in the Sky - Lot #21 (Witt)	Gilboa	Stormwater	Approved
20	Schoharie	Lake in the Sky - Lot #22 (Grundleger)	Gilboa	Stormwater	Approved
21	Schoharie	Lake in the Sky - Lot #28 (Calabro)	Gilboa	Stormwater	Closed

Table 6.3. (Continued) Ashokan, Cannonsville, Neversink, Pepacton, Rondout, Schoharie Reservoirs new projects for 2008.

Map No.	Reservoir Basin	Project Name	Town	DEP Approval Required	Project Status as of 12/31/08
22	Schoharie	Lake in the Sky - Lot 25 (Cheney)	Gilboa	Stormwater	Approved
23	Schoharie	Pine Island - Lot #12 (Latanision)	Gilboa	Stormwater	Complete
24	Schoharie	Pine Island - Lot #21 (Celso)	Gilboa	Stormwater	Closed
25	Schoharie	Pine Island - Lot #22 (DeBenedetto)	Gilboa	Stormwater	New
26	Schoharie	Pine Island - Lot #4 (Czapla, Kathleen & Bruce)	Gilboa	Stormwater	Approved
27	Schoharie	Pine Island - Lot #7 (Galbraith)	Gilboa	Stormwater	Approved
28	Schoharie	DiBenedetto Stream Disturbance	Halcott	Stream Disturbance	No Application
35	Schoharie	Burd Property	Hunter	Stream Disturbance	Closed
36	Schoharie	Colonel's Chair	Hunter	Stormwater	Approved
37	Schoharie	Four Season's Stormwater Improvements	Hunter	Stream Disturbance	Closed
38	Schoharie	Hunter Corridor GEIS - LTAP	Hunter	Other	Closed
39	Schoharie	Latvian Church Stream Disturbance	Hunter	Stream Disturbance	Closed
40	Schoharie	Northstar Dog Grooming (Anne Rothman)	Hunter	Intermediate SSTS	New
41	Schoharie	Schoharie Embankment Repair @ Schoharie Avenue	Hunter (V)	Stream Disturbance	No Application

Table 6.3. (Continued) Ashokan, Cannonsville, Neversink, Pepacton, Rondout, Schoharie Reservoirs new projects for 2008.

Map No.	Reservoir Basin	Project Name	Town	DEP Approval Required	Project Status as of 12/31/08
42	Schoharie	Baumgarten Residence - Control of Algae	Jewett	Other	Closed
43	Schoharie	Camp Tri-Mount	Jewett	Stormwater	Approved
44	Schoharie	Route 296 Culvert Linings & Replacements	Jewett	Other	Closed
45	Schoharie	Bridge Scour Repairs - Route 42 over West Kill	Lexington	Other	No Application
59	Schoharie	Robins, Christopher	Roxbury	Variance	New
67	Schoharie	Hunter Foundation Stormwater Retrofit Project	Tannersville	Stream Disturbance	Closed
68	Schoharie	Nihill, Edward (Fairway Commons)	Tannersville	Sewer Connection	Incomplete
80	Schoharie	Copper Ridge, LLC	Windham	Sewer Collection	Incomplete
80	Schoharie	Copper Ridge, LLC	Windham	Stormwater	Approved
81	Schoharie	Greene-Del Sanitation & Recycling	Windham	Other	Closed
81	Schoharie	Greene-Del Sanitation & Recycling	Windham	Stormwater	Incomplete
82	Schoharie	Sugar Maples Riparian Buffer Project	Windham	Stream Disturbance	Closed
83	Schoharie	Sugar Maples Stream Restoration Project	Windham	Other	No Application

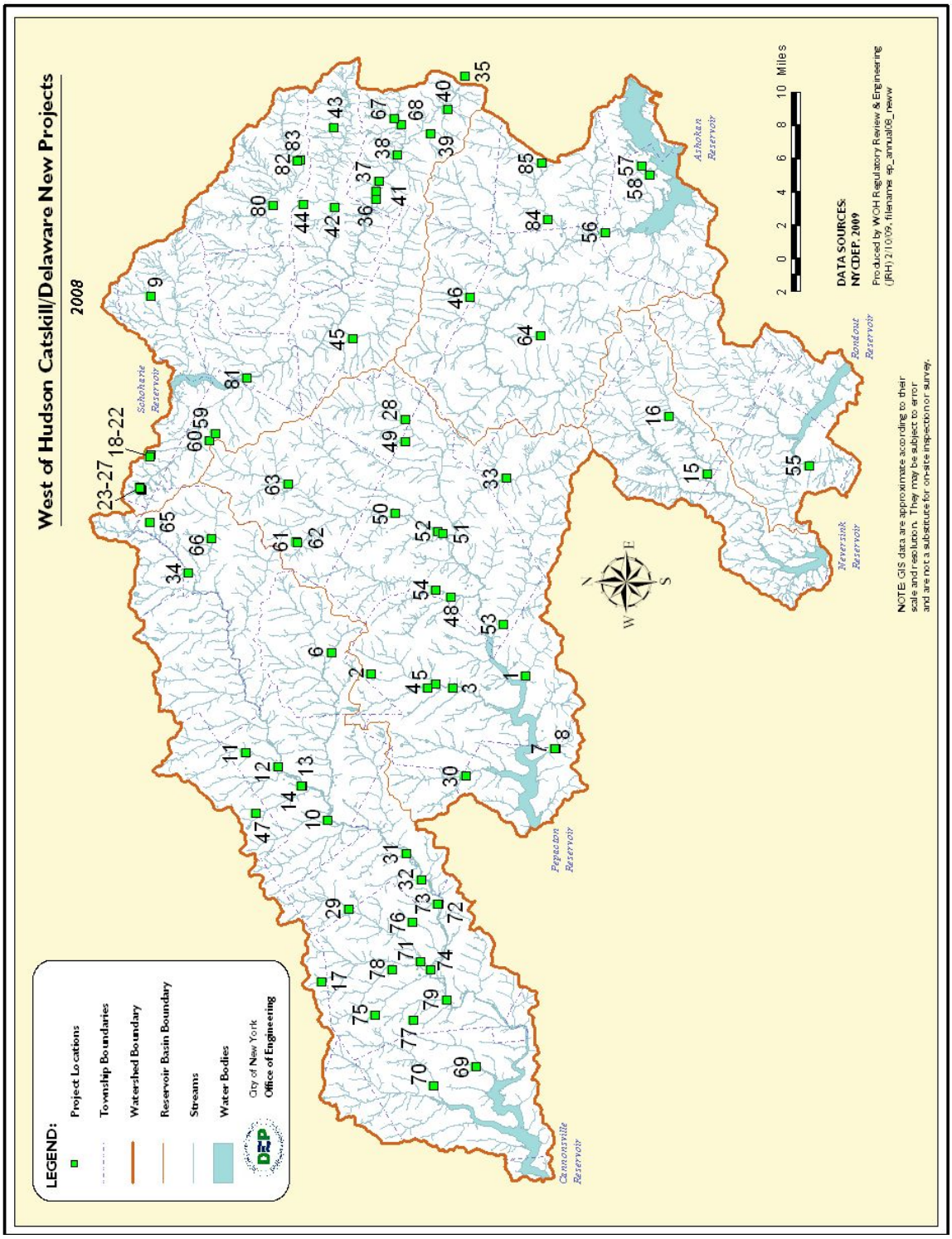

Figure 6.4. West of Hudson Catskill/Delaware new projects for 2008.

Table 6.4. Ashokan and Schoharie Reservoirs individual SSTSs for 2008.

Reservoir	Town	# of Delegated Septics	# of New Septics	# of Septic Repairs	# of Approvals	# of Constructions
Ashokan	Hurley	2	N/A	6	11	9
Ashokan	Marbletown	0	N/A	0	0	0
Ashokan	Olive	5	N/A	14	23	17
Ashokan	Shandaken	7	N/A	31	37	34
Ashokan	Woodstock	8	N/A	12	18	9
Schoharie	Ashland	N/A	7	2	9	11
Schoharie	Conesville	N/A	6	1	6	6
Schoharie	Gilboa	N/A	6	3	9	3
Schoharie	Halcott	N/A	0	0	0	0
Schoharie	Hunter	N/A	3	3	7	8
Schoharie	Hunter (V)	N/A	0	0	0	1
Schoharie	Jewett	N/A	4	6	12	15
Schoharie	Lexington	N/A	10	2	11	11
Schoharie	Prattsville	N/A	2	2	4	5
Schoharie	Roxbury	N/A	3	3	6	1
Schoharie	Stamford	N/A	0	0	0	0
Schoharie	Tannersville (V)	N/A	0	0	0	0
Schoharie	Windham	N/A	10	8	18	16
Totals		**22**	**51**	**93**	**171**	**146**

Table 6.5. Cannonsville, Pepacton, Rondout, Neversink Reservoirs Individual SSTSs for 2008.

Reservoir	Town	# of Delegated Septics	# of New Septics	# of Septic Repairs	# of Approvals	# of Constructions
Cannonsville	Bovina	N/A	7	4	11	11
Cannonsville	Delhi	N/A	1	11	12	18
Cannonsville	Franklin	N/A	1	1	2	2
Cannonsville	Hamden	N/A	12	7	8	11
Cannonsville	Harpersfield	N/A	0	1	0	1
Cannonsville	Hobart (V)	N/A	0	0	0	0
Cannonsville	Jefferson	N/A	3	0	3	1
Cannonsville	Kortright	N/A	1	3	4	8
Cannonsville	Masonville	N/A	0	2	2	1
Cannonsville	Meredith	N/A	4	2	6	5
Cannonsville	Sidney	N/A	0	0	0	0
Cannonsville	Stamford	N/A	2	4	6	6
Cannonsville	Tompkins	N/A	11	6	14	11
Cannonsville	Walton	N/A	9	17	26	21
Neversink	Denning	1	N/A	0	1	3
Neversink	Hardenburgh	0	N/A	0	0	0
Neversink	Neversink	N/A	1	4	5	6
Pepacton	Andes	N/A	8	11	20	13
Pepacton	Bovina	N/A	0	0	0	1
Pepacton	Colchester	N/A	1	1	2	3
Pepacton	Fleischmanns	N/A	0	0	0	0
Pepacton	Halcott	N/A	3	1	4	2

Table 6.5. (Continued) Cannonsville, Pepacton, Rondout, Neversink Reservoirs Individual SSTSs for 2008.

Reservoir	Town	# of Delegated Septics	# of New Septics	# of Septic Repairs	# of Approvals	# of Constructions
Pepacton	Hamden	N/A	1	5	6	0
Pepacton	Hardenburgh	N/A	0	1	1	0
Pepacton	Middletown	N/A	18	25	41	39
Pepacton	Roxbury	N/A	3	7	10	16
Pepacton	Wawarsing	N/A	0	0	0	0
Rondout	Denning	0	N/A	4	5	3
Rondout	Fallsburg	N/A	1	0	1	1
Rondout	Hardenburgh	0	N/A	0	0	1
Rondout	Neversink	N/A	6	9	14	12
Rondout	Rochester	0	N/A	2	2	1
Rondout	Wawarsing	1	N/A	2	2	1
Totals		**2**	**93**	**130**	**208**	**198**

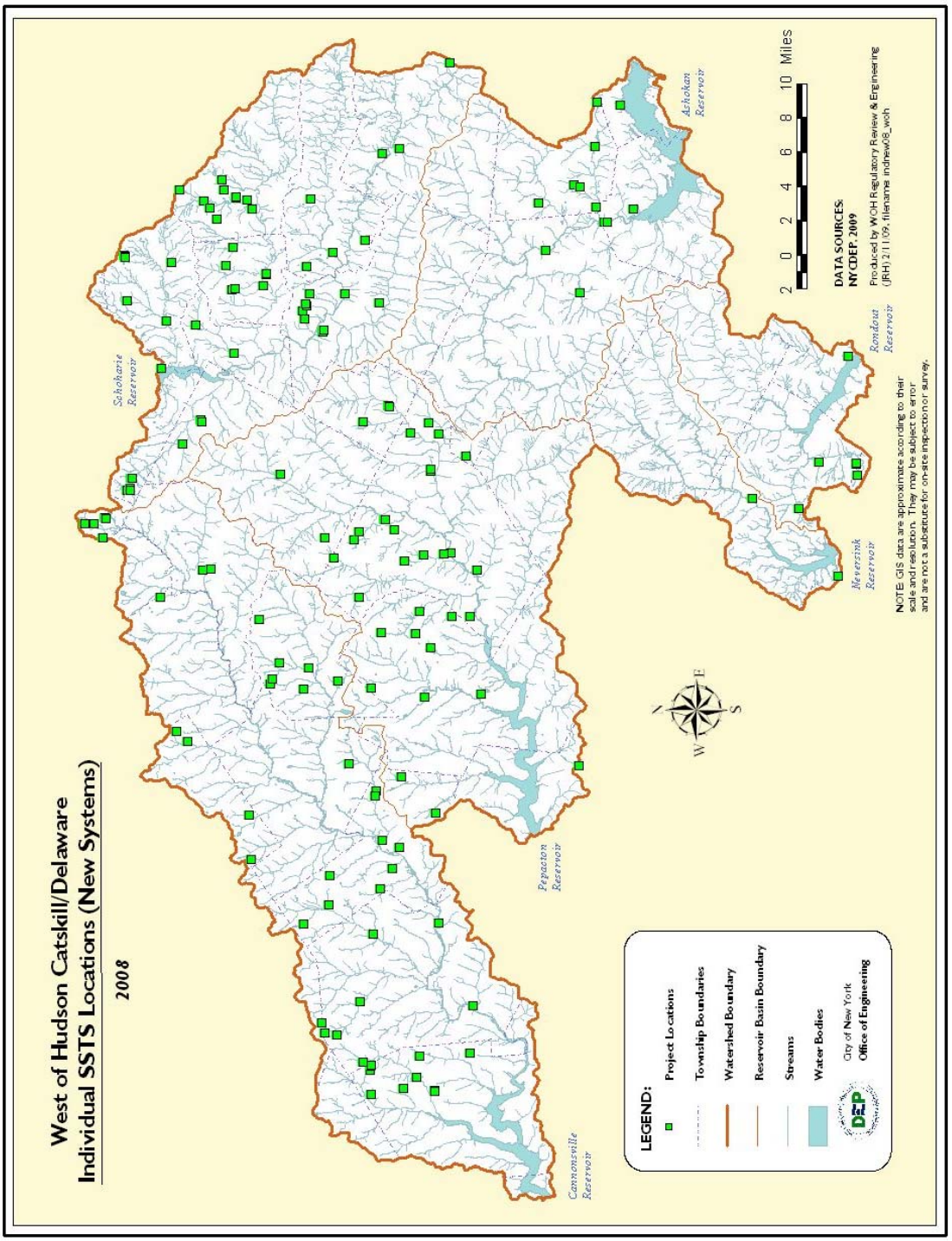

Figure 6.5. West of Hudson Catskill/Delaware new individual SSTS locations for 2008.

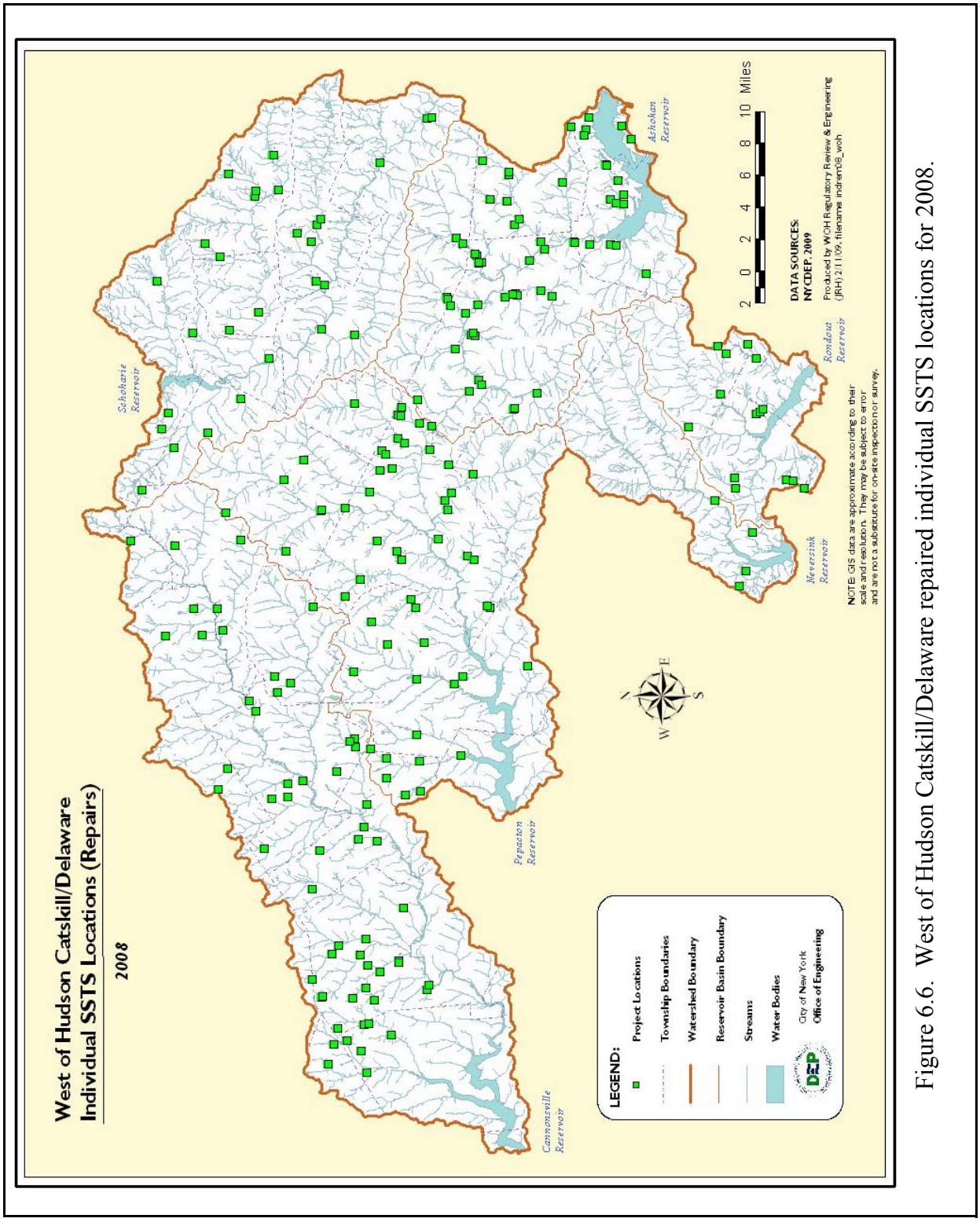

Figure 6.6. West of Hudson Catskill/Delaware repaired individual SSTS locations for 2008.

6.1.2 Enforcement Activities

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

DEP reviews applications, conducts site visits, witnesses soil tests, and inspects construction of all new individual septic systems in the Catskill and Delaware Systems. DEP 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. These activities are coordinated with DEP Legal and Corporation Counsel, local county health departments, local building inspectors, and the Catskill Watershed Corporation if the activity is in an MOA program area.

The DEP Environmental Police patrol throughout 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 the watershed regulations, 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 DEP monthly enforcement meetings for both EOH and WOH.

In 2008, the DEP Police:

- completed 21,408.5 hours of training
- conducted 6,049 preliminary investigations
- conducted 145 long-term investigations related to pollution crime or terrorism
- conducted 11 suspicious incident investigations related to terrorism
- patrolled 2,302,398 miles
- conducted 170,221 physical security inspections

Also in 2008, the DEP Police made 189 arrests, issued 1,685 summonses, and served 162 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.

6.1.3 Delegation Agreements

In 2008, the Westchester County Health Department negotiated a revised Delegation Agreement within the current five-year agreement allowing it to review septic system repairs, a change requiring the County to modify its public health code. As a result, Westchester County, like Putnam County, will now perform reviews of new and repaired septic systems; Ulster County, under its Delegation Agreement, continues to perform reviews of new septic systems only.

DEP received documentation concerning the review of 328 delegated systems during the calendar year 2008. Of these, 130 were reviewed by the county health departments in the Catskill and Delaware Systems; the remaining 198 are located outside the Catskill and Delaware Systems.

6.1.4 Winter Road Deicer Policy and Protection Development

DEP is a member of the deicing task force of the Northern Westchester Watershed Committee, which includes representatives of local highway officials, Westchester County, DOT, Riverkeeper, New York Public Interest Research Group, and DEP. The group 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.

Several of the practices recommended by the Task Force are being considered, and in some cases enacted, at the local, county, and state level. One such practice is enhanced road salt application management by the county and several of the towns. In addition, a bill before the NYS Senate (S. 2255) would designate sections of roadway in close proximity to East of Hudson reservoirs as environmentally sensitive, and require use of an environmentally benign substitute (potassium acetate) to deice them.

6.2 Wastewater Treatment Facility Compliance Inspection Program

At each surface discharging wastewater treatment plant (WWTP) that operates on a year-round basis, DEP 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, DEP 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 sam-

pling results from biweekly DEP sampling and analyses. When needed, DEP laboratories are asked to collect samples and conduct special analyses to identify violations and assist in resolving operational issues.

When violations are identified at WWTPs, DEP coordinates enforcement activities with NYSDEC 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 USEPA, NYSDOH, and the New York State Attorney General's Office.

Facility Compliance in Catskill/ Delaware Watershed

Thirty-six West of Hudson (WOH) WWTPs, including the New Infrastructure Program (NIP) facilities and their respective connections, were inspected on a regular schedule. Of these, 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. DEP conducted 229 scheduled compliance, emergency response, and WWTP upgrade construction inspections for these facilities in 2008.

Wastewater treatment plants in the Catskill/Delaware watershed continue to show improvement in compliance with their State Pollutant Discharge Elimination System (SPDES) Permits.

DEP 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 to remediate the problem with the facility owner and/or operator have failed. DEP, in conjunction with the NYSDEC 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 May 2008 for the Delaware BOCES WWTP (SPDES# NY – 0097446). Although this facility was upgraded in 2004, the facility has violated its SPDES permit limitations for effluent pH since the start of the 2007 monitoring period. DEP recommended that the facility monitor the alkalinity feed and take additional pH readings to correct this condition. The facility

will also alternate the sequential batch reactors (SBR) to address any ammonia spikes and cut down on the formation of filamentous bacteria. The facility has significantly cut down on the number of pH exceedances since the second half of the 2008 monitoring period.

DEP and the NYSDEC Technical Assistance Group (TAG) have worked closely together to identify and troubleshoot abnormal operating conditions at WWTPs in the NYC watershed without instituting enforcement. One notable example of this coordinated effort during the 2008 monitoring period was at the Town of Andes WWTP. The facility reported a plant upset and subsequent bypass of the Continuous Micro Filtration (CMF) process in February 2008. The upset appeared to be the result of a toxic shock load affecting nitrification within the SBR and fouling the CMF's. DEP inspections also revealed numerous design flaws within the treatment process. DEP and TAG initiated a series of investigative activities including inspections, staff interviews, record review, and sample analysis to provide a preliminary assessment of the design operational flexibility of the WWTP. This information was used to produce a comprehensive performance evaluation (CPE) of the subject WWTP which encompassed general plant information, administration, design, operations, maintenance, and plant performance and established the most appropriate and cost-effective improvements to the treatment process. WWTP-Compliance Inspection (CI) staff has coordinated with the Town's design engineer to propose a capital improvement project to enhance the performance of the WWTP.

DEP personnel reviewed, approved, and monitored the implementation and construction of the connections for several WWTPs to NIP facilities. The following are status updates for new connections to the Village of Windham WWTP: Windham Ridge final upgrade approval was issued on October 2, 2008; Crystal Pond Lift Station conducted preliminary start-up testing in December 2008; Windham Mountain Village completed installation and testing of new manholes on May 20, 2008.

Facility Compliance in East of Hudson Watershed

East Of Hudson (EOH), DEP ensures that adequate measures are taken to enforce compliance with the SPDES permits issued to the 72 WWTPs and the 38 groundwater remediation systems, landfills, oil/water separators, and wastewater collection systems that discharge into the EOH watershed. DEP conducted 416 scheduled compliance, emergency response, and WWTP upgrade construction inspections in 2008.

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 were in substantial compliance with their SPDES permit discharge limitations. The Carmel Sewer District #2 WWTP and Mahopac (DEP) WWTP did experience sewage overflows that were not entirely contained, but these did not impact water quality.

DEP performed a Compliance Response Inspection of the Carmel Sewer District #2 WWTP on September 8, 2008, in response to a call from the facility operator about a sewage overflow. The untreated wastewater spilled at the corner of Stoneleigh Avenue and Vista Court. It was estimated between 400-500 gallons overflowed from a manhole on Stoneleigh Avenue. The overflow was directed above a storm drain that most likely discharged into a field directly across the street. DEP traversed the field (covered with about three foot high weeds) from Vista Court to a grassy area on the adjoining property. There was no indication that the wastewater had traveled that far.

DEP performed a Compliance Response Inspection of the Mahopac WWTP on June 5, 2008, in response to a call from the facility operator about a sewage overflow. The facility reported a sewage spill near the preliminary treatment/screening building. A large amount of grease plugged the line leading into the plant, causing an estimated 2,000 gallons of raw sewage to enter a swale in front of the plant head works. The swale was drained using a submersible sump pump, with the majority of the discharge diverted into the plant's equalization tank. Approximately 800 gallons of sewage spilled from the swale into an adjacent wetland along Route 6 but did not reach a receiving stream and did not have an adverse effect on water quality. The pipe was rodded to remove any additional grease. The facility manager contacted all the relevant regulatory agencies, along with the Town of Carmel Building Department, to recommend that they enforce their sewer use ordinance to prevent such an excessive amount of grease build-up in the collection system.

WWTP-CI approved the connection of the Fulmar Road Elementary School WWTP to the Mahopac (DEP) WWTP. Functional Completion for the new Fulmar Road Elementary School pump station was issued by the Town of Carmel and the Mahopac Central School District on September 26, 2008. Putnam County Health Department approval was issued on September 29, 2008, the pump station was officially activated on September 30, 2008, and the WWTP was properly decommissioned.

DEP performed compliance inspections of the Town of North Castle (Old Route 22, Cooney Hill Road, Route 120/Loudens Cove, New King Street, Old Orchard Street) and Harrison (Park Lane) pump stations and collection system throughout the 2008 monitoring period. The inspections revealed no abnormal conditions. DEP is satisfied with the preventative/corrective maintenance activities performed by the Town of North Castle, following the sewage overflow from the New King Street Pump Station on July 31, 2007.

6.2.1 Sampling of Wastewater Treatment Plant Effluents

Sampling of surface-discharging wastewater treatment plant (WWTP) effluents is conducted by DEP's ELAP-approved laboratories. West of Hudson sampling and analyses are performed by Grahamsville Laboratory in the Delaware System and Kingston 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 2008, 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 Fleischmanns, 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 quarterly, 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 2008, the Kingston Laboratory conducted 2,755 analyses on 425 effluent samples and Grahamsville Laboratory conducted 2,831 analyses on 284 effluent samples from WWTPs (and non-contact cooling water discharges) discharging within the watershed. For plants in the East of Hudson FAD basins, Brewster Laboratory collected 232 effluent samples and conducted 2,109 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 ensures timely, thorough, and effective SEQRA environmental reviews in the watershed. To manage these often large and complex projects, and the accompanying SEQRA environmental reviews, DEP tracks all SEQRA projects in the watershed; maintains a database of new projects and development trends in the watershed; interacts with local, state, and federal officials and other parties

interested in DEP's involvement in SEQRA environmental reviews; and makes certain that the appropriate levels of DEP management are kept apprised of the presence and status of potentially controversial SEQRA reviews.

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 6.6. SEQRA Actions 2008.

Received	Reviewed	Comment Letters Issued	Ongoing Reviews	SEQRA Process Closed
109	109	96	71	76

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 6.7. 2008 SEQRA Activity and Status for Type I Actions.

Project	Description	Town/ County	Reservoir Basin	Project Status
Andes Public Library	Preservation, rehabilitation, and expansion of existing Andes Library to include parking, walkway, garden spaces, and improvement to concrete and wooden structures.	Andes/ Delaware	Pepacton	DEP received and commented on Environmental Assessment Form (EAF). Review on-going.
Bovina Highway Garage	Proposal to replace highway garage in its entirety.	Bovina/ Delaware	Cannonsville	DEP issued comments on EAF. Lead Agency made determination. DEP is awaiting Lead Agency Neg. Dec.

Table 6.7. (Continued) 2008 SEQRA Activity and Status for Type I Actions.

Project	Description	Town/ County	Reservoir Basin	Project Status
Ashland Community WWTP	Proposal to construct new WWTP to serve Ashland.	Ashland/ Greene	Schoharie	DEP received Lead Agency Neg. Dec.
Katonah-Lewisboro Union Free School District Playing Fields Redevelopment	Restoration and/or improvement to existing athletic fields, including the conversion of one field surface from natural turf to synthetic turf.	Lewisboro/ Westchester	Cross River	DEP received Lead Agency Neg. Dec.
Hillcrest Commons	Construction of six senior residential buildings, including senior community center, 60,000 sq. ft. of office space in five buildings, and associated driveway and parking.	Carmel & Kent/ Putnam	Croton Falls	DEP received final scoping outline from Lead Agency.
Putnam Community Foundation	Scaled down senior citizen housing units with support facility to include a caretaker cottage and community center.	Carmel/ Putnam	Croton Falls	Lead Agency issued Findings to Approve.
Seven Spring Subdivision	Proposed 17 lot subdivision and private equestrian facility.	Bedford &North Castle/ Westchester	New Croton	DEP received and commented on the DEIS in August 2008.
Northern Westchester Hospital	Proposed zoning change, addition to the hospital, and additional parking.	Mt. Kisco/ Westchester	New Croton	DEP received and commented on the EAF and the expanded EAF and attended public hearing meeting. DEP received Lead Agency Neg. Dec.

Table 6.7. (Continued) 2008 SEQRA Activity and Status for Type I Actions.

Project	Description	Town/ County	Reservoir Basin	Project Status
Millwood Fire House	Proposed construction of new firehouse on Routes 120/133 in the Hamlet of Millwood.	New Castle/ Westchester	New Croton	DEP received and commented on the DEIS in October 2008.
Moresville Energy LLC for Wind Energy Facilities	Proposal to construct a wind energy facility consisting of 33 wind turbines and ~8.27 miles of access roads.	Roxbury & Stamford/ Delaware	Cannonsville, Pepacton, Schoharie	DEP received and commented on the DEIS in June 2008. The Lead Agency has requested additional information from the applicant.
Patterson Crossing Retail Center	Proposal to construct ~439,000 sq. ft. of retail space and 2,097 parking spaces on a ~90-acre parcel.	Patterson/ Putnam	East Branch	DEP received Lead Agency Findings to Approve in July 2008.
Putnam Community Foundation	Construction of 60 apartment units and 60 townhouse units, community center, tennis courts, and multi-sport courts.	Carmel/ Putnam	Croton Falls	DEP received and commented on the DEIS in September 2007.
Union Place	Mixed used development with walkable community center on ~303-acre parcel.	Carmel/ Putnam	Muscoot	DEP received and commented on EAF in June 2008. Lead Agency issued Pos. Dec. and Draft Scoping in July 2008. DEP attended public hearing meeting. Awaiting DEIS.

Table 6.7. (Continued) 2008 SEQRA Activity and Status for Type I Actions.

Project	Description	Town/ County	Reservoir Basin	Project Status
Bedford Community Church	Proposed new facility to include 720-seat church, 250-occupancy banquet facility, 12 classrooms, 240 off-street parking spaces, and subsurface sewage treatment system.	Bedford/ Westchester	Muscoot	DEP received and commented on the DEIS.
Salem Hunt	Proposal to construct 75 condominium units in 15 buildings, a community building, pool, and associated parking.	North Salem/ Westchester	Muscoot	DEP received and commented on DEIS.
Somers Realty Planned Hamlet Development	Mixed use development including 154 residential units, congregate care living space, professional office space, medical offices, retail/ restaurant space, and a public park.	Somers/ Westchester	Amawalk	DEP received and commented on the DEIS in September 2007.
Stateline Retail Center	Retail development including ~180,000 sq. ft. of retail space and 900+ parking spaces.	Southeast/ Putnam	East Branch	DEP received and commented on the DEIS.

7. Catskill/Delaware Filtration/UV Disinfection Facilities

DEP is constructing a UV Disinfection Facility for the Catskill and Delaware water supply. 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.

By the close of 2008, the contractor had completed the contractual excavation of 680,000 cubic yards of material and had excavated an additional 100,000 cubic yards of material that had been requested by DEP. 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.

7.1.2 Permitting

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 has been relocated to the east. DEP obtained permission from the New York State Department of Transportation (DOT) for the relocation of the secondary access road along Grasslands Road/Route 100-C in May 2008.

Greenburg Work Permits

Permits were granted by the Town of Greenburgh in 2007 for work in wetlands and along steep slopes. A third permit, granting permission for tree-cutting, was issued in August 2008. These three permits have been issued in lieu of site plan approval. The Town of Greenburgh also reviewed and approved 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 in early 2008.

7.1.3 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.

7.1.4 Facility Construction Contracts

On January 31, 2008, the CAT-210 G Structures and Equipment contractor, Skanska/ECCO III/J.F.White (SEW), received a Notice to Proceed. As of December 2008 the excavation of the UV facility, including 3,000 cubic yards of rock, had been completed and 10,000 cubic yards of concrete had been placed. Installation of the 144" raw and treated water conduits commenced in July 2008. The manufacture of the energy dissipating valves and the UV Disinfection Units equipment began in late 2008.

Changes to the general contract have been prepared to provide for future UV treated water connections to Westchester County water users. This change was part of an agreement between DEP and the County of Westchester. The portion of the agreement related to these changes was completed in September 2008. The changes include installation of two conduits from the treated water lines to the edge of the DEP property where future water users will be able to connect and where the rate of water usage will be monitored.

On February 25, 2008, the CAT-210 E, H, and P, contractors received their notices to proceed. The electrical contract was registered to Welsbach Electric, while the HVAC and plumbing contracts were registered to L.J. Coppola. As of the end of 2008, all three contractors were mobilized and on-site. The electrical contractor has begun installation of the temporary electric power system and installation of additional security lighting.

7.1.5 Pilot Studies

UV Lamp Fouling Study

By the close of 2007, six test runs were completed and demobilization of the UV Lamp Fouling Study pilot facilities was underway. During 2008 the pilot facility was decommissioned and a draft report was prepared. The report will be finalized in early 2009. Results presented in this report will be used to develop operation and maintenance procedures for the full-scale facility.

Dyed Microsphere Study

This study has been approved and will be performed at the Hydroqual facility in Johnstown, NY. Dyed microspheres will be added to the water to simulate *Cryptosporidium*. The microspheres will be analyzed before and after disinfection to measure the actual rate of inactivation. This study will provide additional information that will aid in the determination of appropriate UV dose during operation.

7.2 Filtration Planning 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. The changes included site plan and grading changes to reflect the relocation of the main entrance, the administration building, and oxygen production plant; relocation of the electrical substation; expansion of the process area; and minor modifications to the hydraulic profile.

The 2007 preliminary design update also included an extensive evaluation of post-treatment chemicals as well as their storage facilities and injection points. As a result, a staged implementation plan has been proposed and the post-treatment chemical building has been relocated.

The evaluation resulted in changes to the UV Facilities contract. The changes being prepared include construction of a post-treatment chemical feed building for the treated water that is being transferred to the Catskill Aqueduct, modifications to the South Forebay for the Delaware portion of the treated water, and installation of chemical feed systems as identified in the 2007 report.

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 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 2008, active surveillance for giardiasis and cryptosporidiosis continued as in prior years. Forty-four 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. For all cryptosporidiosis cases, and as needed for giardiasis cases, public health epidemiologists contact patients to (1) verify the data collected in the case report, (2) collect additional demographic and clinical information, and (3) identify possible sources of exposure. At the time of this writing, the 2008 *preliminary* count of cases reported to DOHMH among NYC residents is 823 cases of giardiasis and 107 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 two 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 two components: (1) monitoring weekly sales volume of non-prescription ADM at a major drug store chain and (2) monitoring daily sales of non-prescription medications at another major drug store chain. Accomplishments in the first ADM system for 2008 include enhancements to the data stream received, migration to an access database, piloting of CDC's Early Aberration Reporting System (EARS) for improved data analysis, and completion of a Corrective Action Report related to ADM promotional sales data.

Educational outreach in 2008 included several presentations by DOHMH or DEP representatives at public health and/or medical schools located in NYC. Additional results and program information can be found in the WDRAP semi-annual and annual reports.

8.2 Cross Connection Control Program

For calendar year 2008, the DEP Cross Connection Control Program met or greatly exceeded the milestones set forth in the July 2007 FAD.

Since May 2008, in its ongoing effort to accelerate compliance with backflow prevention requirements through procedural improvements, DEP has eliminated the 15-day letter to DOHMH (with a copy to the premises owner), which advises that the issuance of a Notice of Violation is imminent. Without the intervening 15-day letter, issuance of the Notice of Violation now follows directly after the issuance of a Commissioner Order (which directs the owner to install a backflow prevention device within 30 days).

During the year, DEP revised its cross connection control handbook, titled "Revised New York City DEP Supplement to the New York State Department of Health's Handbook for Cross Connection Control". In June, the revision was placed on the DEP website. This supplement is intended to function as a guideline for Professional Engineers and Registered Architects in the preparation of backflow preventer plan submittals to the DEP.

Beginning in 2008, DEP engaged a market research firm to identify specific high hazard market sectors. Included among these businesses were car wash facilities, dry cleaners, and auto repair and small medical facilities. In the past, DEP has utilized multiple database sources to identify the types and locations of potential establishments requiring the installation of backflow prevention devices. Moving forward, in addition to these sources, DEP has engaged the services of a non-profit market research firm to provide the most reliable information available on properties of concern.

In total, 79 car wash facilities, 1,818 dry cleaners, 629 auto repair facilities and 459 small medical facilities were inspected, and where necessary or appropriate follow-up actions were initiated.

Acceleration of the inspection phase of the Cross Connection Control Program started in early 2008 with the assignment of one additional Division of Permitting and Inspections inspector to full time cross connection control inspection duty. This has resulted in the number of cross connection inspections increasing from an average of 20 per day to 30 per day. Based on these inspections, Commissioner Orders were sent to property owners advising them of their obligation to comply with cross connection control requirements.

DEP has prepared a contract to retain the services of a consulting engineering firm to perform cross connection control inspections of approximately 11,000 locations over the course of a year. This will complete the inspections of the properties originally designated as potentially high hazard. The consultants will also perform plan review of proposed installations, review initial and annual test reports, and prepare enforcement correspondence as required for DEP signatures.

In 2008, the issuance of calendar year compliance Notices of Violation to delinquent owners in all boroughs was completed, with the exception of the Borough of Queens. Beginning in September, at the request of DEP, the Environmental Control Board added an additional day of hearings for Queens compliance violations. Going forward, the additional hearing day in Queens will remain in effect each month.

DEP is currently in the process of establishing a program to send informational letters and brochures to premises which are considered to be potentially hazardous and which, it is expected, will need to install a backflow prevention device. The correspondence will explain the DEP Cross Connection Control Program and will include a DEP website and telephone number where owners can make inquiries about the process and request information on how to comply with the requirements.

The Cross Connection Control Task Force met once in 2008, on November 7. In attendance were representatives from DEP, the Plumbing Foundation, the Master Plumbers Council, and the American Society of Plumbing Engineers. Topics of discussion included: the status of the DEP Cross Connection Control Program; minor modifications to enforcement correspondence; the bidding of a Cross Connection Control contract; a new DEP program to send informational letters and brochures to potentially hazardous premises; and the ability of DEP to increase the number of violations sent to premises owners for failure to perform an annual test (calendar year compliance).

During 2008, 32 self-certified plans for cross connection control devices and 33 self-certified exemption statements were received.

During the 2008 calendar year, DEP received no inquiries which were treated as potential cross connection control complaints.

The Cross Connection Control Program strives to continue program improvements by using the following program tenets as guidance:

1. All high hazard premises are required to properly evaluate their plumbing system for cross connection hazards and to submit plans for installation of all necessary cross connection control containment devices.

2. Plans submitted are reviewed and approved by DEP, eliminating the need for applicants to submit plans to the New York State Department of Health.

3. Permits for wet connections are issued only with a prior Cross Connection Control submission or review.

4. Records of an installation and initial testing, as well as the annual testing of all existing cross connection control devices, are collected and maintained by DEP.

5. Outreach dialogue with Professional Engineers, industry groups, and plumbing industry professionals regarding DEP's cross connection control program is continuous. Information is always available by telephone call or by visiting DEP's website.

Tables 8.1 and 8.2 present Cross Connection Control Program activities for 2008.

Table 8.1. Cross Connection Control FAD Milestones.

Annual Period	Response to Complaints	Full "High Hazard" Inspections	Enforcement Initiated for "High Hazard" Premises	Backflow Preventer Plans Approved	Backflow Preventer Plans Accepted with Self-Certification	Exemption Requests Processed	Notices of Violation Issued for Failure to Test Annually
Jan-Dec. 2007	4	4232	1122	2120	44	1290	532
Jan-Dec. 2008	-	3207	1124	2642	12	1160	586

Table 8.2. Cross Connection Control Annual Report, 2008.

Month	Inspections				Installation Enforcement						Annual Test Enforcement		Remediation and Voluntary Compliance			
	Total	Needs Device	Does Not Need Device	No Inform	Letters Directing Installation	COMM Orders	"Letters Advising NYSDOH of Pending NOV"	NOVs Issued for Failure to Install	Cease and Desist Orders Issued	Taps Shut	Letters Directing Annual Test	NOVs Issued for Failure to Test	Plans Approved	* Devices Installed and Tested	Devices Tested Annually	Letters Requesting Installation Status
January(Non-HH)	-	-	-	-	-	45	-	15	-	-	1	41	162	276	1,058	379
January(HH)	526	213	313	-	-	65	-	23	-	-	-	6	54	13	114	27
February (Non-HH)	256	126	130	-	-	6	6	20	7	1	22	35	203	180	483	249
February(HH)	449	200	249	-	3	96	93	27	6	-	1	6	54	4	65	49
March (Non-HH)	417	209	208	-	-	84	2	30	-	-	0	54	139	233	492	316
March (HH)	126	49	77	-	2	89	61	22	-	-	0	10	42	5	75	77
April (Non-HH)	348	147	201	-	-	29	9	1	-	-	11	11	119	184	427	338
April (HH)	270	113	157	-	1	34	50	16	-	-	0	2	40	1	53	66
May (Non-HH)	320	182	138	-	-	103	1	1	10	-	9	56	207	412	617	294
May (HH)	207	94	113	-	2	47	30	31	7	-	-	16	79	47	109	27
June (Non-HH)	449	239	210	-	-	58	-	20	-	-	285	39	245	367	350	506
June (HH)	116	50	66	-	-	98	-	39	-	-	77	7	61	14	77	172
July (Non-HH)	585	331	254	-	-	93	-	43	4	-	243	36	151	272	389	699
July (HH)	165	63	102	-	-	170	-	52	6	-	67	10	59	40	162	118
August (Non-HH)	213	98	115	-	-	72	-	22	-	-	306	42	147	340	423	425
August (HH)	325	147	178	-	-	75	-	52	9	-	107	14	46	40	183	107
September(Non-HH)	176	79	97	-	-	88	-	19	8	-	59	46	132	323	691	131
September(HH)	397	170	227	-	1	105	-	35	5	-	12	20	59	49	258	40
October (Non-HH)	434	226	208	-	1	59	-	23	5	-	11	9	122	308	389	98
October (HH)	264	136	128	-	2	149	-	56	10	-	3	10	53	50	245	17
November(Non-HH)	305	193	112	-	-	51	-	16	-	-	-	15	128	272	304	51
November(HH)	88	40	48	-	1	129	-	29	-	-	-	2	49	29	196	6
December (Non-HH)	210	133	77	-	-	101	-	16	-	-	-	66	185	306	862	198
December (HH)	274	102	172	-	-	55	-	32	-	-	-	33	88	34	288	44
Non- High Hazard Total	3,713	1,963	1,750	0	1	789	18	226	34	1	947	450	1,940	3,473	6,485	3,684
High Hazard Total	3,207	1,377	1,830	0	12	1,112	234	414	43	0	267	136	684	326	1,825	750
Current GRAND TOTAL	6,920	3,340	3,580	0	13	1,901	252	640	77	1	1,214	586	2,624	3,799	8,310	4,434

* Based on date initial test report was received by DEP; some of these devices were installed and tested prior to 1/1/08.

9. Education and Outreach

DEP advances the City's long-term watershed protection strategy through active stakeholder collaboration, broad community outreach, and targeted educational programs for upstate watershed residents and downstate water consumers alike. Towards this end, DEP staff within the Bureaus of Water Supply (BWS) and Communications and Intergovernmental Affairs (BCIA) collaborate with numerous upstate and downstate watershed partners to educate, inform, promote, teach, and raise awareness about the importance of the water supply, source water protection, water conservation, environmental stewardship, and sustainability practices.

The 2007 FAD requires DEP to implement and report annually on the educational efforts of the Watershed Agricultural Program, Watershed Forestry Program, Stream Management Program, and CWC Public Education Program, in addition to other school-based education efforts, general community outreach, and partnerships with regulatory and local government officials. The FAD specifically requires DEP to collaborate with local municipal officials on education, outreach, and training programs that promote the merits and principles of land use planning, stream corridor protection, and stormwater management. This annual report summarizes key 2008 education and outreach accomplishments according to six major audience categories.

9.1 Water Consumers (downstate audiences)

DEP's official website (www.nyc.gov/dep) features a wealth of information about the water supply, reservoir levels, watershed protection and conservation programs, drinking water quality, and environmental education activities. In 2008, DEP published and distributed 870,000 copies of its annual *New York City Water Supply and Quality Report*. DEP also continued to work on the City's tap water marketing campaign in collaboration with the New York City Department of Health.

DEP actively promoted a Payment Incentive Program (PIP) in 2008 that was offered to more than 25,000 eligible customers to settle past-due water and sewer charges through incentives and other reductions. About 21,000 customers settled their water/sewer bills either in full or through future partial payment plans.

DEP joined the Groundswell Community Mural Project to create a four-story mural entitled "Water is the Life of New York City" that stands adjacent to a DEP Shaft Site in Brooklyn. The mural is the creation of 14 young people (ages 14-21) who worked with professional artists as well as DEP educators to learn about the water supply system (including a tour of the Croton Reservoir) as part of their artistic experience.

DEP worked with six Hydrant Education Action Teams (HEAT) comprised of 75 high school and college students who canvassed New York City neighborhoods disseminating information about the effects of illegally-opened fire hydrants on water pressure in the City's distribution system. DEP and HEAT also participated in "Summer Streets," an educational event on three consecutive Saturdays in August, whereby many streets (including Park Avenue) were closed from Central Park to the Brooklyn Bridge. DEP and HEAT helped raise awareness about two priority topics: reusable drinking water bottles and illegally-opened fire hydrants.

DEP collaborated extensively with the Queens Museum of Art during 2008 to help celebrate the restoration and homecoming of the 27-piece watershed relief model that was originally commissioned for the 1939 World's Fair. DEP conducted two professional development workshops at the museum where non-formal and formal educators learned how to incorporate the watershed relief model and New York City panorama into their classroom water supply lesson plans, while the museum hosted a public exhibition of student journal entries and photographs taken during the July 2007 "Mountaintop to Tap" watershed trek. The Queens Museum of Art received a WAC bus tour grant in 2008 and is working closely with DEP to develop a tour itinerary for summer 2009.

DEP maintains an educational presence at several highly visible Greenmarkets within New York City. Also during 2008, DEP kicked off World Water Week by partnering with UNICEF on the NYC Tap Project Water Walk at Riverside Park in Manhattan, during which hundreds of people walked one mile carrying containers of water. As part of the Jamaica Bay Watershed Protection Plan, DEP sponsored a "State of the Bay" Scientific Symposium that featured 19 speakers and attracted nearly 100 participants. DEP also developed, promoted, and utilized the Newtown Creek Scavenger Hunt and Nature Trail, which educates visitors about the connections between wastewater treatment and source water protection programs.

As part of a citywide effort to conserve water and reduce stormwater runoff, DEP initiated a pilot Rain Barrel Giveaway Program in 2008 for eligible home owners in Queens who live in the Jamaica Bay Watershed. As part of this pilot program, DEP distributed 250 rain barrels to home owners and taught them how to capture stormwater from their roofs and store/use this water for landscaping and other purposes.

9.2 Watershed Landowners (upstate audiences)

The Watershed Agricultural Program educates farmers and the agribusiness community about operation and maintenance of Whole Farm Plans, nutrient management plans, and agricultural best management practices. During 2008, WAC collaborated with Delaware County CCE and other partners to conduct the following education programs for 500 total participants: Annual Catskill Regional Dairy, Livestock and Grazing Conference; Winter Crop School (No-Till Corn Planting and Forage Seeding); Beef Field Days; Sheep and Goat Field Day; New Farm Ventures

Workshop; Estate Planning for Farmers and Landowners; six pasture walks and/or farm tours; two nutrient management credit workshops; and two backyard maple schools. In 2008, WAC also partnered with Delaware County CCE and Department of Public Works to sponsor the 12th annual Clean Sweep Chemical Disposal Day for Delaware County residents, farmers, and small businesses.

The Watershed Forestry Program educates forest landowners about sustainable forest management planning and stewardship practices. In the East of Hudson Watershed, WAC partnered with Clearpool Education Camp to conduct two landowner workshops that were attended by 25 total participants. In the West of Hudson Watershed, WAC partnered with Delaware County CCE to conduct two forest landowner education workshops at the Lennox Model Forest, which attracted about 30 participants.

The Stream Management Program educates streamside landowners about water quality protection and riparian buffer management practices, primarily through partnerships with county CCE and SWCD offices but also through the www.catskillstreams.org website which attracted nearly 150,000 hits during 2008. Many stream-related education and outreach efforts occur during property site visits, riparian tree planting activities (such as the DEC Hudson River Estuary "Trees for Tribs" Program), or during public information meetings and workshops. Highlights include presentations to the Woodland Valley Landowners Association, installation of a kiosk at the Esopus Creek Demonstration Site, and an Esopus Creek community meeting attended by 45 people.

DEP reaches out to watershed landowners to educate them about the benefits of the Land Acquisition Program (including conservation easements) and to encourage their support and participation. In 2008, DEP sponsored a landowner/land trust workshop on "The Financial Benefits of Land Conservation" in collaboration with the Delaware Highlands Land Conservancy; participated in Forestry Friday School organized by Delaware County CCE; and co-sponsored the Ulster County Land Trust Conference which educates watershed landowners about conservation options.

CWC sponsored three home owner education workshops (one each in Pine Hill, Hunter, and Delhi) covering septic system maintenance topics that were attended by several dozen participants. CWC also developed a comprehensive landowner packet of informational materials concerning natural gas and oil drilling in the Marcellus Shale, and this packet is available on the CWC website (www.cwconline.org).

9.3 School Groups And Youth Audiences (upstate and downstate)

DEP hosts and supervises the New York City coordinator of Trout Unlimited's Trout in the Classroom (TIC) education program. More than 500 total classrooms participate in TIC, including more than 139 New York City classes, about 30 East of Hudson schools, and more than

50 West of Hudson schools. The fall 2008 TIC teacher training workshop held in Hyde Park, Dutchess County, attracted 180 participants. Under a separate banner, DEP also joined CWC and other watershed partners to support "Take A Kid Fishing Day" at the Ashokan, Rondout, Cannonsville, Pepacton, and Kensico Reservoirs for more than 300 children, parents, and guests.

DEP sponsored the 22nd annual Water Conservation Art & Poetry Contest, which attracted 300+ fourth, fifth, and sixth grade students from all five New York City boroughs. More than 800 people attended the annual awards ceremony, and contest entries are posted on the DEP website. DEP also supported the Kensico Environmental Enhancement Program (KEEP) 2008 Art & Poetry Contest, which attracted 700+ middle school students from five East of Hudson Watershed schools.

The Catskill Center for Conservation and Development continues to implement the core school-based education programs of the Watershed Forestry Program. During 2008, the Catskill Center conducted the 10th annual Watershed Forestry Institute for Teachers (20 participants) and associated 10-year reunion event (35 participants), completed the 2007-2008 Green Connections Program (400 students, five school partnerships), and launched both the 2008-2009 Green Connections Program (500 students, six school partnerships) and the annual Catskill Stream and Watershed Education Program (targeting 30 West of Hudson Watershed classrooms).

CWC continues to implement its Public Education Grants Program that supports school-based watershed education projects for New York City and West of Hudson audiences. During its Round 11 grant cycle, CWC awarded 27 education grants totaling $134,910. To date, CWC has awarded nearly 290 grants totaling over $1.4 million.

WAC continues to support the Watershed Forestry Bus Tour Grants Program in partnership with the DEP and USFS. During 2008, 21 bus tour grants were awarded and 21 watershed bus tours were completed for 1,000+ participants, including one tour that DEP organized for about 45 non-formal educators from New York City. Approximately 100 bus tour grants have been awarded to date, which has allowed nearly 5,000 downstate visitors (primarily students) to experience and learn first-hand about the traditional working forest landscape of the upstate watershed.

DEP collaborated with the Watershed Environmental Education Alliance (WEEA) to update and produce the 2008-2009 revised edition of the *New York City Watershed Environmental Education Resource Directory: A Field Trip Guide for School Teachers and Educators*, which is posted on the DEP website and other WEEA partner websites.

DEP attended the Science Council of New York City (SCONYC) annual teacher conference, the 2008 Environmental Expo, the annual Operation Explore teacher training, and the annual Green Horizons Career Day that attracts hundreds of middle school students. For the

eighth consecutive year, DEP helped the Council on the Environment of New York City with in-City and upstate tree planting activities that involve 100+ high school students from New York City and the watershed.

DEP collaborated with the New York Public Art Fund to create an educational teacher resource companion piece (grades K-12) to the "Waterfalls" art exhibit that took place in New York City. DEP also worked with the LaGuardia and Wagner Archives to produce a fourth grade curriculum ("Water: An Underground History of New York"), in addition to participating in the day-long Drop Summit where 75+ high school and college students discussed and explored youth-led, community-based water projects.

Ulster County CCE began developing a Youth Watershed Stewards Program in addition to training and working with six Esopus Volunteer Stream Stewards. In tandem with these efforts, eight people participated in a 4-H stream monitoring workshop.

9.4 Local Government and Municipal Officials

DEP partnered with Greene County SWCD and CWC to support the second annual Schoharie Watershed Summit that was attended by nearly 120 local government officials and landowners representing 11 municipalities. Training topics included a summary of the Schoharie Turbidity Reduction Strategy, the impacts of infrastructure on stream stability, stormwater management and regulations, wetland protection and regulations, digital floodplain maps and management, and an exercise on subdivisions.

DEP and Greene SWCD conducted their second annual stream tour for local officials and residents that highlighted the importance of wetlands and the impacts of invasive species (e.g., Japanese knotweed). Also during 2008, Greene County SWCD met with each of the county municipal boards regarding their adoption of stream management plans (all have been adopted); facilitated a highway superintendent focus group meeting to discuss programs available to local municipalities; and partnered with DEP, DEC, and the Lower Hudson Coalition of Conservation Districts to sponsor a sold-out training workshop on the NYSDEC General Permit (GP-0-08-001) that focused on the design, installation, construction, repair, and maintenance of erosion and sediment control practices.

Ulster County CCE coordinated a "Flood Response, Recovery and Mitigation" workshop that attracted 125 participants representing a dozen stakeholder groups.

Delaware County SWCD conducted a variety of stream-related education/outreach activities during 2008 that were geared towards local officials. Highlights included: creation of the Delaware Basin Project Advisory Committee; adoption by two municipalities (Village of Margaretville and Town of Andes) of the East Branch Stream Corridor Management Plan; a culvert management workshop was held for 95 participants, including highway superintendents and local

contractors; a pilot flood response training program for local contractors and highway superintendents was developed; and a floodplain presentation was conducted for the Village of Walton Planning Board.

CWC sponsored the eighth annual Catskills Local Government Day that was held at Frost Valley YMCA and attracted over 140 participants, including planning board members, code enforcement officers, local government employees, highway department staff, and community leaders. This day-long event featured training workshops and informational sessions conducted by the Department of State and others. In 2008, CWC also conducted two educational training workshops for local planning and zoning board members.

DEP serves on the Board of Directors for the New York State Urban and Community Forestry Council and continues to support regional ReLeaf urban forestry educational programs for local officials and community leaders. In January, DEP and WAC sponsored the annual Region 3 ReLeaf Conference in Westchester County that attracted more than 150 local officials and forestry professionals.

DEP and WAC continued to participate in the Catskill Regional Invasive Species Partnership (CRISP) and the Lower Hudson Partnership for Regional Invasive Species Management (PRISM) along with numerous local, state, and regional partners. DEP and WAC also joined other local and state partners to support 2008 New York State Forestry Awareness Day in Albany, which targets local and state legislative officials.

9.5 Watershed Professionals, Business and Industry Groups

The annual NYC Watershed Science and Technical Conference was held at West Point Academy and attended by several hundred scientists, professionals, and watershed managers. This annual conference is organized and sponsored by the Watershed Protection and Partnership Council, New York Water Environmental Association, DEP, WAC, CWC, US Geological Survey, and the Departments of State, Health, and Environmental Conservation.

WAC continued to support the Catskill WoodNet website (catskillwoodnet.org)and the Pure Catskills branding campaign (buypurecatskills.com) which promote local farm and forest products. Catskill WoodNet boasts 71 business listings and Pure Catskills boasts 200+ business listings. In 2008, WAC published 31,000 Pure Catskill product directories that were distributed to 400+ regional locations. WAC also sponsored a series of 15 Pure Catskills outreach events held locally throughout the watershed region and attended by thousands of people, in addition to participating in a Sullivan County “Rural Life in the Catskills Forum” that was held to educate town boards, county employees, and local business owners about the economic importance of farm and forest-based businesses.

During 2008, the Watershed Forestry Program sponsored 12 logger training workshops (87 participants), four forester training workshops (80 participants), and three local lumber grading workshops (200 total participants). Forty-six professional foresters are currently trained to develop watershed forest management plans and 68 loggers are fully certified through the voluntary NYS Trained Logger Certification Program.

DEP coordinated a special meeting of the Hydrologic and Habitat Subcommittee of the New York State Water Quality Coordinating Committee to focus on developing a white paper that helps define a statewide policy and strategy for ensuring best practices during post-flood stream work. DEP and many of its Stream Management Program partners also sponsored and/or participated in numerous training programs throughout the year, including a follow-up Native Plant Seed Collection workshop.

Greene SWCD partnered with the Hunter Foundation and Catskill Mountain Foundation to incorporate stormwater retrofits into their main street revitalization projects to be used as educational demonstrations for local businesses and watershed professionals.

DEP's Land Acquisition Program works with realtors, land trusts, and other community groups to educate them about the program and to encourage their support. In 2008, DEP hosted a roundtable discussion for watershed land trusts at the Northeast Land Trust Rally held by the Land Trust Alliance; sponsored a land trust workshop in collaboration with the Delaware Highlands Land Conservancy; hosted a meeting of West of Hudson Watershed Land Trusts to discuss partnership opportunities; co-presented along with WAC at the National Land Trust Rally held in Pittsburgh; and co-sponsored the Ulster County Land Trust Conference.

9.6 Recreational Groups and Other Local Public Audiences

DEP mailed the Summer 2008 *Watershed Recreation* newsletter to 110,000 DEP Access Permit holders in addition to finalizing a DEP Sign Design Manual which will guide the design and specifications for all signs posted on City-owned watershed lands. DEP also conducted or supported numerous community-based activities on City-owned lands during 2008, including guided interpretive hikes, tree planting projects, reservoir clean-up projects, fishing demonstrations, and bald eagle observation sites at two reservoirs.

DEP participates in dozens of community outreach events throughout the East and West of Hudson Watersheds, during which tens of thousands of people—youth and adult audiences alike—received DEP education and informational materials pertaining to watershed protection, water conservation, and environmental stewardship. Highlights include the Cauliflower Festival in Margaretville, Cobleskill Sunshine Fair, Delaware County Fair, Dutchess County Fair, Grahamsville Little World's Fair, Putnam County 4-H Fair, Ulster County Fair, Ulster County Environmental Awareness Day, Westchester County 4-H Fair, Woodstock "Go Green" Day, and Yorktown Grange Fair.

DEP supported and participated in the second annual Batavia Kill Stream Celebration Day along with Greene County SWCD and other local partners. The event attracted over 1,000 community members. DEP and Greene County SWCD also conducted a volunteer riparian planting project on the East Kill for 47 students and parents who also attended a workshop that explained the stream restoration project and design principles.

In addition to the events already described throughout this chapter, DEP's watershed partners also participated in the following community events during 2008: Bethel Woods Harvest Festival, Student Watershed Congress (Hunter), Sidney Earthfest, Sandcastle Day (Windham), Catskill Educators Showcase (Oneonta), Pakatakan Farmers Market (Halcottsville), Teen Marine Adventure (Manhattan), Riverkeeper Waterfest (NYC), Ulster County Biz Showcase (Stone Ridge), Shandaken Day (Mt. Tremper), New Amsterdam Public Market (Manhattan), Trout Unlimited Camp (DeBruce), Winter Jam (Manhattan), and Susquehanna Valley Garlic Festival.

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 Wards 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. The 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. The consumption has been recorded under 1,100 MGD for two out of the last three 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 the 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 gcpd around 1990 to 135.23 gcpd for year 2008.

Highlights of DEP's ongoing water efficiency program include leak detection, water metering, toilet replacement program, locking hydrant caps, and educational programs. Events and advancements during 2008 include:

10.1.1 Measures to improve water efficiency in the distribution system

Main Replacement and Leak Detection

- In FY2008, DEP surveyed more than 3,850 miles of the City's water mains. 429 leaks and breaks were found and repaired and the average time to restore water to customers after confirming a break was 12.1 hours. The entire city is on a three-year survey schedule while the drainage areas for the Wards Island, Newtown Creek, and North River Wastewater Treatment Plants are on a nine-month schedule. This area of concentrated attention covers all of Manhattan, half of the Bronx, and about one-quarter of Brooklyn. The leak detection program has brought the distribution system leakage rate down to about 10-15% of the rate in the 1980s.
- Since 1970, with a small number of exceptions, each year 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 water mains in the system.
- A review of system distribution losses was conducted during late 2006 as part of the depart-

ment's "Dependability Program" and is under review by the Bureau of Water and Sewer Operations. The water balance table will be updated once that review is complete.

10.1.2 Water Conservation Program and Activity Updates

Water Metering

The city is now 97%+ metered. The remaining 25,000 unmetered accounts include, approximately:

- Properties surcharged for failing or refusing to meter (40%)
- Unmetered exempt properties (4%)
- Unmetered city properties (3%)
- Properties with technical difficulties waiting to be metered (15%)
- Vacant properties (2%)
- Others (36%) which include accounts still labeled "unmetered" because they are part of multi-account metered properties on 'frontage transition," properties with meters never set up properly on the account, properties served by adjoining metered properties and other minor categories. These will mostly resolve themselves once all properties are either on metered billing or the Multifamily Conservation Program rate.

DEP is performing the following actions to resolve the last 1%+ of unmetered properties:

- Bidding new installation/replacement contracts for Brooklyn/Queens and Manhattan/Bronx.
- Mailing a solicitation to unmetered exempt customers informing them of their obligation to meter and referring them to a DEP Contractor.
- Mailing "final warning letters" to customers who did not respond to metering attempts during the last contracts but whose notification records were insufficient to support assessing a surcharge for failing to meter.
- Continuing the metering of unmetered public schools and other public buildings.
- Regular review of properties originally found to be vacant to ensure they are metered when renovated.
- DEP has updated reimbursement amounts and made other changes to the Reimbursable Metering Program. A public notice was issued during spring 2007 and the rule changes were finalized at a New York City Water Board meeting in September 2007.

Advanced Metering Infrastructure

This project has moved forward in 2008 by completion of the following tasks:

- DEP and the New York City Department of Information Technology and Telecommunications (DoITT) completed contract negotiations with Aclara RF (formerly Hexagram) and a contract to purchase a citywide AMI system.
- Aclara RF, DoITT, and DEP have begun network design.
- DEP has bid contracts to install the AMI transmitters and to replace approximately 400,000 old meters beginning in March 2008. Installation of the system can be substantially complete in three years. The AMI system will read meters at least four times a day resulting in a dra-

matic expansion of water consumption data and providing a low-cost route to monthly billing. Customers will be able to access all of their reads online and DEP will move to monthly billing for most customers.

Changes in Water Use Rules

DEP has completed revisions in RCNY Chapter 20, "Rules Governing the Supply and Use of Water." A final public hearing was held on June 16, 2008 and when the revisions receive final approval from the city's Law Department they will take effect. The proposed changes related to water conservation and water quality include the following:

- Requirement that any lead or galvanized metal service pipe be completely replaced, rather than repaired, if it leaks. This is aimed at speeding the replacement of these types of services both for water quality purposes and to reduce distribution system losses.
- Requirement that water meters, service pipes and associated vales and fittings be manufactured of a "no lead" alloy.
- Requirement, or clarification, that public fountains and sprays must have automatic shutoffs.

Upgraded Analysis of Customer Demand

DEP is in the process of developing revised water demand projections for New York City. The basis for the projections and analyses will be the existing available metering data for years 2001-2007 and onward. DEP is conducting extensive analysis of the existing data to identify water usage statistics by building class and land use classifications. Since approximately 97% of New York City is metered, the volume of data generated in the years 2001 through 2007 is massive. To properly manage and organize the data, Microsoft SQL server software is being used and a staff person partially dedicated to this function has been hired. The statistical analysis portion of the study will be performed using SAS® software which is designed specifically for analysis of large databases. Additionally, geographic and spatial analyses will be performed using ArcGIS software. The addition of far greater amounts of data through AMI will add to the depth of the analysis. This project began in early 2008.

Incentive Programs

No funding is currently planned for any incentive programs beyond a first phase of toilet replacements that will be limited to apartment buildings applying for the New York City Water Board's Multifamily Conservation Program. The development of software for applications processing and analysis commenced in late 2008 and the program itself will begin in 2009. DEP has begun briefing manufacturers on planned details. The program will be amenable to relatively easy expansion if funds for a larger program are provided in the future.

Fixture Replacements in Public Buildings

DEP Contractors performed design surveys of rest rooms in public schools in Manhattan, the Bronx, Queens and Brooklyn during 2008 to develop data and existing condition observations that will form the basis for a future project with the School Construction Authority and the Department of Education to replace toilets, lavatory faucets and urinals in public schools.

Conservation Rates, Stormwater Rates and Incentives for Stormwater BMP's

The Water Board issued a consultant RFP in June 2008 to examine advantages and disadvantages of several conservation rates, examine practical issues that must be addressed to implement a stormwater rate and research possible incentives for stormwater management BMP's.

10.2 Updates to Drought Management Plan

In 2008, 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 2008 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 2008. 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 2008, DEP conducted two hydrostatic tests and two backflow tests. The hydrostatic test involves shutting down the tunnel and isolating it from the reservoirs at each end. The water level in the tunnel drops due to the leakage. This is measured, and an accurate leakage rate is calculated. The backflow test involves shutting down the tunnel to allow water to flow backwards into the tunnel from West Branch Reservoir. Water flowing past the downstream flowmeter to "feed the leak" is measured as a negative number, and is interpreted as the net leakage. None of these tests showed results that indicated an increase in leakage.
- During 2008, work continued under the Tunnel and Shaft Rehabilitation Program construction contract. The work includes 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. Two dives were performed at Shaft 6. The first was for an inspection of the Shaft pressure boundaries. The second was to begin the process of replacing the gate valve at the bottom of the shaft. This work is required to allow the contractor to install the new tunnel unwatering pumping station in the dry while the tunnel is running.

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. In 2008, the AUV had been upgraded and we are preparing for a new inspection. The upgrades include a new temperature-conductivity sensor and improved photographic strobes.

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 2008, DEP's consultant continued design of two custom vehicles that could investigate the areas of concern in the tunnel.

Water Supply Dependability Analysis

In 2008, DEP proceeded to conduct facility planning on the four selected projects 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. The projects are In City Groundwater (up to 55 MGD), Catskill Aqueduct Capacity Optimization (up to 60 MGD), The 3rd Catskill Delaware Aqueduct, and Demand Management (up to 20 MGD). Of the supply alternatives, there remains a shortfall of over 200 MGD from the original 330 MGD requirement. The intent is to supplement these projects with other alternatives that will quickly provide water in an unplanned scenario. Ultimately, DEP will make an informed decision if the parallel tunnel program, the supply alternatives, or a hybrid will proceed to design and construction.

References

Baldigo, B.P., D.R. Warren, A.S. Gallagher-Ernst, S.J. Miller, D. Davis, W. Keller, T.P. Baudanza, D. DeKoskie, and J.R. Buchanan. 2008. Restoring geomorphic stability and biodiversity in streams of the Catskill Mountains, New York, USA. Pages 1777-1790 *in* J.L. Nielsen, and coeditors, editors. Proceedings of the Fourth World Fisheries Congress: Reconciling fisheries with conservation, Symposium 49. American Fisheries Society, Bethesda, Maryland.

Baldigo, B.P. and D.R. Warren. 2008. Detecting the response of fish assemblages to stream restoration: Effects of different sampling designs. North American Journal of Fisheries Management 28(3):919-934.

Baldigo, B.P., D.R. Warren, A.G. Ernst, and C.I. Mulvihill. 2008. Response of fish populations to natural-channel-design restoration in streams of the Catskill Mountains, New York. North American Journal of Fisheries Management 28(3):954-969.

Bryant, R. B., T. L. Veith, P. J. A. Kleinman, and W. J. Gburek. 2008. Cannonsville Reservoir and Town Brook watersheds: Documenting conservation efforts to protect New York City's drinking water. Journal of Soil and water Conservation 63 (6): 339-344

DEP. 2008a. Multi Tiered Water Quality Modeling Program Annual Status Report – EPA Filtration Avoidance Deliverable Report. New York City Department of Environmental Protection, Valhalla, New York. October 2008.

DEP. 2008b. 2009 Watershed Water Quality Monitoring Plan. New York City Department of Environmental Protection, Valhalla, New York. October 2008.

DEP. 2007. Wetlands Protection Program Wetlands Protection Strategy Update. Valhalla, NY. 9 p.

DEP. 2007. Multi Tiered Water Quality Modeling Program Annual Status Report – EPA Filtration Avoidance Deliverable Report. New York City Department of Environmental Protection, Valhalla, New York. October 2007.

DEP 2006. Wetland Water Quality Functional Assessment. Final Report for Project 4.2 of the Surface Drinking Water Act Grant 4. 17 pp plus appendices.

Ghebremichael, L.T., Veith, T.L., Hamlett, J.M., Gburek, W. 2008. Precision feeding and forage management effects on phosphorus loss modeled at a watershed scale. Journal of Soil and Water Conservation. 63(5):28-291.

Pierson, D.C., R.K. Gelda, S.W. Effler, D.M. O'Donnell and A.R. Prestigiacomo. 2008a. Use of automated monitoring to estimate the load of turbidity entering a drinking water reservoir. Verh. Internat. Verein. Limnol., 30(Part 1):113–116.

Pierson, D.C., E.M. Schneiderman and M.S. Zion., 2008b. Potential Effects of Climate Change on New York City Water Supply Quantity and Quality: An Integrated Modeling Approach. *2008*

Reynolds, C.S., A.E. Irish and J.A. Elliott. 2001. The ecological basis for simulating phytoplankton responses to environmental change (PROTECH). *Ecol. Model.* 140: 271-291.

Tiner, R.W. (compiler). 2008. Wetlands of the West-of-Hudson Watershed of the New York City Water Supply System: 2004 Status and Trends since the Mid-1980s. U.S. Fish and Wildlife Service, National Wetlands Inventory, Ecological Services, Region 5, Hadley, MA. 24 pp.

Tiner, R.W., J. Q. Swords, and H.C. Bergquist. 2005. Wetlands of the East of Hudson Watershed of the New York City Water Supply System: 2004 Status and Recent Trends (1994-2004). U.S. Fish and Wildlife Service, National Wetlands Inventory, Ecological Services, Region 5, Hadley, MA. Prepared for the New York City Department of Environmental Protection, Valhalla, NY.

Tiner, R.W., J. Q. Swords, and H.C. Bergquist. 2005a.Wetlands of the Delaware and Catskill Watersheds of the New York City Water Supply System: 2003 Status U.S. Fish and Wildlife Service, National Wetlands Inventory, Ecological Services, Region 5, Hadley, MA. Prepared for the New York City Department of Environmental Protection, Valhalla, NY.

Tiner, R.W and J. Stewart. 2004. Wetland Characterization and Preliminary Functional Assessment of Wetlands Functions for the Delaware and Catskill Watersheds of the New York City Water Supply System. US Fish and Wildlife Service, National Wetlands Inventory, Ecological Services, Region 5, Hadley, MA. Prepared for the New York City Department of Environmental Protection, Valhalla, NY. 50 pp. plus appendices.

Tiner, R.W., C.W. Polzen, and B.J. McClain. 2004. Wetland Characterization and Preliminary Functional Assessment of Wetlands Functions for the Croton Watershed of the New York City Water Supply System. US Fish and Wildlife Service, National Wetlands Inventory, Ecological Services, Region 5, Hadley, MA. Prepared for the New York City Department of Environmental Protection, Valhalla, NY. 22 pp. plus appendices.

Tiner, R.W. 1996. Wetlands in the Watersheds of the New York City Water Supply System. Results of the National Wetlands Inventory. U.S. Fish and Wildlife Service, Ecological Services, Northeast Region, Hadley, MA. Prepared for the New York City Department of Environmental Protection, Valhalla, NY. 19 pp.

UFI. 2003. Upgrades to Cannonsville Reservoir Eutrophication Model to Accommodate the Effects of Sediment Inputs and Resuspension and Associated Phosphorus Cycling. Submitted to the New York City Department of Environmental Protection, Valhalla, New York.

USEPA. U.S. Department of the Army. December 2008. Clean Water Act Jurisdiction Following the U.S. Supreme Court's Decision in Rapanos v. United States & Carabell v. United States. Guidance issued to EPA regions and USACE districts. 13pp.

USEPA. 2001. US EPA Method 1623: *Cryptosporidium* and *Giardia* in Water by filtration/IMS/FA. EPA/821-R-01-025.

USEPA. 1996. ICR Laboratory Microbial Manual. EPA 600/R-95/178. Office of Research and Development. Washington D.C. Government Printing Office.

Veith, T.L., Ghebremichael, L., Cerosaletti, P.E., Dewing, D.R. 2008. Exploring Management Options for Increasing Corn Land on NY Farms Affected by Rising Corn Prices. American Forage and Grassland Council Conference Proceedings. Abstract #1757.

Walter, M; Bishop, P.; Easton, Z.M.; Steenhuis, T. S. Do water quality BMPs work? Combined monitoring and modeling hold the answer. American Geophysical Union, Fall Meeting 2008

Watershed Science and Technical Conference, West Point, NY, September 16-17, 2008.

Westchester County Department of Planning. 2007. Northern Westchester Watershed Committee Highway Deicing Task Force Report. White Plains, NY. 26p.

Appendix A: Map Production

A.1 Water Quality (WQ) Map Products

- Investigated incident sites (sewage/petrochemical spills) with related water quality sample and/or cleanup sites for Special Investigation Reports
- Overview of Kensico Reservoir basin and selected monitoring sites for Kensico Annual FAD Report
- Overview of CATUEC cove, Kensico Reservoir, for monitoring project QAPP
- Series of monitoring site plots (stream, wastewater treatment plants) for DEC/DEP MOU 2005 and 2006 Addendum E reports on stream water quality
- Overview of distances of routine stream monitoring sites from Grahamsville and Kingston Labs for WQ management
- Series of monitoring site plots (keypoint, stream, reservoir, biomonitoring, meteorological, snow survey, wastewater treatment plants) for Watershed Water Quality Monitoring Plan
- USGS stream gauge sites under consideration for DEP/USGS contract renewal
- Series of Schoharie Reservoir bathymetry and Schoharie Reservoir basin features (orthoimagery, land use) as template for creation of watershed atlas
- Series of Peach Lake drainage basin plots (orthoimagery, planimetric, soil) for WWQSR Program Evaluation & Planning Unit
- EOH drainage basin boundary delineations, showing connectivity between the basins, with areas of each, for Water Systems Operations

A.2 Watershed Protection and Planning (WPP), Regulatory Review & Engineering (RRE) Map Products

- Catskill/Delaware Semi-Annual Project Locations Map (FAD)
- Catskill/Delaware Semi-Annual Projects Under Construction (FAD)
- Catskill/Delaware Semi-Annual Major SEQRA Projects (FAD)
- Catskill/Delaware Maps developed in support of project reviews (several)
- Catskill/Delaware Maps developed in support of SEQRA reviews

A.3 WPP Watershed Lands and Community Planning (WLCP) Map Products

- Proposed alternate routes for the New York Regional Interconnect (NYRI) energy transmission infrastructure through the WOH watershed for analysis of proximity to NYC lands, infrastructure, and other potential environmental impacts
- Natural Gas Drilling Permits and Leases by Lat./Long. or Parcel Taxmap Number, for analysis
- of proximity of activities to NYC lands, infrastructure, and other potential environmental impacts
- NYC-owned Land Acquisition Program (LAP) parcels for purpose of recreational use and management review
- Field data collection and analysis maps for the Ashokan Basin Stream Management Planning Program
- Federal, state and municipal wetland permit application reviews, depicting wetland polygons, streams, basins, contours, parcels, municipal boundaries, orthoimagery, reservoirs and roads

- SEQRA project reviews both on City-owned lands and watershed lands, identifying site locations, potentially regulated wetlands and watercourses, and other sensitive features
- Occurrences of terrestrial and aquatic invasive species in the Catskill (WOH) and Lower Hudson (EOH) regions, to support development of strategies to prevent invasive species establishment and spread, and creation of priority invasive species lists
- WLCP program status (FAD)
- Planning Basin & Stream Restoration Project Sites (FAD)
- Dam Safety Engineers and Control Center Maps, used to monitor and record seismic activity with respect to reservoir dams
- Sanitary infrastructure maps portraying wastewater service areas in EOH communities
- Semi-annual status of Natural Resource Management Program (NRM) "Recreational Use" by basin
- Quarterly Forestry Management Plan status
- Quarterly Land Acquisition "Basin Status"
- Monthly Land Acquisition "Community Review" of lands under contract by NYC
- Ongoing NRM digital-photo locations for conservation easements
- Ongoing Land Acquisition conservation easement contracts
- Ongoing Land Acquisition Schedule D NRM use
- Ongoing Land Acquisition Overview for potential easement or acquisition partners
- Status of Watershed Agricultural Program activities, including progress of all WAC programs: whole farm plans, forestry plans, BMP projects, model forests, WAC farm easements, and forestry economic projects